Energy Conservation and Demand Management Plan for the University of Toronto Mississauga

June 2014

Introduction

On August 17, 2011 the provincial government of Ontario passed Ontario Regulation 397/11 under the Green Energy Act. This regulation requires public agencies, including post-secondary institutions, to prepare 5- year Energy Conservation and Demand Management Plans.

The University of Toronto Mississauga, established in 1967, is a satellite campus of the University of Toronto. The campus sits of 225 acres of land alongside the Credit River in Mississauga, about 33 km west of downtown Toronto. At the time of the writing of this plan, the campus has approximately 12,600 undergraduate students, 600 graduate students, and over 2,000 full- and part-time employees. Approximately 1,550 students live in on-campus residences. There are a total of 48 buildings on the UTM campus, with a total floor area of 185,484 gross square meters. 38% of the campus' space is dedicated to teaching and research, 33% is residences, and the remainder is composed of a mix of libraries, student services, administrative, and miscellaneous uses. The energy used to maintain these facilities is significant.

The environmental effects of energy use have become a prime concern. Among these environmental effects of energy use is climate change. The burning of fossil fuels (including coal, oil, gasoline and natural gas) releases carbon dioxide, the primary gas responsible for climate change. Predicted impacts of climate change include sea-level rise, species extinctions, an increase in the frequency and intensity of storm events, and increasing drought.

In Southern Ontario, climate models predict an increase of anywhere from 2-5^{o}C by the end of this century. It is predicted that both winters and summers will get warmer, with less precipitation. Both winter and summer precipitation will decrease, and less precipitation will fall as snow in winter. Local effects of these changes can include an increased frequency, severity, and duration of summer heat waves; spreading of new diseases from warmer climates such as Lyme disease and malaria; worsening of smog, affecting those with chronic lung diseases such as asthma; and an increase in the frequency and severity of extreme weather events.

In addition, energy costs are expected to rise significantly in both the short and long term. The Ontario government has predicted that electricity prices are expected to rise by 46% over the next five years. In addition, natural gas rates have recently been increased by 40%. UTM can mitigate the impact of these price increases, and guard against future increases, by taking action now to reduce our energy use. The addition of renewable, on-campus sources of energy can also help by reducing the amount of energy that has to be purchased.

Creating solutions to an issue that is global in scope and has effects as drastic as those predicted by climate change scientists requires more than an ad hoc approach to reduction of greenhouse gases. It requires a harmonized, coordinated approach including conservation, energy efficiency, use of established and emerging technologies, and individual behavioural changes. To that end, this Energy Conservation and Demand Management Plan has been written in order to guide the University of Toronto Mississauga on the path to carbon reduction, and, ultimately, a sustainable future.

Current Energy Use

In calendar year 2012 (from January 1, 2012 to December 31st, 2012), the university used 35,824,431 kWh of electricity and 4,303,014 cubic meters of natural gas.

A History of Energy Management at UTM

The University of Toronto has always been committed to the preservation of the natural environment. UTM in particular had faced unique challenges as the campus has grown considerably over the past several years, growing from just 4,542 students in 2000-2001, to 11,674 students in 2012-2013. This growth has necessitated the expansion of the campus facilities and the construction of new buildings. In 2004, the slogan "Grow Smart, Grow Green" was adopted as the guiding principle for campus development, balancing the need for growth with environmental sensitivity and responsibility. As a microcosm for the pressures of urban growth, UTM remains committed to prove that expansion and development can be accomplished in an environmentally sensitive and responsible manner. "Grow Smart, Grow Green" provides a framework to guide all our decisions that may impact upon our environment.

Green Building

The University of Toronto has an unofficial standard of LEED (Leadership in Energy and Environmental Design) silver for all new construction projects. The UTM campus currently has 3 LEED buildings and 1 LEED renovation, plus 2 new LEED buildings under construction.

