UNIVERSITY OF ONTARIO INSTITUTE OF TECHNOLOGY

ENERGY CONSERVATION AND DEMAND MANAGEMENT PLAN

2014-2019

This plan addresses UOIT's 5 year energy management and conservation strategy. It includes technical, organizational, and behavioral measures to be implemented across campus in an effort to further reduce energy use and operating costs.

Office of Campus Infrastructure and Sustainability

7/1/2014

UNIVERSITY OF ONTARIO INSTITUTE OF TECHNOLOGY
CAMPUS INFRASTRUCTURE AND SUSTAINABILITY

Go green Stay blue

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Executive Summary

The Energy Conservation and Demand Management Plan was developed to fulfill reporting requirements of the *Green Energy Act 2009* and to support UOIT's commitment to improving energy performance and reducing overall energy usage within the built environment, operations and programs. Additionally, this comprehensive plan contributes to the development of a larger foundation and framework that will ensure continuous sustainability integration throughout the UOIT campus and community.

Background

The Energy Conservation and Demand Management Plan was undertaken to fulfill the reporting requirements under the Province of Ontario's Green Energy Act 2009, Ontario Regulation 397/11.

This Energy Conservation and Demand Management Plan has two parts:

1. A summary of the University`s annual energy consumption and greenhouse gas emissions for its operations. The first listing was submitted July 1, 2013 for the 2011 calendar year, and is due annually thereafter.

2. A description of previous, current and proposed measures for conserving and otherwise reducing the amount of energy consumed by the University`s operations and for managing the public agency's demand for energy, including a forecast of the expected results of current and proposed measures. O. Reg. 397/11, s. 4 (2).

This Plan will be made available to the public on July 1, 2014 and reviewed on an annual basis to ensure progress is being made and to update as necessary. As per the reporting requirements, *on or before July 1, 2019 and on or before every fifth anniversary thereafter, the University shall publish on its website and intranet site, and make available to the public in printed form at its head office all of the information that is required to be published and made available:*

1. *Energy consumption and greenhouse gas emission data.*
2. *A description of current and proposed measures for conserving and otherwise reducing energy consumption and managing its demand for energy.*
3. *A revised forecast of the expected results of the current and proposed measures.*
4. *A report of the actual results achieved.*
5. *A description of any proposed changes to be made to assist the public agency in reaching any targets it has established or forecasts it has made. O. Reg. 397/11, s. 6 (3).*

List of Acronyms

ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers
BAS	Building Automation System
BTESS	Borehole Thermal Energy Storage System
CFL	Compact Fluorescent Light
ECDMP	Energy Conservation and Demand Management Plan
ECM	Energy Conservation Measure
ekWh	Equivalent Kilowatt Hours
GEA	Green Energy Act
GHG	Greenhouse Gas
HRU	Heat Recovery Unit
HVAC	Heating, Ventilation, and Air Conditioning
LED	Light Emitting Diode
LEED	Leadership in Energy and Environmental Design
MNECB	Model National Energy Code for Buildings
OCIS	Office of Campus Infrastructure and Sustainability
RETS	Renewable Energy Technology Systems
UOIT	University of Ontario Institute of Technology
UOITD	University of Ontario Institute of Technology Downtown Location
UOITN	University of Ontario Institute of Technology North Location

INTRODUCTION

UOIT, accepting its first students in 2003 is the first new university created in Ontario in over 35 years. Now in its 11th year with a rapidly growing enrollment of 9000, UOIT has become a leader among North American universities in sustainable design and technology-enriched learning environments; boasting Canada's largest geothermal well field system and Ontario's first ever laptop-based program.

Since inception, UOIT has prioritized energy performance and carbon control by incorporating emerging technologies, sustainable design, architectural design and campus planning. The energy efficiency features on campus are multi-facetted and use both simple and highly technological approaches. From Borehole Thermal Energy Storage System (BTESS) to the simple green roofs, UOIT has fully espoused the principles of environmental stewardship and energy conservation.

The North Oshawa location which is shared with Durham College is what really sets the University apart. This integrated village has created a strong campus identity that fosters social and academic interaction and responds to the ecological context of the site. Designers incorporated a number of environmentally-advanced features into the 8 building complex, thus creating a sustainable campus that limits energy and resource consumption while providing a supportive and inspiring environment. These efforts have been recognized by the Ontario Conservation Action Team who awarded UOIT in recognition of Outstanding Leadership in Sustainable Energy Practices 2005.

SUSTAINABILITY STRATEGY

Recognizing that energy conservation and carbon neutrality are moving targets where technology and applications are ever changing and improving, UOIT has adopted an integrated sustainability approach. Through the Office of Campus Infrastructure and Sustainability (OCIS) resources are dedicated to the ongoing integration, performance measuring and reporting of sustainability initiatives.

OCIS 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 UOIT. Our five year strategy will focus on energy use reduction while also considering renewable and other on-site generation applications.

Energy Conservation Design Features

UOIT currently incorporates dozens of design elements into its eight-building facility in their North Oshawa location, making it one of the most energy-efficient complexes in North America. Sustainable design features are also applied to the Downtown location buildings owned by UOIT, however large scale modifications are limited in leased buildings (See: Appendix A)

Looking Ahead

In order to accommodate its rapid enrollment growth since 2003, UOIT has undergone multiple campus expansion projects. The requirement for additional academic, social and institutional office spaces continues to grow significantly each year, therefore a Joint Campus Master Plan (JCMP) with Durham College has been initiated. This plan focuses on a new sequence of sustainable campus development up to 2030.

