UNIVERSITY OF TORONTO MISSISSAUGA

Broader Public Sector Energy Conservation and Demand Management Plan (Updated)

This report fulfills the requirements of O. Reg. 25/23, which states that BPS entities must report their 2022 and 2023 energy consumption by July 1, 2024.

Prepared by:

Sustainability Office, Facilities Management and Planning
University of Toronto Mississauga
July 1, 2024

DEFY GRAVITY

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Introduction

The University of Toronto Mississauga (UTM) has taken a bold step in addressing climate change. Through its planning, UTM is committed to not only achieving carbon neutrality by 2043, but also becoming climate positive by 2050. This involves reducing the University's environmental footprint while also creating a net positive impact.

Overview

The development of the University of Toronto Mississauga's Demand Management (CDM) Plan (2025-2030) is intended to meet the requirement under the Broader Public Sector: Energy Reporting and Conservation and Demand Management Plans (Ontario Regulation 25/23). Moreover, it is a strategic plan to outline and highlight previous, current and proposed energy efficient measures at University of Toronto Mississauga to reduce its energy usage and greenhouse gas (GHG) emissions.

Our updated CDM plan builds on the existing plan by highlighting the specific steps, targets, and timelines for energy and GHG reduction measures that have been developed since the CDM plan was completed. Our updated CDM plan was created in compliance with regulation and was approved by management on July 1, 2024. The 2019-2024 CDM plan is available for download here.

Background on University of Toronto Mississauga

The University of Toronto Mississauga was established in 1967 and is situated on 225-acres of protected greenbelt along the Credit River. The suburban campus today has over 14,000 undergraduate and graduate students, 3,000 full and part- time employees, and 240,000 square meters of building gross floor area.

Sustainability is a priority for UTM. UTM recently released several reports, including its Campus Master Plan, Sustainability Strategic Plan, and Climate Positive Plan, which build on the goals of the 2019-2024 CDM Plan and set a roadmap for reaching ambitious climate targets of a 39% reduction in GHG emissions by 2030, net zero by 2043, and net positive energy by 2050.

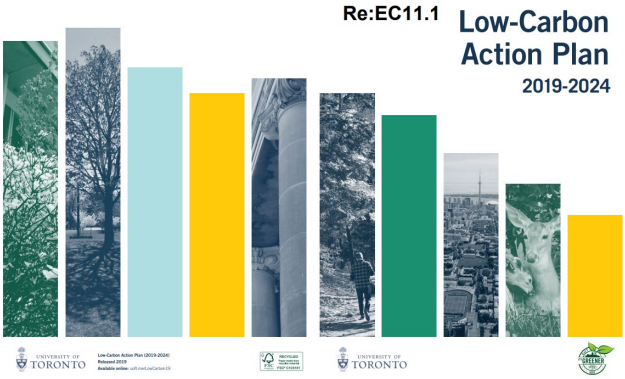
Updates to UTM's Climate and Energy Targets since the Publication of the 2019-2024 CDM Plan

Since the release of the 2019-2024 CDM plan, UTM has developed a set of strategic frameworks for achieving its climate targets, campus development plans, and vision for sustainability. New climate targets were set in the 2023 Climate Positive plan, which replace the targets set in earlier publications.

Publications and studies since the release of the 2019-2024 CDM Plan

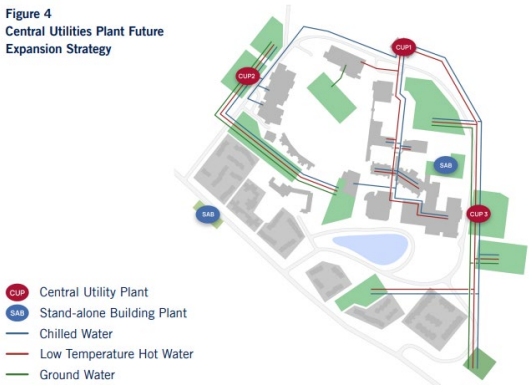
October 2019 - University of Toronto Low Carbon Action Plan –

- A tri-campus plan (University of Toronto: St. George, Mississauga, and Scarborough) report that set the goal of reducing carbon emissions by 37% by 2030 based on 1997 levels. The report lays out a three-pronged approach of:
- Producing clean energy and capturing carbon.
- Developing efficient energy distribution system.
- Reducing consumption.



