Durham College

Conservation and Demand Management Plan

2014 - 2019

July 2014

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Executive Summary

The Durham College of Applied Arts and Technology continually aims to improve upon the energy performance of its facilities. This includes the monitoring and analysis of energy data, identification of energy efficiency opportunities and optimization of the college's operations.

To date, Durham College has undertaken several initiatives to improve energy efficiency, including the installation of an extensive energy monitoring system, replacement of existing windows with high efficiency models, installation of variable speed drives, and use of lighting occupancy sensors. These measures have resulted in immediate and long-lasting energy efficiency improvements and the college plans to continue to pursue energy efficiency upgrades in all aspects of its operation.

This report is intended to build upon Durham College's sustainability platform and act as the college's Energy Conservation and Demand Management Report submission, meeting the Ontario Ministry of Energy's requirements under Ontario Regulation 397/11. This report details the current energy performance and greenhouse gas (GHG) impact of Durham College, while also setting goals to improve site energy efficiency and reduce GHG emissions over the next five years.

Currently, Durham College has an energy use intensity (EUI) of 1.54 GJ/m^2 (per year). This EUI is above the benchmark average for colleges in Ontario, indicating that better energy performance is attainable at the site. A goal of reducing facility energy consumption by 10% and achieving an EUI of 1.40 GJ/m^2 has been set, with energy savings being targeted in the following areas:

- Pneumatic Conversions / DDC Upgrades
- Advanced Lighting Controls
- Building Commissioning
- Equipment renewal and reconfiguration

The estimated annual savings from this target are presented in the table below.

Electricity (kWh)	Natural Gas (m3)	Utility Cost ($)
5,059,000	154,000	$562,000

Durham College Mission, Vision and Values

Our mission, vision, values were created to help ensure the success of our students, staff and faculty. We work hard to follow these guiding principles.

Mission

The student experience comes first at Durham College.

Vision

Durham College is the premier post-secondary destination for students who succeed in a dynamic and supportive learning environment. Our graduates develop the professional and personal skills required to realize meaningful careers and make a difference in the world.

Values

Our values drive our organizational culture and behaviour in delivering our vision and mission.

We value:

- **Integrity and transparency** – we behave and communicate sincerely and honestly.
- **Respect –** we treat everyone with dignity deliver superior service and offer a safe environment.
- **Equal access and diversity –** we embrace diversity, ensure accessibility and champion all learners.
- **Personal and team accountability –** we do what we say we will do and are creative and innovative in how we conduct our business.

Goals and Objectives

Durham College is committed to setting and achieving ambitious goals for its students, staff, community and the school itself in order to continue evolving as a top higher education facility in Ontario.