Design and construction of UOITN adhered to LEED "gold" standards, incorporating energy efficiency in all aspects of the building design, including building envelope, lighting and mechanical design. A target performance of 50% better than MNECB was established for the academic buildings while 40% was used for the arena. The facilities are up to 46% (33,308 GJ annual) below what is required under the elite energy efficiency 90.1 standard recognized by ASHRAE and exceed Provincial 2020 energy reduction targets. Highlighted below are some energy efficient features applied to the UOITN location infrastructure.

Heating, Cooling & Ventilation

Geothermal Well Field

UOITN is home to Canada's largest geothermal system (and the second largest in North America), a 1,500-ton BTESS which sits hidden beneath the 7500 square meter quad at the center of the complex. The installation is made up of over 370 bore holes (180m deep) that are used to heat and cool the campus buildings. Water circulates through the underground network (150 kilometers of polypropylene piping). In the winter, the geothermal system takes heat from the earth, and carries it to the buildings. In the summer, the same system removes heat from the buildings and disperses it into the ground. The innovative system links each building to a central HVAC plant.

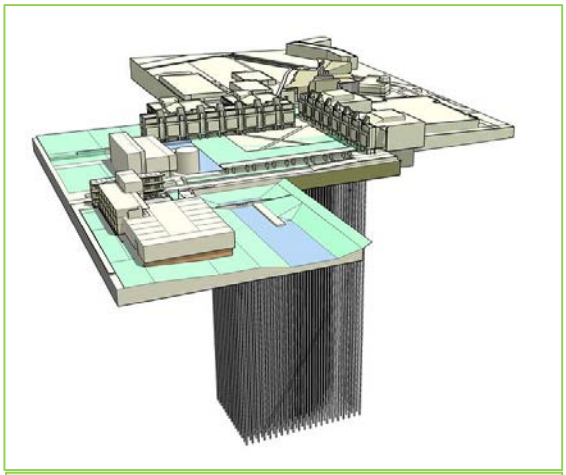

Figure 1: Rendering of UOIT's Geothermal System
Source: RAIC, 2011

Central Plant

UOIT has a central plant that provides a cooling and heating system for the entire North location. The efficient HVAC solutions applied integrated with the custom-designed geothermal systems deliver energy efficiency that is 50% better than MNECB requirements. Supplemental heat is being provided by three of six, 95%-plus efficient condensing boilers, which

provide heat for entrances, hallways and other areas where doors are frequently opened and closed and where heat doesn't reach easily. Chillers, used to create air conditioning, use magnetic induction in a centrifugal compressor system. A series of heat exchangers, with a 30% glycol mix, prevents the coils from freezing in the winter. Classrooms are equipped with an energy recovery wheel located just below the rooftop to preheat the outside air with heat recovered (71.7% effectiveness) from exhaust air. In the case of laboratories, where air contamination is a major concern, a loop system is used to reclaim waste heat.

Cogeneration Plant

A ground source heat exchanger is used as the primary source for heating and cooling at the central plant. Thermal energy produced at the plant is used to heat existing and new buildings on the Durham College and UOIT campus, while electricity produced is used to displace electrical load from the provincial supply grid.

Ventilation

The University campus has a relatively high occupancy load, but it is also a transient occupancy schedule. The mechanical systems at UOIT have been designed to efficiently meet the building ventilation requirements, while responding to the variable occupancy levels of the buildings spaces. In order to capture free cooling opportunities, 100% outdoor ventilation is available to all spaces of the buildings so no mechanical cooling is required when ambient air can provide the required conditioning. To minimize ventilation heating as well as ventilation air cooling, two thermal energy recovery wheels have been installed in the University's ventilation system to capture the sensible and latent heat of air being exhausted from the buildings as well as two run-around loops in the research buildings and a tilt plate recovery system in the arena. The mechanical systems are all variable air volume systems where the volume is controlled by variable frequency drives on the supply and return fan motors. Carbon Dioxide sensors are used to implement a demand ventilation strategy, controlling the outside air ventilation supplied to the space based upon its occupancy.

BAS

The facilities are all operated with computerized comprehensive building automation systems. All incoming electrical feeds are monitored with electronic metering as well as sub-metering at the distribution points so that the ongoing building operation can be optimized. Centralized computer control systems off lights in rooms when they're unoccupied using occupancy sensors, monitor air temperatures and automatically oversee other aspects of the interior space. CO^2 monitors assess air quality and control the outside air use.

Building Envelope

Walls, Roofs & Insulation

UOITN buildings are designed with high levels of insulation, in the outer envelope. The roof has an "R-Factor" of 30, the walls have an R-Factor of 24, and the windows have an R- Factor of 9 with thermally broken frames and no thermal bridging. Penthouse walls were all insulated to R-20 to avoid waste heat losses from the mechanical spaces. For a substantial capital cost saving for the perimeter heating system, the university buildings have a high efficiency glazing system, allowing for a complete neutralisation of the perimeter skin of the building. To significantly reduce the yearly energy

consumption of the building our exposed concrete structure provides thermal massing and the sod roofing will reduce heat losses in the summer and solar gain in the summer.