The Hazel McCallion Academic Learning Centre, completed in 2006, is certified LEED silver and was the first LEED building at the University of Toronto. The building includes a rooftop garden, water-efficient fixtures, and energy-efficient building systems.

The William G. Davis Building 3rd floor renovation was completed in 2008, and is certified LEED Gold. The renovation includes natural light from skylights, occupancy sensors to automatically shut off lights when a room is unoccupied, and water-efficient fixtures.

The Instructional Centre was constructed in 2011 and has received LEED silver certification. The building features green and white roofs, energy-efficient computer and AV equipment, and an advanced lighting system. The building is heated and cooled entirely by a geothermal system (see Alternative Energies section) and also features a solar photovoltaic array (see Alternative Energies section).

The Health Sciences Complex was completed in 2011 and is aiming to be certified LEED silver or better (certification currently pending). The building features 3 rooftop gardens, a rainwater reuse system, and high-efficiency windows.

Construction is currently underway on 2 buildings, both of which are targeting LEED silver certification or better. The Innovation Complex will expand the current Kaneff Centre and will feature light harvesting and sun shading. Deerfield Hall (North Building reconstruction phase A) is replacing the old, inefficient eastern portion of the North Building. The building will feature a green roof and rainwater reuse system.

Energy-efficiency projects

High-albedo & vegetated roofs

Approximately 60% of UTM's roofs are high-albedo or vegetated.

As part of planned roof replacements on UTM's older buildings, high-albedo (white) roofs have been installed. The white roofs reflect solar radiation, reducing a building's cooling load and energy used for air-conditioning in the summer. White roofs are present on the William G. Davis building, Erindale Studio Theatre, Instructional Centre, and the Health Sciences Complex.

In addition, 5 UTM buildings have green roofs or rooftop gardens. The Communication, Culture, & Technology building, the Recreation, Athletics, & Wellness Centre, the Instructional Centre, and the Health Sciences Complex all have green roofs; the Hazel McCallion Academic Learning Centre has a publically-accessible rooftop garden.

Laboratory renovations

As part of planned laboratory renovations, old, inefficient fume hoods were replaced with newer, high-efficiency models. These high-performance fume hoods operate at a much lower face velocity than the old hoods, exhausting much less conditioned air while providing the same level of protection for the operator. In addition, the new hoods have auto sash closure system. When the user steps away from the hood, the system senses this and responds by automatically lowering the sash. These new hoods represent a significant reduction in energy use and costs for the space. In addition, more efficient exhaust fans were installed.

Lighting replacements

Over time, almost all campus old, inefficient T-12 fluorescent lamps have been replaced with newer, more efficient T-8 lamps. These upgrades have taken place as part of planned renovations to office, classroom, and laboratory space.

In addition, most of UTM's street and pathway lighting has been upgraded to energy-efficient light-emitting diode (LED) fixtures. LED fixtures use much less electricity than incandescent or fluorescent lights, and last a much longer time, cutting down on replacement & maintenance costs. There are also plans to upgrade more exterior fixtures to LED technology.

LED lighting has also been heavily used in the theatre program. In 2010, at the MiST Theatre, 12,000 watts of overhead stage lighting were converted to 972 watts of LED stage lighting fixtures. At Erindale Studio Theatre in 2013, 18,000 watts of cyclorama lighting were removed from service and replaced with 400 watts of new LED lighting.

Chiller Replacement

In 2006 UTM's 40-year old, inefficient central chiller was replaced with a new, efficient, variable-speed unit. The new chiller uses much less energy to provide the same amount of cooling.

Alternative Energies

Geothermal

UTM's Instructional Centre is completed heated and cooled by a geothermal system. The system was installed in the playing field next to the building when the building was constructed. The system consists of 117 boreholes, each of which are 168 meters deep. In the summer, heat is taken out of the building and stored in the ground. In the winter, the stored heat is taken out of the ground and returned to the building. Since there is no need for a separate boiler and chiller to heat and cool the building, this system saves a significant amount of energy. The only energy used is a small amount of electricity to run the pumps.