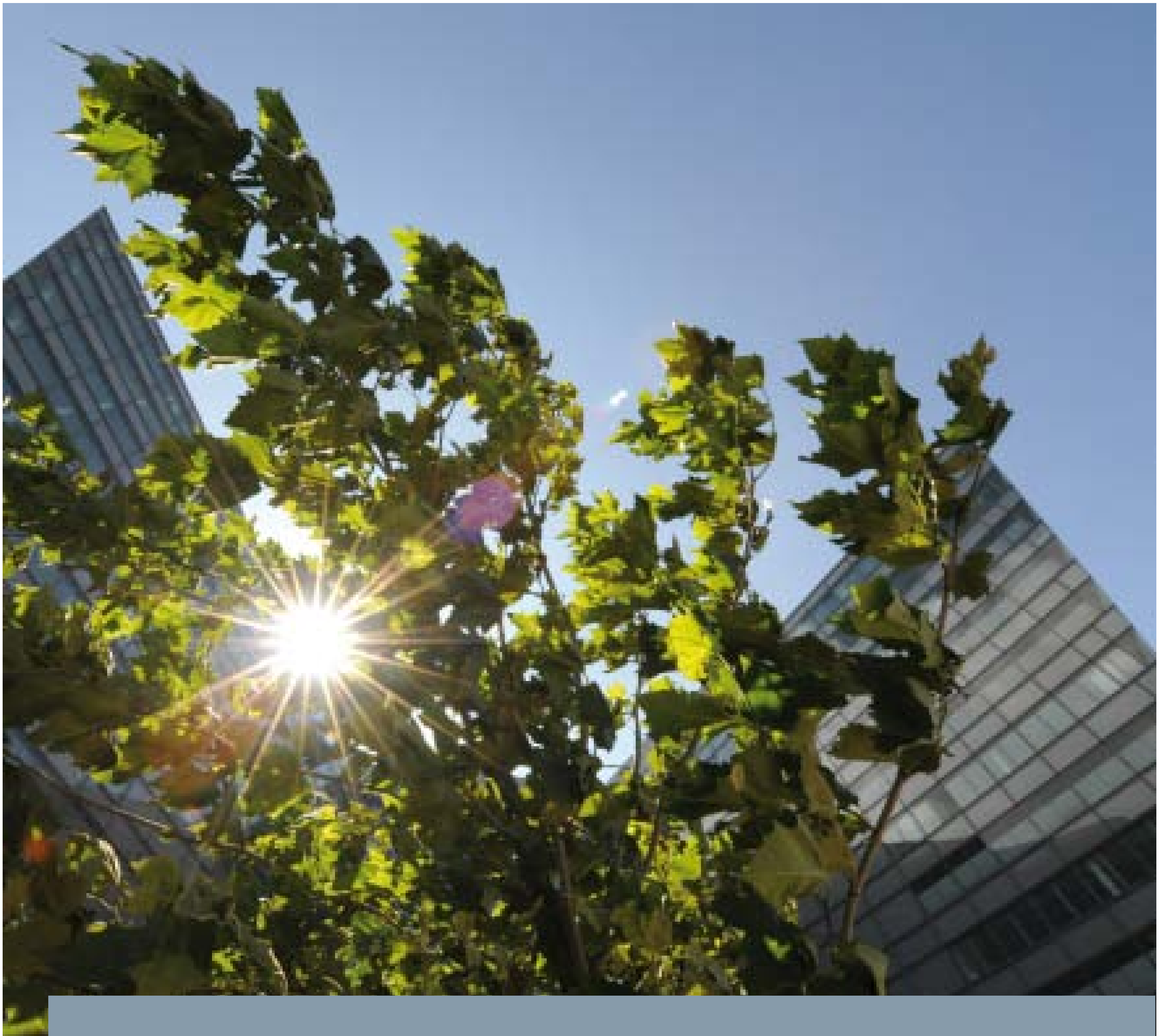
Goals

- **Our students –** To provide students with the best possible learning experiences by offering new opportunities for experiential learning, fostering greater mobility within the post-secondary system and ensuring all necessary supports are in place.
- **Our people –** To capitalize on the vast experiences and expertise of our people and help them make the best possible contribution towards the student experience.
- **Our business –** To be prudent stewards of all resources so that we are financially responsible, demonstrate good governance and are system leaders in making decisions that support outstanding teaching and learning.
- **Our community –** To ensure the college, in all its actions and decisions, is contributing to the economic and social prosperity of our communities.

Durham College aims to improve upon its sustainability practices and energy performance while continuing to enrich its academic portfolio. While the college has already implemented several projects aimed towards reducing site-wide energy consumption, there remain several additional opportunities to decrease electricity, natural gas and water consumption and reduce the school's GHG footprint.

Moving forward, Durham College aims to continue improving upon the energy performance of its facilities on all three campuses while also offering innovative academic programs geared towards sustainability and energy conservation. In terms of facility operation, it is the goal of Durham College to become a top energy performer in its category of higher education institutions. This report outlines both the current energy performance of the college, as well as the energy performance target moving forward and how it will be achieved.

Durham College commits to being environmental stewards and leading through specific actions that reduce the college's carbon footprint. Durham College strives to advance individual and collective efforts and accountabilities throughout the Durham College community to make sustainability a priority in the life of the college. While this report focuses on campus energy consumption and meeting the submission requirements of the *Green Energy Act*, it represents only one aspect of Durham College's overall sustainability goals.



Overview of Facilities

Durham College

Overview of Facilities

Durham College's primary campus is located in Oshawa, Ontario, with satellite campus buildings in both Whitby and Pickering, Ontario. The primary campus includes several buildings, including classrooms, lecture halls, laboratories, workshops, student housing, office areas, libraries, recreational facilities, cafeterias/eateries, and more. Building ages on this site range from the campus' first building, the Simcoe Building which was constructed in the late 1960's, to the Campus Recreation and Wellness Centre which opened in 2007 and the Student Services Building which opened 2011.

Space heating is supplied by hot water perimeter radiators and terminal reheat units, with hot water being supplied by natural gas fired boilers located in various mechanical rooms (Willey, South Wing & Athletics). The Willey Building and South Village Residence receive heat from the combined heat and power (CHP) plant.

Heating and Cooling are supplied to several buildings through the rooftop AHUs by direct expansion (DX) cooling units and gas fired heating. D Wing, F Wing, G Wing, L Wing, Simcoe Bldg, & Student Centre are the main areas.

Additional cooling is provided by several chillers on site which provide chilled water to AHUs serving the Willey building, South Wing & Athletics Facility.

Domestic hot water (DHW) is supplied by natural gas fired DHW heaters located in various mechanical rooms.

Lighting throughout the site is primarily T8 fluorescent, compact fluorescent or other high efficiency fixture types. Lighting control is limited but some stand alone occupancy sensors are installed. It was observed that most of these sensors do not turn off in the normal course of the day, due to high reset time.

Plumbing fixtures are primarily standard flow toilets, urinals, and faucets.

The HVAC system is controlled by Siemens Apogee Direct Digital Controls (DDC). There is also a Siemens Insight front end for monitoring and controlling of points. The level of integration of the control system is high with most systems fully controlled by the DDC system.

Renewable Energy

Durham College has made renewable energy a focus both through its academic programs as well as in its daily operation. The campuses have been equipped with a variety of renewable energy sources including a geothermal system, a solar PV array and wind turbines. These systems act to provide renewable heating, cooling and electricity to the campus while also acting as teaching tools for the various sustainability and technical programs offered by the college. Paired with the many high efficiency elements of the building, these renewable energy sources result in a facility that requires much less grid electricity and natural gas than a comparable building.

Geothermal

The Oshawa campus is equipped with a 70 ton geothermal ground-source heat pump system capable of providing both heating and cooling to the building. The system uses 32 vertical boreholes to transfer heat between the building and the ground as needed, greatly reducing the need for gas and electric heating and cooling at the site.