Windows

The building envelopes were all designed with two types of windows. The first are high performance Heat Mirror™ windows with a center of glass thermal resistance matching that of 25mm of polystyrene. Windows are super-high efficiency, with special thermal properties to maximize the use of passive solar heat metal oxide-coated window glazing that blocks 99.5% of UV rays. The other type of window used is Softcoat LoE². These windows provide the highest level of comfort and energy savings year round. They block up to 84% of the sun's harmful ultraviolet rays and deliver a remarkable 96% performance improvement in winter nighttime insulation (R-value) compared to non-coated air-filled insulating glass. The coating is virtually invisible to the eye – it is just like looking through clear glass. Controlling solar gain not only saves energy during the air-conditioning season, it improves the comfort and livability of sunny rooms during the spring and fall when the cooling system isn't normally used.

Figure 2: Solar reflective windows.

Vegetated Roofs

Four buildings are constructed with extensive "green roofs" to total 1600 square meters. The use of grass and soil on rooftops to aid drainage, retain heat and improve air quality. Roof runoff water is collected in an underground cistern with a capacity of 250,000L. This water is then used for irrigation and flushing within the buildings surrounding the quad; reducing UOIT's fresh water consumption of treated water from municipal sources.

Figure 3: Vegetated roof on building of North location.

Solar Shading, Daylight & Lighting

Lighting

Each building is designed around a central atrium that provides natural light through all the floors. Orientation specific solar shading is used to reduce solar gain. The lighting was designed with T5 & T8 luminaires with dimming electronic ballasts and comprehensive occupancy sensor coverage in the new buildings. Light levels are thus set at optimal levels and controlled by photo sensors in the spaces, and lighting energy is eliminated when the spaces are unoccupied.

Water Conservation

Storm Water Collection & Management
Each building has been designed with a second plumbing system that collects storm water from the roofs and stores it in a 250,000L underground cistern. This water is then used for irrigation and flushing within the buildings surrounding the quad; reducing UOIT's fresh water consumption of treated water from municipal sources.

Figure 4: UOIT storm water management system.
Source: RAIC, 2011

Grey Water Collection & Management
The aquatic toxicology lab uses approximately 88,000L of fresh water per day. This water is supplied by the municipality in order to ensure high quality, low-in-metals water. This water is further filtered for use within the lab with the Grey water leaving the lab it is then directed to the 250,000L underground cistern, where it is reused. The stored Grey water is then used within the buildings for toilets and urinals.

These systems along with state-of-the-art sensor controls and low flow water features throughout the buildings help UOIT save 32 million liters of water per year.

Campus-Wide Efficiency Measures – UOITD & UOITN

- All new buildings are made with recycled concrete.
- 100% incandescent bulb phased out to LED modeled reduction of 85kw of demand.
- Occupancy sensor lighting systems and dimmable lighting systems applied in classrooms and offices campus-wide.
- Light harvesting sensors installed in areas to reduce power demand on sunny days.
- Installed compactors for waste compression
- 65 advanced power meters installed within University buildings for accurate energy use recordings.
- Changing paper supply to only recycled content and wheat derived products.
- Waste wise campaign aimed at educating students and staff re: waste streaming and responsible consumption
- Installation of 32 hydration stations and reusable bottle distribution to all staff & students along with campus-wide messaging. In under 4 months, 15,000 bottles have been diverted from landfills.
- Blue Team focused on sustainability issues and initiatives.

ENERGY CONSUMPTION ASSESSMENT

Facility	GHG Emissions (kg)	Purchased Electricity (kWh)	Natural Gas (m^3)
Tennis Centre	357,118	612,110	157,147
Campus Ice Centre	654,983	2,023,031	241,531
Campus Corners	101,966	343,478	36,121
DTB - Bordessa Hall	63,519	548,983	5,129
ACE - Automotive Centre of Excellence	778,748	3,576,579	226,433
CERL - Clean Energy Research Centre	133,050	125,217	63,880
UB - Business and IT	2,101,265	12,655,755	443,773
UP - Pavilion	24,710	88,488	8,481
UOIT - Faculty of Education	116,436	602,036	30,367
Regent Theatre	61,775	221,221	21,203
61 Charles	289,592	643,309	119,813
Totals	**4,683,162**	**21,440,207**	**1,353,878**

Table 1: 2011 BPS Consumption Data as per 397/11 2013 submission.