Solar

UTM currently has 2 solar photovoltaic arrays. The first array, installed in 2005, is located on the façade of the William G. Davis Building and has a total capacity of 5.4 kW.

The second array is located on the Instructional Centre was integrated into the architecture of the building and installed when the building was constructed in 2011. The Instructional Centre panels are tilted at the optimum 45 degree angle to the sun, and also double as sun shades, reducing the building's cooling load in summer. The Instructional Centre array has a total capacity of 21 kW.

Transportation

UTM is primarily a commuter campus. As a result, UTM has instituted several programs to reduce the pressure on parking lots and reduce our greenhouse gas emissions from transportation.

UTM operates a shuttle bus which provides non-stop express service from the UTM campus to the St. George (downtown) campus. The shuttle is fare-free for UTM students.

The U-pass bus program, instituted in 2007, provides a universal bus pass for all students via a levy which students may not opt out of. The U-pass is available to all full and part-time undergraduate and graduate students in both the fall/winter and summer sessions. The pass allows fare-free unlimited travel on MiWay, Mississauga's public transit system.

The UTM BikeShare program, instituted in 2004, allows students, staff, and faculty to rent bicycles free of charge for a 48 hour period. Bikes may be used for transportation or recreation. BikeShare also performs educational repairs for campus community members.

The department of Parking & Transportation also runs a carpool program, encouraging faculty, staff, and students to carpool to campus instead of driving a single-occupant vehicle. The carpool program designates highly preferable parking spots for registered carpools, and ensures an Emergency Ride Home for carpool members.

The Eco-Park rebate program provides and incentive for those who purchase fuel-efficient vehicles. Those who drive low-emission vehicles – those which emit less than 125 g CO_2/km – can apply for a partial reimbursement of the cost of a parking permit.

There are also Zipcars available on campus. Zipcar is a car-sharing service that provides access to vehicles for those who may sometimes need a car, but want to avoid purchasing one. Campus community members can sign up with Zipcar and take advantage of the service.

Faculty, staff, and students may also purchase discounted Metropasses, which allow unlimited travel on the Toronto Transit Commission's public transit system.

Energy conservation targets

The UTM campus has been in a state of constant growth since approximately 2001. Due to the increase in students, staff and faculty, the construction of new buildings, and the addition of more energy-intensive research facilities to the campus, our energy use has grown considerably during this time. For this reason, UTM has chosen to use an intensity-based target, rather than an absolute target. This will more fairly represent the results of energy conservation strategies, since substantial improvements in energy conservation can be unintentionally masked by construction of new buildings and the addition of energy-intensive research facilities to the campus.

UTM has elected to target zero increase in energy intensity (energy use per gross square meter of built space). Each year we will calculate the energy used per square meter of building space, and compare to the previous year. If our energy intensity decreases, we will use the new, lower energy intensity as the new baseline against which future values will be compared.

Proposed Energy Conservation Strategies

UTM is using a multi-pronged approach to reducing our energy consumption and greenhouse gas emissions. No one strategy will significantly reduce our energy use; for this reason, UTM is choosing to use a diverse range of programs and projects. These include building energy-efficiency into new construction; building energy-efficiency into renovation projects; retrofits of older and outdated equipment with more energy-efficiency models; use of renewable and non-polluting energy sources; and behavior-change programs to encourage campus community members to use energy wisely.

Project Name: Cooling Tower Replacement

Date of Completion: 2014

Description: Replacement of the campus' main cooling tower at the Central Utilities Plant is being undertaken and will be complete by the cooling season of 2014. The old tower was 40 years old, oversized, and extremely inefficient. The new tower will result in significant energy and water savings for the campus.