Solar

The rooftop of the Whitby campus is outfitted with over 350 solar photovoltaic panels, capable of generating 78 kW of renewable energy. The PV system is part of the Ontario Power Authority's *Feed-in-Tariff* program, which allows the college to sell generated renewable electricity to the Ontario grid.

Wind

In addition to the solar PV, the Whitby campus rooftop includes six vertical axis wind turbines (VAWTs) which generate usable power while also acting as a key teaching tool for the Wind Turbine Technician program. These turbines require lower minimum wind speeds to operate and are capable of generating 21 kW of renewable energy for the campus.

Utility Data Analysis

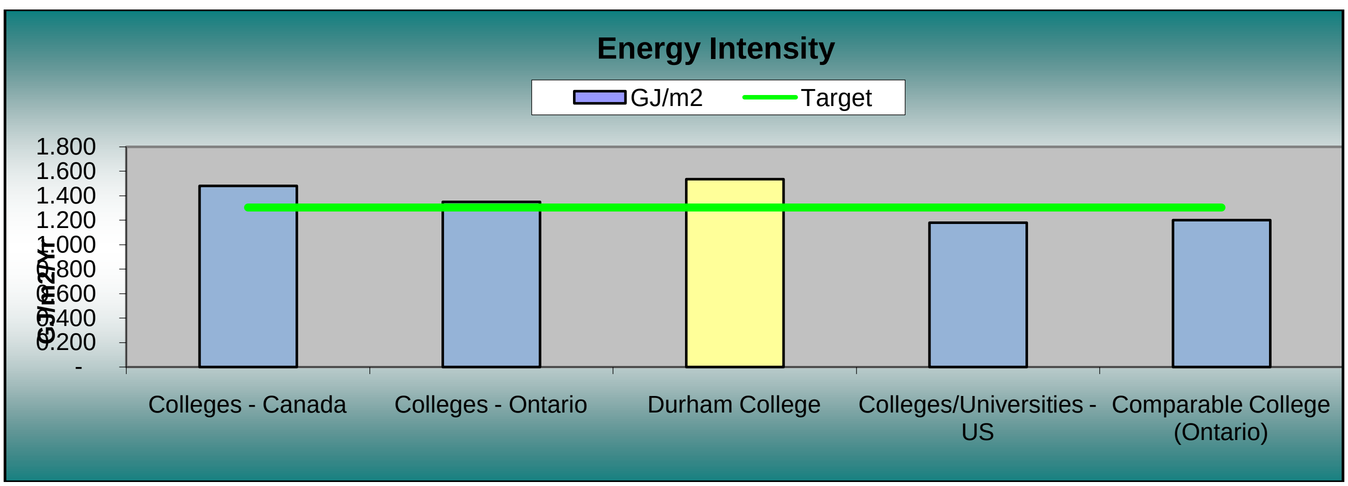
Utility Data Analysis

In order to understand the energy potential on campus a utility data analysis of Durham College, inclusive of campus facilities in Oshawa, Whitby and Pickering has been completed. In this analysis, the energy usage of Durham College is compared to other similar facilities and Canadian survey data in order to benchmark the facility energy performance. The energy profile found was then compared to weather patterns to determine if a correlation could be established.

Facility Benchmark and Utility Consumption

As the college's physical footprint is likely to continue to grow as the campus and program offerings expand, it is more useful to assess energy performance as a relative metric as opposed to absolute energy consumption. For this purpose, site energy consumption is assessed in GJ/m2 (per year), which also allows for easy comparison against benchmark averages and similar facilities.

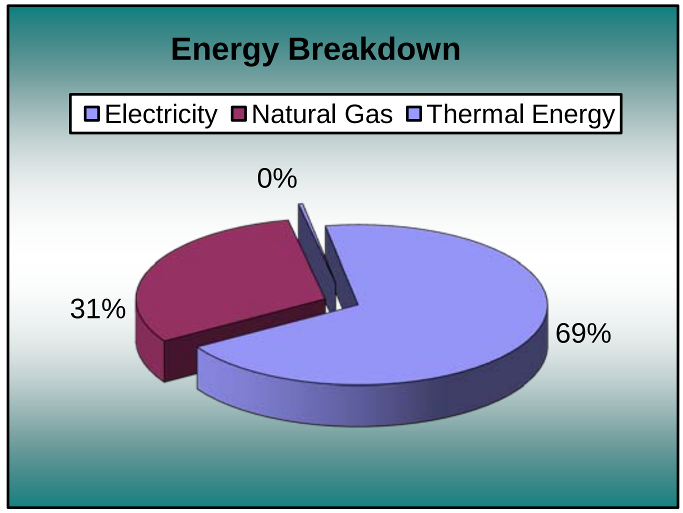
Energy Intensity Comparison



Comparing to Durham College's energy intensity of 1.54 GJ/m^2, it is believed that there are several energy savings opportunities at this facility. It can be seen that college facilities as a whole is currently above the benchmark average for colleges in Ontario as well as the benchmark for colleges in Canada. Under this CDM a reasonable reduction target of 10% of current energy use has been identified to reduce the EUI to 1.4 GJ/m^2.