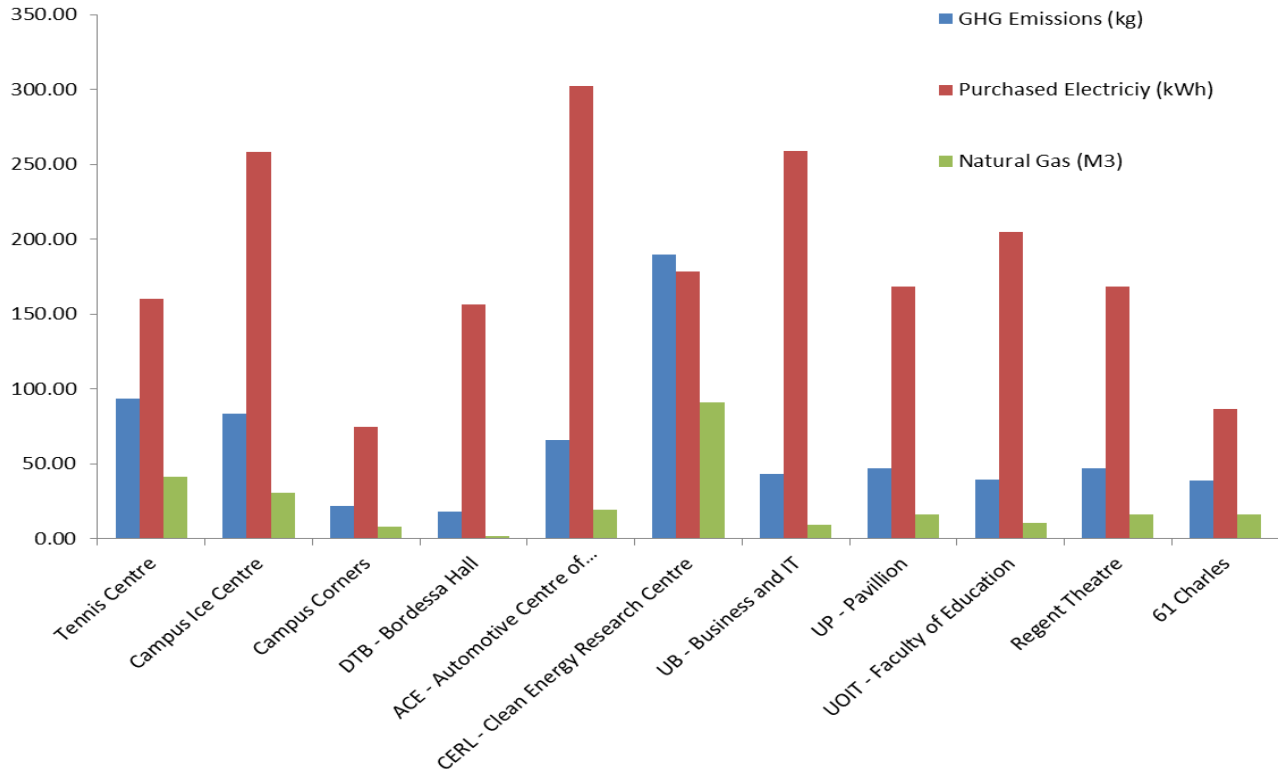

Figure 5: 2011 Energy consumption and GHG emissions (2013 BPS submission) snapshot by facility. Numbers have been normalized by square footage. The central plant is housed in the Business and IT (UB) facility, therefore accounts for the consumption load of 5 different buildings (Library, UB, U5, and Science). 2012 is expected to show a large jump in UB data as with the addition of ERC to the central plant load.

GOALS AND COMMITMENTS

The goals developed for this ECDMP have not taken into account the rapid growth and planned expansion of the school within the next 5 years. UOIT currently runs at a high efficiency, however the University will aim to improve upon current energy systems and commits to the continual application of highly rated energy saving and renewable energy technologies in the long term. Until further expansion projects commence the focus in the forthcoming years will be reducing energy usage of current infrastructure via robust and measureable applications.

	2011 BPS Consumption Data as per 397/11			Consumption Reduction Goals 2014 - 2019		
Facility	**GHG Emissions (kg)**	**Purchased Electricity (kWh)**	**Natural Gas (m^3)**	**GHG Emissions (kg)**	**Purchased Electricity (kWh)**	**Natural Gas (m^3)**
Tennis Centre	357,118	612,110	157,147	311,384	581,505	147,164
Campus Ice Centre	654,983	2,023,031	241,531	587,213	1,763,682	223,747
Campus Corners	101,966	343,478	36,121	98,907	326,304	35,037
DTB - Bordessa Hall	63,519	548,983	5,129	57,167	442,435	4,975
ACE - Automotive Centre of Excellence	778,748	3,576,579	226,433	755,386	3,081,356	214,371
CERL - Clean Energy Research Centre	133,050	125,217	63,880	129,058	118,956	56,695
UB - Business and IT	2,101,265	12,655,755	443,773	2,101,265	12,655,755	443,773
UP - Pavilion	24,710	88,488	8,481	23,969	84,064	8,227
UOIT - Faculty of Education	116,436	602,036	30,367	104,793	492,835	24,187
Regent Theatre	61,775	221,221	21,203	30,888	210,160	15,298
61 Charles	289,592	643,309	119,813	196,652	611,144	110,950
Totals	**4,683,162**	**21,440,207**	**1,353,878**	**4,396,682**	**20,368,196**	**1,284,424**
Net Reduction				**286,482**	**1,072,010**	**69,545**
				- 6.00%	**- 5.00%**	**5.00%**

Table 2: 2014- 2019 reduction goals using 2011 Energy Consumption and GHG Emissions (2013 BPS submission) as baseline. Reductions are not estimated for UB as the addition of ERC to the central plant load will result in higher numbers for 2012 data.