Project Cost: $1,600,000

Estimated demand savings: 206 kW

Estimated Energy Savings: 472,345 kWh

Project Name: North Building Reconstruction Phases A & B

Date of Completion: September 2014 (Phase A), 2017 (Phase B)

Description: The 40-year old North Building, originally intended to be a temporary structure, is the oldest academic building on the University of Toronto Mississauga campus. The North Building is old, inefficient, and no longer meets the needs of the campus community.

A 2-phase plan to replace the North Building with a new, LEED certified structure begun in 2012. The western portion of the building was demolished and is being replaced with a new building that will be certified LEED silver or better. While the new building will be significantly larger, it will represent a large reduction in energy intensity over the old structure.

The second phase of the project is scheduled to begin immediately after completion of the first phase. Demolition of the remainder of the North Building and replacement with a new, LEED-certified building will result in a further reduction in energy intensity. The second phase is scheduled to be completed in 2017.

Project Cost: Phase A: $56 million

Estimated savings: Phase A: 489.407 kWh/square meter. Note that these savings are estimates based on energy modeling, and do not predict actual energy use.

Project Name: Boiler Replacement

Date of Completion: 2014

Description: UTM currently operates 3 coil tube boilers at the Central Utilities Plant, which provide steam to several buildings on campus. While the age of these boilers varies, the oldest is over 20 years old and very inefficient. These boilers have reached the end of their life, and will be replaced with newer, more efficient models.

Project Cost: Estimated at $500,000

Estimated Energy Savings: Unknown, but will be substantial

Project Name: Metering

Date of Completion: 2014

Description: If you can't measure it, you can't manage it. UTM is committed to operating in a safe and sustainable manner and the fundamental tool to an effective management of campus energy consumption is a metering system.

The metering system installation in progress now, will allow UTM to centrally collect, analyze, monitor, and report on UTM building by building energy consumption. Subsequently, UTM will utilize this data to:

- Monitor and track key performance indicators;
- Benchmark building energy performance and identify opportunities to reduce energy;
- Reduce CO2 emissions;
- Identify anomalies in consumption pattern, determine inefficiencies and flagged them for improvement;
- Detect system component failure allowing for rapid remediation which prevent system from long hours operations at sub-standard energy performance and avoid subsequent damage to other components;
- Reduce resources requirements for meter reading;
- Justify capital improvement

The implementation of the metering system campus wide includes installation of new electricity, water (chilled water and domestic water), steam and gas meters at 13 facilities and integration of measured data into a central energy management software. Where connection of existing utility meters through data loggers or equivalent devices is possible the installation of new meters is not required.

Project Cost: $956,367

Estimated Energy Savings: The implementation of the metering system (Energy Management System) can generate savings up to 30%. Studies have shown that:

- Implementation of a utilities monitoring program alone can bring up to 2-5% savings;
- Using the information generated by the monitoring program for optimizing equipment operation and maintenance will generate additional 10% savings
- Ongoing monitoring, benchmarking and energy efficiency projects can achieve savings upwards of another 15-30%

Project Name: Building Dashboard

Date of Completion: To be determined

Description: Energy feedback displays, often referred to as Building Dashboards, are a behaviour-change tool that are becoming more common on university and college campuses. These displays typically show real-time energy and water use in various campus buildings, allowing building occupants to monitor energy use and modify their behaviour accordingly, and see the results of this behaviour change on energy use. Occupants can also see green features of their buildings, and use this system to see the energy generated by renewable or alternative energies in campus buildings.

Building dashboard systems can also be used to facilitate energy reduction competitions between different buildings on campus (most commonly campus residences). These energy reduction competitions typically result in lower energy use (Compete to Reduce, 2014).

Project Cost: Unknown

Estimated Energy Savings: One paper that reviewed multiple studies on the effectiveness of feedback on energy consumption found that direct feedback via display monitors reduced energy consumption by 5-15% (Darby, 2006). During Campus Conservation Nationals 2014, universities and college buildings that competed in an energy-reduction competition decreased energy use by an average of 4.5% (Compete to Reduce, 2014).

References

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