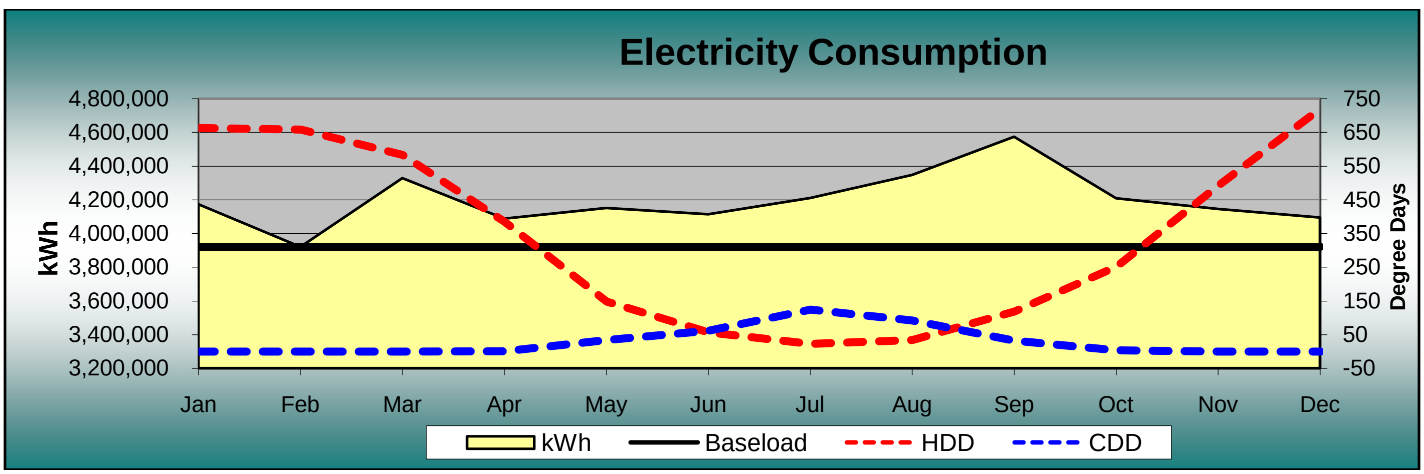
Energy Source Breakdown

Natural gas accounts for 31% of the energy use by the college while electricity accounts for 69% of the energy use and thermal energy accounts for <1%. Natural gas consumption would typically be expected to account for a greater percentage of total energy use (40-50%). This anomaly is believed to be attributable to efficient boilers installed, and also the ability to utilize the geothermal plant to offset some of the thermal load



Detailed Consumption Analysis

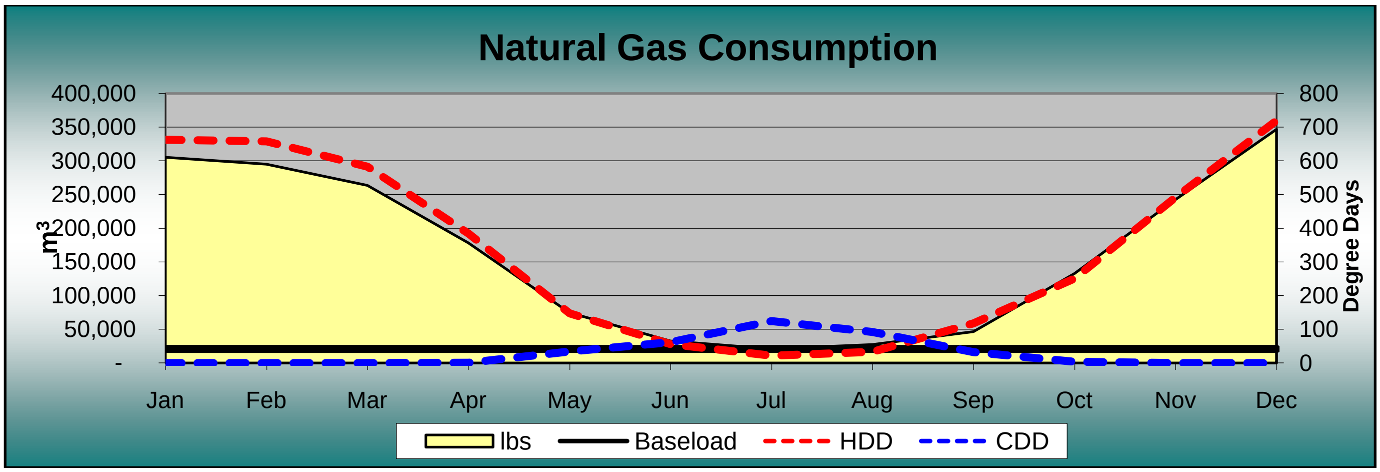
A more detailed analysis was completed on the most recent full calendar year consumption data available (Jan-Dec 2013) provided by Durham College to review the trend in data in relation to weather and also to identify any major data anomalies that were present.



The graph above depicts the electrical consumption on a monthly basis. This energy profile is fairly inconsistent with multiple spikes and valleys throughout the year. While there is increased electricity consumption between July-September, likely attributable to increased cooling loads, there is not a strong overall correlation between cooling degree days and electricity consumption. The significant drop in monthly energy consumption for February can be attributed to February being a shorter month – extrapolating the daily electricity consumption in February 2013 for the primary 2000 Simcoe St. N electricity account for a 30-day month increases monthly electricity consumption by over 200,000 kWh and eliminates the valley. Electricity consumption can also be seen to increase in the month of September, the highest monthly consumption of the year, while cooling degree days are relatively low. In part, this is expected to be due to increased activity on campus as it is the beginning of the academic year.