Overall Goal: The overall goal is to implement a comprehensive Energy Management Program aimed at continuous improvement of University energy performance and reporting while achieving the following five-year minimum reduction targets in current buildings:

- 6% GHG emissions reduction from 2011 levels by the year 2019
- 5% purchased electricity reduction from 2011 levels by the year 2019
- 5% natural gas reduction from 2011 levels by the year 2019

Energy Conservation and Demand Management Measures

The measures below have been developed as part of the Energy Management Program to ensure UOIT meets energy targets for 2019. Measures have been subdivided into 3 categories: Technical, Behavioural, and Organizational.

Technical Measures

- Work with utility companies to ensure applications for incentives for various energy projects are submitted.
- Design lighting to be at or below ASHRAE 90.1-2013 power density requirements.
- Optimize lighting controls such as occupancy/vacancy controls, daylight sensors/controls and dimmable fixtures.
- Investigate RETS to reduce dependence on finite energy sources by 10%.
- Investigate living wall air-filtration system options and implement at least one project.
- Install additional hydration stations campus wide to reduce water bottle waste, indirectly reducing GHG emissions and dependence on fossil fuels (transportation, process).

Behavioural Measures

- Consider including elements and/or methods of green education within the campus to increase the visibility of the Sustainability program on campus and encourage student, staff participation in programs.
- Develop a Sustainability Team program in order to build a network of sustainability-focused individuals across the University;
- Develop an energy management arm of the Sustainability Team.
- Encourage environmental awareness and participatory planning among staff, students and community members.
- Reduce total cost of electricity through campus-wide energy literacy program.
- Implement engagement program to solicit energy saving ideas from students, faculty, and staff.
- Reduce campus-wide paper usage 25% by 2019.
- Implement campus-wide composting program which includes an accelerated decomposition system on-site.

Organizational Measures

- Implement an institutional Sustainability Policy which identifies UOIT's overarching sustainability goals.
- Develop a formal policy statement that commits UOIT to energy management and GHG reductions as an integral part of its operations along with measureable goals, targets, and objectives
- Develop a procurement policy that incorporates assessing, wherever possible through all life cycle phases, the environmental impact of all products.

NEXT STEPS

Next steps include:

- Submission of EDCMP and the University's 2012 energy data to the Province of Ontario as per Green Energy Act 2009, Ontario Regulation 397/11.
- Make EDCMP available to the general public via online and physical mediums.
- Complete the Energy Management Program Action Plan which outlines how energy reduction measures will be implemented.
- Consolidate the EDCMP and Action Plan into one seamless Plan.
- Prepare and publish a summary of the Plan as an easy reference for the general public.

The action plan will be a living document. Anticipated improvements in knowledge and capacity will result in enhancement of proposed action.

As the action plan evolves, subsequent processes will be developed in regards to:

- Implementing
  i.e. Project prioritization, financial analysis, etc.
- Monitoring/evaluating
  i.e. Monitoring plans will be developed to track progress vs. targets.
- Reporting/Communicating
  i.e. Regular energy performance summary reports.

Figure 6: Illustration of proposed energy management program action plan- a living document.

Projects/Programs/Processes						
Activity	Objective	Measurement of Success	Cost	Estimated Annual Savings	Groups and Staff Involved	Target Date

CONCLUSION

This report provides a background UOIT's current energy conservation practices and highlights the measures that will be taken to further reduce campus-wide consumption by 2019.

Building on UOIT's 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. The Plan also positions the University in compliance with the Green Energy Act, Ontario Regulation 397/11.

Through the EDCMP, it is recommended that by 2019, UOIT achieve:

A minimum of:

- 6% GHG emissions reduction from 2011 levels by the year 2019
- 5% purchased electricity reduction from 2011 levels by the year 2019
- 5% natural gas reduction from 2011 levels by the year 2019

Continual application of energy-efficient measures and improved reporting and communication efforts are anticipated to produce significant positive results.

Respectfully submitted,

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Murray Lapp
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APPENDIX A – CAMPUS PORTFOLIO

CAMPUS PORTFOLIO

The UOIT Campus is divided into two main locations: Downtown Oshawa and North Oshawa. Downtown Oshawa is comprised of a series of buildings both owned and leased by the University. North Oshawa is partly shared with Durham College and is a cutting-edge location built with technology-rich and environmentally-advanced features. Building profiles are detailed below.

Downtown Oshawa Location

Administrative Buildings

Bordessa Hall (Leased)

The Faculty of Social Science and Humanities occupies Bordessa Hall at 55 Bond Street East, immediately to the north of the Regent Theatre.

The 2,800-square-metre, five-storey facility includes four large classrooms, labs, and study space for undergraduate and graduate students, a student lounge, a boardroom and faculty offices. Bordessa Hall also houses the Centre for Evaluation and Survey Research (CESR).

Indigenous Resource Centre

UOIT's newest facility, the Indigenous Resource Centre, completed construction in 2014. This unique building is an inclusive space that offers programs and services to help Indigenous and non-Indigenous students to learn and succeed at UOIT.

Classrooms and Related Facilities

Regent Theatre (Owned)

Given the theatre's history (over 100 years old), the role it has played in downtown Oshawa and the special attachment the community continues to have for the Regent, UOIT is proud to have played a part in the restoration of the theatre returning it to its former glory.