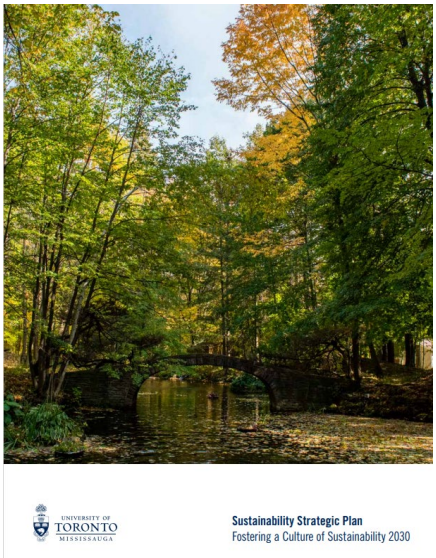
July 2020 UTM - Utilities Master Plan

- A study on approaches to decarbonizing campus energy use while expanding to meet the needs of a growing student population. The recommended approach is electrifying the Central Utilities Plant, utilizing Geo-exchange for heating and cooling requirements, and increasing PV generation capacity.



January 2021- UTM Sustainability Strategic Plan

- Encompassing the 17 United Nations Sustainable Development Goals, the Sustainability Strategic plan outlines the university's ambitions for advancing sustainable practices through:
- Access to education in sustainability
- Research
- Campus engagement
- Civic engagement
- Human resources and infrastructure



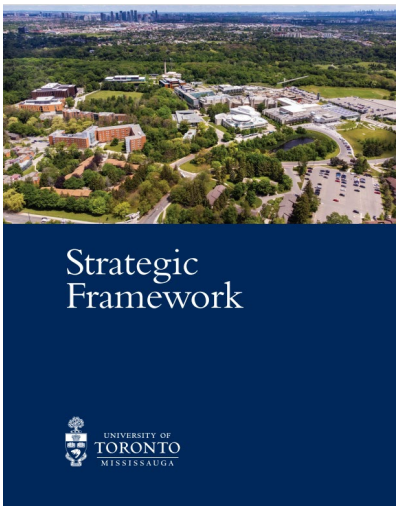
November 2021 - UTM Campus Master Plan

This plan lays out the long-term goals of campus development, including, but not limited to:

- The creation of a flexible outdoor campus commons (Campus Green) and a pavilion building, which will form the new heart of campus.
- The improvement of the pedestrian experience on campus through the establishment of 'shared streets' along Residence Road and portions of Outer Circle.
- The introduction of new cycling infrastructure along Collegeway and Outer Circle Road.

March 2022 – UTM Strategic Framework

This document highlights the priorities, commitments, and accountabilities of the institution with the goals of:



- Empowering research discovery and impact
- Embracing the campus's location, history, and culture in planning
- Building efficient and sustainable operations
- Encouraging collaboration and belonging
- Fostering student success

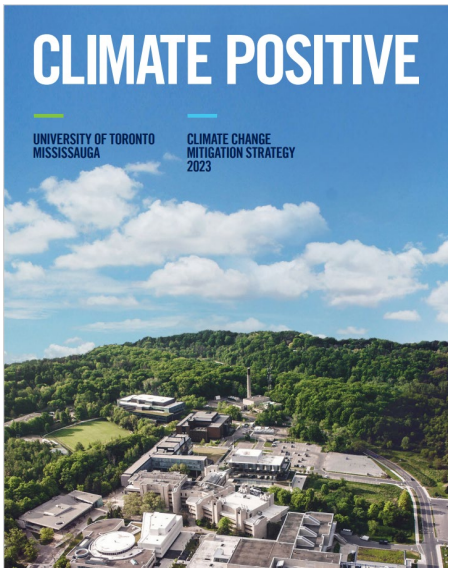
February 2023 – UTM Campus-Wide Building Energy Audit Report

Energy audits were conducted on all buildings on campus. A list of 240 energy efficiency and conservation measures was developed. These measures play an important role in reaching the targets laid out in the UTM Climate Positive Plan described below.