Of particular interest is the significant electrical base load. This indicates heavy run hours on base building systems including lighting, pumps and fan systems which would be likely targets to meet energy reduction targets.

Natural gas has an annual consumption profile as shown below:



The monthly natural gas profile shows a very strong correlation to heating degree days. A key observation is that consumption is very low in the summer with a rapid increase as weather cools. This indicates that almost all natural gas is being used for space heating and that domestic hot water usage at the site is relatively low. Such a high correlation between gas consumption and heating degree days indicates that likely targets for gas savings would focus on reducing space heating needs, particularly when spaces are unoccupied.

Utility Rate Analysis

For the purpose of this report, Durham College has utilized blended energy rates for electricity and natural gas used at Durham Colleges Oshawa, Whitby and Pickering sites. These were found from dividing the total cost of the commodity (before taxes) by total consumption. They are:

- Electricity: $0.1033/kWh (blended)
- Natural Gas $0.25/m3

Electricity and Natural Gas rates are normal for this area and customer size, with rates for both utilities expected to continue to increase in coming years based on reports from the OPA, OEB and Enbridge.

Energy Conservation Measures

Energy Conservation Measures

As a result of the preliminary site investigation the Facilities Management has identified the following potential Facility Improvement Measures (FIMs) for Durham College.

- Commissioning Advantage
  - Detailed investigation and analysis of building and equipment performance
  - Identification of building improvement opportunities to drive increased occupant comfort and energy efficiency

- HVAC Retrofits
  - Upgrade A, B and C Wing AHUs with newer units with improved efficiency, control and sizing
  - Constant air volume to variable air volume retrofits
  - Implementation of demand control ventilation and occupancy based controls
  - Maximize the use of economizers/free cooling

- Building Automation and Controls
  - Upgrade building automation system and controls, replacing all pneumatic controls with new electronic (DDC) controls and expanding existing DDC controls at the at the Oshawa / Whitby Campus

- Energy Management
  - Increased gas and electricity monitoring throughout the campus to allow for increased monitoring and management of campus loads
  - Increased demand management and participation in the OPA's DR3 program
  - Scheduling of equipment to operate as needed

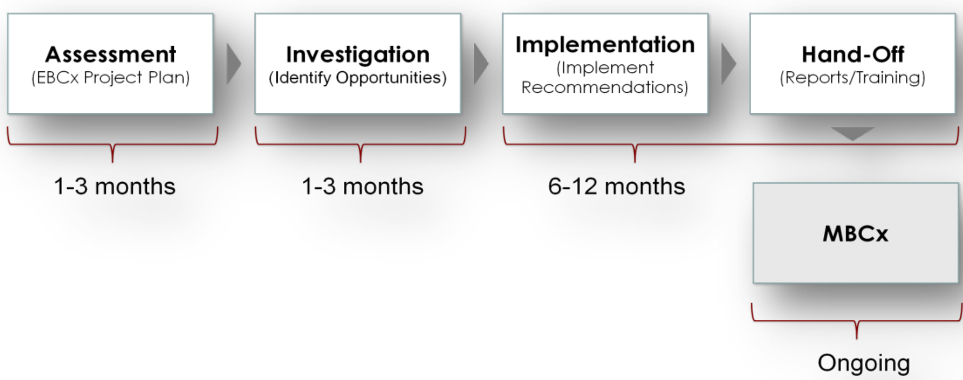
- Computerized Maintenance
  - Use of a newly implemented computerized maintenance system to improve preventative maintenance and efficiency of equipment

Not currently summarized in this report, but planned for future implementation is an additional measure:

- Optimization of Co-Generation Use
  - Increased use of electricity from on-site cogeneration facility to reduce peak grid electricity consumption
  - Expanded use of cogeneration thermal energy for on-site heating

Commissioning Advantage

Over time facilities change; HVAC equipment and systems are modified or removed, new HVAC equipment is added and the requirements of the occupants and facility fluctuate. As such, ensuring building equipment and systems are functioning at their peak performance in relation to the current environment is crucial. The Commissioning Advantage Program (CxA) is designed to execute the characteristic Existing Building Commissioning (EBCx) phases, implement commissioning conservation measures in an expeditious manner and establish a protocol to ensure persistence of all building performance improvements provided by this initiative. Commissioning programs are becoming increasingly recognized as a cost-effective, quality-driven process to improve building performance. The CxA process undertakes the following process:



The primary focus of the Commissioning Advantage Program is identifying and implementing "low cost/no cost" operational improvements given a building's current facility requirements (CFRs) to improve overall building performance including comfort and energy savings. It is a systematic process for improving and optimizing a building's operations and supporting those improvements with enhanced documentation and training for Durham College staff. The process focuses on the operation of mechanical and electrical equipment, lighting, and related controls, and is intended to optimize how equipment operates as a system.

A few examples of major elements that will be addressed under the CxA program include:

- Documentation Review and Building Staff Interviews

- Sensor and Actuator Calibration Review
- Systems Diagnostics Monitoring including critical building automation system trending, portable data logging, etc.
- Trend Major Control Loops and space temperatures to determine stability of control systems
- Testing and Balancing of major AHU’s and Pumping systems as required. Recalibration where necessary

CxA initially focuses on operations and maintenance opportunities within our facility (e.g. optimizing temperature set points and equipment scheduling) to achieve efficiency improvements, with the end goal of using minimal energy to meet our facility requirements. It also identifies, addresses, and fixes short falls when the HVAC equipment is not operating as originally intended. Commissioning the existing HVAC systems can have a significant impact on the energy consumption as well as the performance and life expectancy of the HVAC equipment.