Reopened in September 2010, the Regent is used as a large lecture theatre for UOIT students, and for community and cultural events during the evenings and on weekends throughout the year.

Faculty of Education (Leased)

The Faculty of Education was the inaugural UOIT faculty at the university's Downtown Oshawa location.

The building boasts many of the features that all UOIT students have come to expect from the innovative university, including wireless Internet connections. Students also benefit from classrooms equipped with movable walls to provide larger spaces as required, innovative teaching technologies to help facilitate their learning and specialty classrooms for their science, art and drama studies.

61 Charles Street (Capital Lease)

Located on Charles Street immediately east of the General Motors Centre, the former Alger Press Building was renovated and refurbished in 2010.

The first and second floors include classrooms and lecture halls, office space, study areas, student services including the Registrar's office, the Student Life office, Student Awards and Financial Aid, a library dedicated to the Faculty of Social Science and Humanities' diverse programs and other common areas for students and faculty.

The third floor is the home of UOIT's senior administration offices, External Relations (including Advancement, and Communications and Marketing), and Central Scheduling.

North Oshawa Location

UOIT's buildings on the North Oshawa location set it apart. Designers incorporated a number of environmentally-advanced features into the buildings including green roofs, coated windows and a geothermal heating and cooling system. Within them students attend classes in state-of-the-art learning facilities where they are immersed in a leading-edge, technology-rich learning environment that allows them to connect with their professors and peers at anytime from anywhere.

Classrooms and Related Facilities

Academic Success Centre (U6)

Located in the U6 Building, the Student Learning Centre (formerly the Academic Success Centre) is committed to providing all UOIT students with tutorial and academic assistance of the highest calibre.

The academic subject specialists and peer tutors help with mathematics, writing, ESL writing, and study skills.

North Oshawa Library

The award-winning North Oshawa Library is designed to incorporate leading-edge technology while maintaining the comfort of a traditional library. Students enjoy 6,800 square metres of total learning space over four floors, including the Dixon-Alger Fireside Reading Room with a two-storey glass rotunda overlooking Polonsky Commons.

The North Oshawa Library is equipped with heat recovery systems using total energy wheels and CO^2 ventilation controls, and also features:

- Individual and collaborative learning spaces
- Seating capacity of 500
- A reading room and fireplace
- 160,000-volume book capacity
- 160 computer workstations
- Wired and wireless environments
- Features to assist students with visual and learning disabilities
- A Starbucks café

The Campus Libraries system also operates the Education Library, and the Social Science and Humanities Library at UOIT's downtown Oshawa location; as well as the Library at Durham College's Whitby Campus.

UB - Business and IT

The Business and Information Technology building offers our students innovative research laboratories, lecture halls, and a large cafe.

This five-storey (including basement) university academic building consists of biology labs, offices, lecture halls and cafeteria. Hydronic heating and cooling is used for the entire building through fan coils and unit heaters. The heating water and chilled water for heating and cooling is obtained from the central plant that feeds 6 buildings.

The primary source of heating and cooling at the central plant (located in the basement of the Business & IT Building) is a ground source heat exchanger. There is 1 chiller that reject heat to the ground loop during the summer months and there are 2 reversible heat pumps that extract and reject heat to the ground loop at the central plant. The heating water and chilled water are pumped to the buildings using variable speed pumps. There are six boilers installed at the central plant. The boilers currently generate the heating water for perimeter heating and domestic hot water. However, the boilers will be made stand-by in the near future when the ground source central plant is fully functional.

There are 2 heat exchangers, one using low temperature heating water and the other using medium temperature heating water. A third heat exchanger generates the chilled water for the building using primary chilled water from the central plant. The secondary pumps that circulate heating and chilled water within the building are variable speed type. There are 2 variable volume type air-handling units that distribute conditioned air to the spaces. Under-floor air distribution is used in all the spaces except a few from level 1 to level 4.

A heat recovery unit **HRU-1** supplies outdoor air to both the air-handling units **AHU-1** and **AHU-2**. **HRU-1** has a heat recovery coil to recover heat from the exhaust air.
There are many types of external walls mentioned on the architectural drawings and included in the simulation. 100mm thick semi-rigid insulation is used in all the types of external walls. 3 of the walls have copper cladding at the exterior and one has aluminum panel.
There are 3 types of roofs used in the simulation. All have 2 layers of 75mm thick polystyrene insulation (one layer of 150mm thick polystyrene insulation is used in the simulation).
Most of the lighting fixtures have either T8 fluorescent lamps or compact fluorescent lamps. There are a few halogen and metal halide lamps. The overall lighting power density in the proposed building was **13.81W/m^2** compared to **17.27W/m^2** in the reference building.

This facility was demonstrated to exceed the energy use of a building built to Model National Energy Code for Buildings by **59.5%.** The table below summarizes the energy savings achieved by the building as demonstrated using the EE4-CBIP energy simulation software (EOI #1462).

Laboratories

General Motors of Canada Automotive Centre of Excellence

The General Motors of Canada Automotive Centre of Excellence (ACE) is the first commercial automotive research, development and innovation centre of its kind in the world. This is a place where industry, researchers and students collaborate to create, test and validate paradigm-shifting innovations with a focus on bringing them to market as rapidly as possible. ACE has an array of testing equipment, including one of the largest and most sophisticated climatic wind tunnels on the planet.

ACE enables knowledge and practical experience to combine more effectively and to create synergies across disciplines and skill sets, leading to a stronger manufacturing economy in Canada. At the same time, it helps educate and train the skilled personnel needed to take the automotive industry and manufacturing to a new level of competitiveness and success.

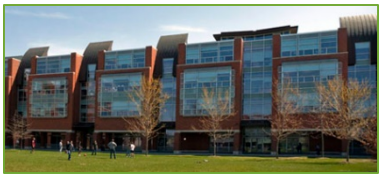
Energy Systems and Nuclear Science Research Centre (ERC)

The Energy Systems and Nuclear Science Research Centre (ERC) is a 9,290-square-metre facility that houses UOIT's unique-in-Canada education programs and research in geothermal, hydraulic, hydrogen, natural gas, and nuclear solar and wind energy technologies. The ERC enables leading-edge research in clean and green energies and technologies, and promotes Canada's entrepreneurial advantage through public-private research and commercialization partnerships.

The spacious, four-storey ERC features a spectacular glass- covered atrium, a 72-seat lecture theatre, three 50-seat classrooms, two 30-seat tutorial rooms with flexible seating, 12 labs, 11

student-study (breakout) rooms, dedicated working stations for graduate students and offices for faculty and administration;

Science Building



UOIT's Science building offers 214,374 square feet of space, designed specifically for the sciences. It includes a 250-seat lecture theatre, 30 labs and a student study hall, among many other student-friendly features.

This four-storey building houses:

- Two beautiful atria;
- 10 lecture halls, six classrooms;
- A 250-seat lecture theatre;
- Research laboratories;
- Meeting rooms;
- Thirty chemistry, physics and biology labs;
- Faculty and staff offices;
- A study hall that overlooks the Polonsky Commons; and
- A 20,000-litre wet lab.

Science Building West Half

The Science Building was built in two phases and was therefore modeled separately is a 9,636 square meters, four storey complex incorporating classrooms, computer resources, labs and office areas. This facility exceeded the energy use of a building built to Model National Energy Code for Buildings (MNECB) by **61.7%**.

Science Building East Half

The building is a five-storey (including basement) 8,074 square meter university academic building consists of science labs, offices and storage rooms. Hydronic heating and cooling is used for the entire building through fan coils and unit heaters. The heating water and chilled water for heating and cooling is obtained from the central plant that feeds 6 buildings.

The Science Building East Half facility was demonstrated to exceed the energy use of a building built to Model National Energy Code for Buildings by **36.8%**. The table below summarizes the energy savings achieved by the building as demonstrated using the EE4-CBIP energy simulation software (EOI #1460).

Science East consumes the bulk of the energy for the building because of its teaching spaces and research wet labs.

OPG Engineering Building

The Ontario Power Generation Engineering building houses state-of-the-art labs, academic offices and other learning spaces spread over 40,000 square feet of space.

This three-story building features:

- a rapid prototyping and manufacturing lab
- a combustion and engines lab
- a mechatronics lab
- an emerging energy systems lab with solar, wind, hydrogen and fuel-cell technology

The building's equipment was carefully selected to educate students about technologies of the future and the building itself has become a showcase for the delivery of engineering education.

Clean Energy Research Laboratory

The Clean Energy Research Laboratory (CERL) is used to conduct research on hydrogen production, heat engines and nanotechnology. Currently, researchers are working on the world's first lab-scale demonstration of a copper-chlorine cycle for thermochemical water splitting and nuclear hydrogen production. Hydrogen is a clean energy carrier of the future and potentially major solution to the problem of climate change.

Using nuclear, solar or other heat sources (such as waste heat from furnaces or industrial plant emissions), the Cu-Cl cycle promises to achieve higher efficiencies, lower environmental impact and lower costs of hydrogen production than any other existing technology. In addition, research in CERL is conducted on new types of heat engines for cleaner generation of electricity, including a Marnoch heat engine, and nanotechnology devices for waste heat recovery in automotive, computer, mobile device and other applications.

Administrative

Campus Corners (Leased)

Located on the southeast corner of Conlin Road and Simcoe Street, Campus Corners is the home of the UOIT Office of Graduate Studies (OGS) (main floor).

OGS administers the strategic growth, development and regulations pertaining to our graduate degree programs. It represents the academic unit at Academic Council and to internal and external individuals and groups.

The building also serves as office space for Finance and Administration; Human Resources; Information Technology Services; Payroll; Purchasing; the Office of Research Services; the Office of Technology Transfer and Commercialization; and the Office of Campus Infrastructure and Sustainability. A number of non-university commercial services are also located in the Campus Corners plaza.

U5 Building (Temporary Structure)

U5 is home to the Registrar's office (RO), the Office of Graduate Studies (OGS) and the Student Experience Centre (SEC).

The RO is responsible for a wide range of functions supporting the university's academic programs including:

- Accounting cashier service;
- Admissions and transfer credit office;
- International office;
- Recruitment office;
- Records and Registration services; and
- Student Awards and Financial Aid office.

OGS administers the strategic growth, development and regulations pertaining to our graduate degree programs. It represents the academic unit at Academic Council and to internal and external individuals and groups.