Key limitations of the existing systems will be addressed, and any operational modifications will be corrected. Sample Items that would be included at Durham College as part of an CxA measure include:

Fan Start/Stop Optimization	Critical Zone Temperature Reset	VFD Static Pressure Reset
Zone Scheduling	Night / Unoccupied Setback	Replace Failed Devices
Expansion of BAS	Enthalpy Economizing	Identification of Plugged Coils
Identification of Pneumatic Leaks		

Heating, Ventilation and Air Conditioning (HVAC) Retrofits

Air Handling Unit (AHU) Refurbishment and Replacement

Many of the air handling units (AHU's) are in need of repairs and upgrading. Heating and cooling coils are inefficient, dampers are inoperative, drain pans are rusty, and insulation is torn or missing,

Over the years, the cost of maintenance has becoming a major burden to facility operations staff. AHU's are an integral part of an HVAC system and must function as designed to adequately supply required conditioned air to a space.

As part of the capital improvements and energy conservation strategy, Durham College will specifically target units in A, B and C-Wing at the Oshawa campus as these are some of the oldest systems on campus. As part of the replacement strategy the following will be considered:

- Right Sizing of equipment to meet current loads and downsizing where possible
- Installation of VFD's to control airflows to meet space requirements
- Heat Recovery, where possible
- High Efficiency Fan Systems (Fan Walls)
- Zoning of Systems

Constant Volume (CV) to Variable Air Volume (VAV) Conversions

Many of the existing systems at Durham College are constant volume, though spaces have variable use and occupancy.

Durham College plans to convert many of the existing systems to variable air volume. Some of these will be incorporated as part of the planned AHU Replacement. Others will be retrofit of existing system.

Under a retrofit system, existing constant volume zone controls or re-heat terminals will be retrofitted with new controllers, actuators, and sensors. Further, all fans will be equipped with variable speed drives to control the pressurization and drive the savings by reduction in volume based on feedback from damper position in the spaces.

Several benefits are realized through a CV to VAV conversion including: Fan Motor energy is reduced, heating and cooling requirements are reduced, Equipment Life is extended, occupant comfort is improved.

Demand Control Ventilation

The amount of fresh air required in a space varies based on occupancy. The more people in the space, the more outside air should be delivered. The existing air handling units supply conditioned air to the spaces and have minimum control of outside air. The occupancy of these spaces varies throughout the day, but currently the amount of outside air delivered to the space remains constant.

Durham College will be implementing carbon dioxide (CO2) sensors in the return air streams of the air handling units to monitor the percentage of CO2 in the space. Based on that percentage the outside air, return air and exhaust air dampers can be more tightly controlled to supply the space with the proper amount of ventilation air. This reduces the energy required to condition the outside air.

This type of control, called demand control ventilation, offers a means of optimizing the amount of ventilation required for a building or space. Energy savings are achieved by limiting the volume of outside air that must be conditioned.

Demand control ventilation (DCV) is a control strategy that adjusts the amount of outside air based on the number of occupants and activity taking place in various spaces. Not heating or cooling unnecessary quantities of outside air conserves energy. Ventilation is based on the needs of the occupants of the space rather than using a fixed strategy based on design occupancy.

DCV modulates ventilation to maintain target cfm-per-person ventilation rates based on actual occupancy. CO2 is used as an occupancy indicator to modulate ventilation below the maximum total outdoor air intake rate while maintaining the required ventilation rate per person.

In more Lab Intensive environments, Durham College will explore a more comprehensive form of DCV. This is a specific solution, Aircuity. Aircuity sensing goes above standard CO2 and expands to monitor VOCs in the air stream in more critical environments. Utilizing this controls strategy, significant energy savings can be realized in those lab environments that have a high requirement for outdoor air to meet air quality requirements.

Lighting Systems

Lighting Control System

Lighting fixtures consume a significant amount of energy in a higher education building. Replacing old, inefficient light bulbs and ballasts with new, energy-efficient models yields immediate energy savings.

At Durham College, the lighting is primarily all new high efficiency fixtures. Replacement of any of the fixtures would not yield justifiable paybacks; however, significant savings can be realized by utilizing lighting control techniques. Durham College will be implementing GAMMA lighting controls which can be integrated to the Siemens Insight front end. This is very advantageous compared to other lighting control systems as Insight and Gamma can share outputs (i.e. occupancy sensor input) and the system can be controlled without the need for a new front end. Using the GAMMA system, advanced control techniques will be possible.

In many common open areas around the camps, many of the lights are on overnight with no mechanism to turn the lights off when not in use. This represents a significant cost as the lighting is not required overnight. A schedule will be initiated for the main system lighting so that only emergency lighting remains on at night. This system will have manual override features for cleaning staff or other night time occupants if needed. A push button override will be installed in an area only accessible by appropriate staff.

Several buildings also have many large windows that let in significant amounts of natural light. During the day, all the required lighting for many areas can be accomplished by outdoor light but currently the lighting needlessly stays on. Daylight harvesting will be implemented in several key areas.

The lighting usage will be reduced while not impacting lighting quality. As a secondary benefit, and tied into the CxA measure, the outputs from the GAMMA controls will be directly integrated to the Insight front end. As a result, HVAC commissioning can include occupancy based feedback from the lighting control system.

Reset Occupancy Sensors in Washrooms and Offices

In some area of the campus, occupancy sensors are used to turn off periodically used areas when they are not needed. This includes washrooms, storage rooms, and some offices.

Facilities Management will optimize the settings on the motion sensors so that the lighting in the unoccupied spaces is not overused. This will be done in all areas where it is deemed that savings can be realized.

Direct Digital Controls

Direct Digital Control (DDC) Retrofit and Expansion

Several existing systems at the Durham College campuses still utilize aged pneumatic controls as well as basic electronic control systems. Pneumatic systems, while reliable, are becoming increasingly more difficult and expensive to maintain. Durham College will be investing in replacement of existing pneumatics with Direct Digital Controls (DDC) as well expanding existing DDC controls with more advanced strategies.

DDC provides more effective control of HVAC system by providing more accurately sensed data. Electronic sensors for measuring the HVAC parameters of temperature, humidity and pressure are inherently more accurate than their pneumatic predecessors. Since the logic of a control loop is now included in the software, this logic can be readily changed. In this sense, DDC is far more flexible in changing reset schedules, setpoints and the overall control logic. Users are apt to apply more complex strategies, implement energy saving features and optimize their system performance since there is less cost associated with these changes than there would be when the logic is distributed to individual components.

DDC systems, by their very nature can integrate more easily into other computer-based systems. DDC systems can integrate into fire control systems, access/security control systems, lighting control systems and maintenance management systems.

Many energy-efficient control strategies employed in pneumatic logic can be easily duplicated in DDC logic. Due to the addition of more complex mathematical functions (easily obtained in software) strategies such as demand monitoring and limiting can be more easily implemented with DDC systems. The overall demand to a facility can be monitored and controlled by resetting various system setpoints based on different demand levels. If a DDC system is installed at the zone level, this could be accomplished by decreasing the requirement for cooling on a zone-by-zone basis.

By storing trends, energy consumption patterns can be monitored. Equipment can also be centrally scheduled "on" or "off" in applications where schedules frequently change.

Peak Demand Limiting (Load Management)

A building's electric demand load profile will vary throughout the day depending on the electrical loads within the building and when they operate. Peak Demand is the maximum demand load on a building during a 15-minute period within 24 hours. The peak demand windows are established by the building's local electric utility, with the most common being a 15-minute window. The electric utility monitors the building's demand and charges a demand cost in accordance with the tariff assigned to that building's particular account.

Durham College will utilize the automation system to implement a peak demand limiting (PDL) strategy using the building's existing APOGEE System and the PDL application programming within APOGEE to maintain a specified demand limit threshold. This is accomplished by monitoring the demand load and adjusting equipment operation or shutting off electrical equipment for set periods in order to maintain a demand setting without compromising occupant comfort or building operations. Typically, the electrical loads are prioritized such that those with the least impact are the first to be affected in a PDL situation. For the Durham College, limiting the peak demand in a facility can result in considerable demand cost savings.

As part of our implementation of Peak Demand Control limiting, we will be exploring increased participation in the OPA Demand Response 3 (DR3) program.

Campus Wide Metering

Installation of Electrical and Natural Gas, and BTU Meters

Durham College already has an extensive electrical submetering network. However, over time, the calibration of the systems has not been fully maintained. Under our CDM program we will be completing a full calibration of all meters to ensure data quality is accurate.

In addition, Natural Gas and BTU meters will be installed in strategic locations across campus. This includes main natural gas lines for large campus buildings, and BTU metering on central chilled water and hot water systems.

The end-result of this process will be an energy data network which will allow for full tracking of energy on campus. This will allow for ongoing tracking of energy performance of implemented measures, as well as identification of key areas for energy improvement.

Upgrade of Schneider Ion Monitoring System

In order to fully utilize the existing and planned submetering infrastructure, Durham College will be upgrading our existing Schneider Ion Energy Monitoring system. The new system will combine all system to a centralized server so that Durham can track all energy patterns from a central system.

Computerized Maintenance

Archibus Computerized Maintenance System

Durham College has recently purchased and implemented a computerized maintenance and management system through Archibus. This will provide the campus with a huge upgrade and modernization of our preventative maintenance program at our facilities.

Maintenance plans a significant role in driving energy savings. If equipment is not properly maintained, it becomes less efficient. Fan and Pump Motors have to work harder if they are not properly lubricated, Air Handling systems are less efficient if filters are plugged, etc. The program will be implemented and will drive savings at minimal cost over the 5-year CDM plan.

5-Year Plan Summary

Living GREEN

Project Summary

Financial Summary

The following table provides the projected cost and savings of the proposed measures under the CDM.

Project Financials

Measure	Cost	Savings	Payback
Building Recommissioning	$415,000	$166,000	2.5
Lighting Controls	$306,000	$47,000	6.5
DDC Upgrades	$352,000	$88,000	4.0
HVAC Upgrades	$1,710,000	$171,000	10.0
Demand Response	$117,000	$39,000	3.0
Campus Energy Metering	$200,000	$33,000	6.1
Computerized Maintenance	-	$18,000	-
Total	**$3,100,000**	**$562,000**	**5.5**

Implementation of all measures would result in an energy use reduction of 10%.