The SEC works with students, faculty, staff and the community to create a welcoming, supportive and challenging learning experience. The SEC offers Career Services; support through Disability Services; provides resources to students, landlords and residents through its Off-Campus Living service; and oversees numerous programs including Orientation and Student Workshops

Student Recreational and Athletic Facilities

Campus Recreation & Wellness Centre

In September 2007 a 90,000 -square-foot expansion to the Campus Recreation and Wellness Centre (CRWC) was completed and the grand opening was held on September

12, 2007. The CRWC features a 10,000-sq.-ft. cardio, weight, and fitness centre overlooking Oshawa creek and green space; a 23,000-sq.-ft. triple gymnasium for intramural sports, campus recreation and varsity; a 200-metre indoor jogging track suspended from the second level of the gymnasium and overlooking the gym space; two aerobic/dance studios, 1,800-sq.-ft. in size, featuring hardwood floors, mirrors, equipment, a sound system, and storage are designed for a variety of classes including spinning; and modern change rooms including showers and a steam room, a student lounge, two student training rooms, and student sports club and intramural offices.

Tennis Centre (Temporary Structure)

UOIT's Campus Tennis Centre is a superior year-round facility that offers beginner, recreational and competitive players with access to six clay courts. The facility features a clubhouse with a pro shop and change room facilities with showers.

Campus Ice Centre

Operational since September, the new twin-pad arena is the result of a partnership between the City of Oshawa, Durham College and the UOIT and is already alleviating Oshawa's ice shortage by providing users of all ages and genders with available ice time throughout the week.

The facility features two NHL-sized ice pads, 10 change rooms, a sports retail outlet, offices, a community room and food and beverage facilities. A target performance of 40% better than MNECB was used for the arena.

APPENDIX B – 2012 CONSUMPTION DATA

UP or DOWN ARROW in column A to read	Energy Consumption and Greenhouse Gas Emissions Reporting - for 2012													
Confirm consecutive 12-mth period (mth-yr to mth-yr)														
Sector														
Agency Sub-sector	University													
Organization Name	University of Ontario Institute of Technology	Please fill in the mandatory fields indicated in red, in addition to submitting data on your energy usage.												
								Energy Type and Amount Purchased and Consumed in Natural				Total (calculated in webform)	
								Electricity		Natural Gas			
Operation Name	Operation Type	Address	City	Postal Code	Total Floor Area	Unit	Avg hrs/wk	Quantity	Unit	Quantity	Unit	GHG Emissions (Kg)	Energy Intensity (ekWh/sqft)
Stephenson Building	*Classrooms and related facilities*	*2160 Yonge Street*	*Toronto*	*M7A 2G5*	*135034*	*Square meters*	*70*	*2181065*	*kWh*	*125300*	*Cubic meter*		
Tennis Centre	Student recreational facilities and athletic facilities	50 Conlin Rd West	Oshawa	L1L 1C7	3822	Square meters	168	658317	kWh	109140	Cubic Meter	269567.7955	44.19656241
Campus Ice Centre	Student recreational facilities and athletic facilities	2200 Simcoe St Nor	Oshawa	L1H 7L7	7832	Square meters	168	2224583	kWh	217264	Cubic Meter	624414.1358	53.77765054
Campus Corners	Administrative offices and related facilities	2069 Simcoe St Nor	Oshawa	L1H 7K4	4609.95	Square meters	50	449903	kWh	30544	Cubic Meter	100955.9952	15.60863547
UB - Business and IT	Classrooms and related facilities	20 Founders Drive	Oshawa	L1G 8C4	48947.19	Square meters	70	17216430	kWh	390122	Cubic Meter	2391041.124	40.54667645
ACE - Automotive Centre of Excellence	Laboratories	60 Founders Drive	Oshawa	L1G 8C4	11827.05	Square meters	90	6395654	kWh	332215	Cubic Meter	1242333.259	77.97284277
CERL - Clean Energy Research Centre	Laboratories	90 Founders Drive	Oshawa	L1G 8C4	701.41	Square meters	70	130525	kWh	42928.65	Cubic Meter	93697.68576	77.71755214
UP - Pavillion	Classrooms and related facilities	11 Avenue of Cham	Oshawa	L1G 8C4	526.0223	Square meters	70	91500	kWh	25000	Cubic Meter	56053.335	63.08560239
UOIT - Faculty of Education	Classrooms and related facilities	11 Simcoe St. North	Oshawa	L1G 8C4	2941	Square meters	70	534357	kWh	29235	Cubic Meter	106592.1266	26.69453071
DTB - Bordessa Hall	Administrative offices and related facilities	55 Bond St	Oshawa	L1G 8C4	3507.07	Square meters	70	575621	kWh	6406	Cubic Meter	67393.9974	17.05181163
Regent Theatre	Classrooms and related facilities	48-50 King St	Oshawa	L1G 8C4	1315.15	Square meters	90	198478	kWh	15708	Cubic Meter	48759.79604	25.81343011
61 Charles	Classrooms and related facilities	61 Charles Street	Oshawa	L1G 8C4	7452	Square meters	70	644543	kWh	58931	Cubic Meter	173318.4495	15.84348372