5-Year Schedule

The proposed schedule for the implementation, including annual budget ($) as well as electricity (kWh) and natural gas (m^3) savings is shown in the table below.

	FY 14/15			FY 15/16			FY 16/17			FY 17/18			FY 18/19			Measure Payback
Measures	Budget	Savings (kWh)	Savings (m3 Gas)	Budget	Savings (kWh)	Savings (m3 Gas)	Budget	Savings (kWh)	Savings (m3 Gas)	Budget	Savings (kWh)	Savings (m3 Gas)	Budget	Savings (kWh)	Savings (m3 Gas)	
Building Recommissioning	$ 207,500	755,000	19,500	$ 207,500	1,510,000	39,000	$ -	1,510,000	39,000	$ -	1,510,000	39,000	$ -	1,510,000	39,000	2.5
Lighting Controls	$ -	-	-	$ 102,000	151,000	-	$ 102,000	302,000	-	$ 102,000	453,000	-	$ -	453,000	-	6.5
BAS Upgrades	$ 70,400	151,000	7,800	$ 70,400	302,000	15,600	$ 70,400	453,000	23,400	$ 70,400	604,000	31,200	$ 70,400	755,000	39,000	4.0
HVAC Upgrades	$ -	-	-	$ -	-	-	$ -	-	-	$ 855,000	755,000	29,500	$ 855,000	755,000	29,500	10.0
Demand Response	$ -	-	-	$ 39,000	126,000	-	$ 39,000	252,000	-	$ 39,000	378,000	-	$ -	378,000	-	3.0
Campus Energy Metering	$ 50,000	75,500	1,750	$ 50,000	151,000	3,500	$ 50,000	226,500	5,250	$ 50,000	302,000	7,000	$ -	302,000	7,000	6.1
Computerized Maintenance	$ -	-	-	$ -	-	-	$ -	50,333	3,333	$ -	100,667	6,667	$ -	151,000	10,000	0.0
Total	$ 327,900	981,500	29,050	$ 468,900	2,240,000	58,100	$ 261,400	2,793,833	70,983	$ 1,116,400	4,102,667	113,367	$ 925,400	4,304,000	124,500	5.5

Sustainability

In 2012 Durham College launched a new campus initiative under the banner of “Living Green”. With oversight by Durham Colleges Sustainability Committee, the Living Green initiative seeks to enhance the environmental sustainability of campus operations, planning, administration, curriculum, research, innovation and stakeholder engagement. Durham College has hired a Sustainability Coordinator to promote Living Green initiatives and foster a culture of sustainability. Durham College also continues to leverage its unique partnership with the University Of Ontario Institute of Technology (UOIT), as they are an integral component in the development of broad-reaching and successful sustainability initiatives, throughout our shared campus environment and beyond.

This project will conserve resources and reduce environmental impacts through energy conservation, reduction of fossil fuel consumption, and reducing on-site emissions as well as upstream emissions associated with electricity generation.

Carbon Footprint reduction

The figure below shows the carbon reduction affect this project will have, both on an annual basis and over the 5-year plan.

Current Footprint

CO_2e Emissions	
Electricity	11,892.179
Natural Gas	3,735.784
Heating Oil - Distillate	0.000
Heating Oil - Residual	0.000
Total	15,627.963

Annual Reduction

CO_2e Emissions	
Electricity	1,194.904
Natural Gas	292.599
Heating Oil - Distillate	0.000
Heating Oil - Residual	0.000
Total	1,487.503

Total Project Term

CO_2e Emissions in metric tons	
Electricity	5,974.519
Natural Gas	1,462.996
Heating Oil - Distillate	0.000
Heating Oil - Residual	0.000
Total	7,437.515

Executive Approval

Durham College is pleased to submit this Energy Conservation and Demand Management submission to meet the Ontario Ministry of Energy's requirements under Ontario Regulation 397/11.

This Energy Conservation and Demand Management plan highlights Durham Colleges' current energy consumption patterns, provides targets for energy reduction and identifies key areas of focus to drive energy savings.

Durham College is committed to meeting the targets identified within this CDM and will continue to be proactive with energy conservation to continue our efforts towards sustainability.

Key highlights of Durham Colleges' Conservation and Demand Management Plan if all measure can be implemented include:

- Reduction of our Energy Use Intensity from 1.54 GJ/m^2 to 1.40 GJ/m^2
- 10% total energy reduction at the campus
- Reduction of 7,400 Tons of GHG emissions over the 5-year plan if all measures

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Appendix A: List of Abbreviations

List of Abbreviations

AHU	Air Handling Unit
BAS	Building Automation System
CDD/HDD	Cooling Degree Days / Heating Degree Days
CDM	Energy Conservation and Demand Management Plan
CHP	Combined Heat and Power
CV / VAV	Constant Volume / Variable Air Volume
CxA/EBCx	Commissioning Advantage / Existing Building Commissioning
DCV	Demand Control Ventilation
DDC	Direct Digital Controls
DHW	Domestic Hot Water
DR3	Demand Response 3 Program
DX	Direct Expansion
EUI	Energy Usage Intensity
GJ/m2	Gigajoules of Energy Per Square Meter
HVAC	Heating, Ventilation and Air Conditioning
kW	Kilowatt
kWh	Kilowatt-Hour
OPA	Ontario Power Authority
PV	Photovoltaic
VAWT	Vertical Axis Wind Turbine