December 2023 – UTM Climate Positive Plan

In 2023 UTM released its Climate Positive Plan. This report outlines the climate change mitigation strategy for the next 28 years and provides a roadmap for reaching the university's GHG reduction targets. The targets of this plan supersede the previous targets.
The updated climate targets are as follows:

- 2030: A 39% reduction in GHG emissions compared to the 1990 baseline of 16,377 tonnes eCO2
- 2043: Carbon Neutrality
- 2050: Climate Positive through net positive energy use



The framework proposes reaching the targets by upgrading and optimizing how the campus consumes, distributes, and produces energy.

Consume

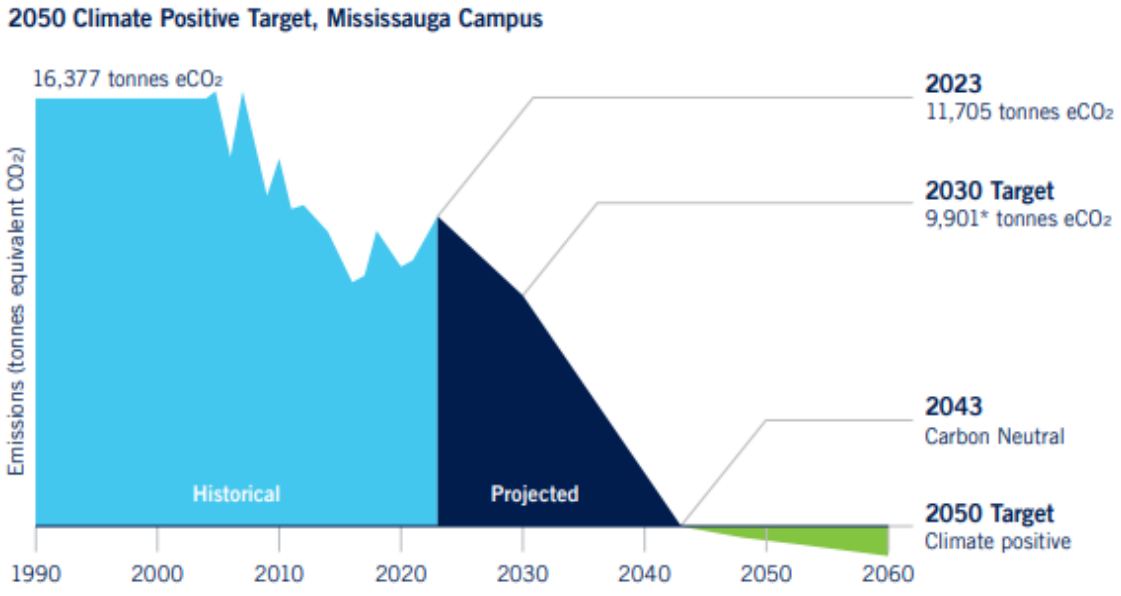
Energy conservation measures such as heating, ventilation and air conditioning (HVAC), building envelope (doors, windows, walls and roofs) lighting, building controls, water and renewables will be implemented. These measures will result in savings at the point of use resulting in decreased need for production and distribution.

Distribute

Efficient distribution of energy throughout campus will be an integral part of our electrification efforts. Converting all steam boilers to electric domestic hot water, and converting steam distribution to hot water will result in energy efficiencies.

Produce

By 2043 we will be a net-zero campus; continuing our strategy of investing in renewable energy. By including, solar, wind and grey water heat recovery, our campus will be producing net positive energy by 2050.



Updated Goals and Objectives for Conserving Energy

Organizational Energy Goals

- As a world class institution, the University of Toronto Mississauga has a responsibility to take decisive, bold action against climate change as it is one of the most pressing challenges of this generation.
- Build on the research and best practices of other leading institutions.
- Extend the power of sustainability from campus into the wider world.

Energy Conservation and Demand Management objectives

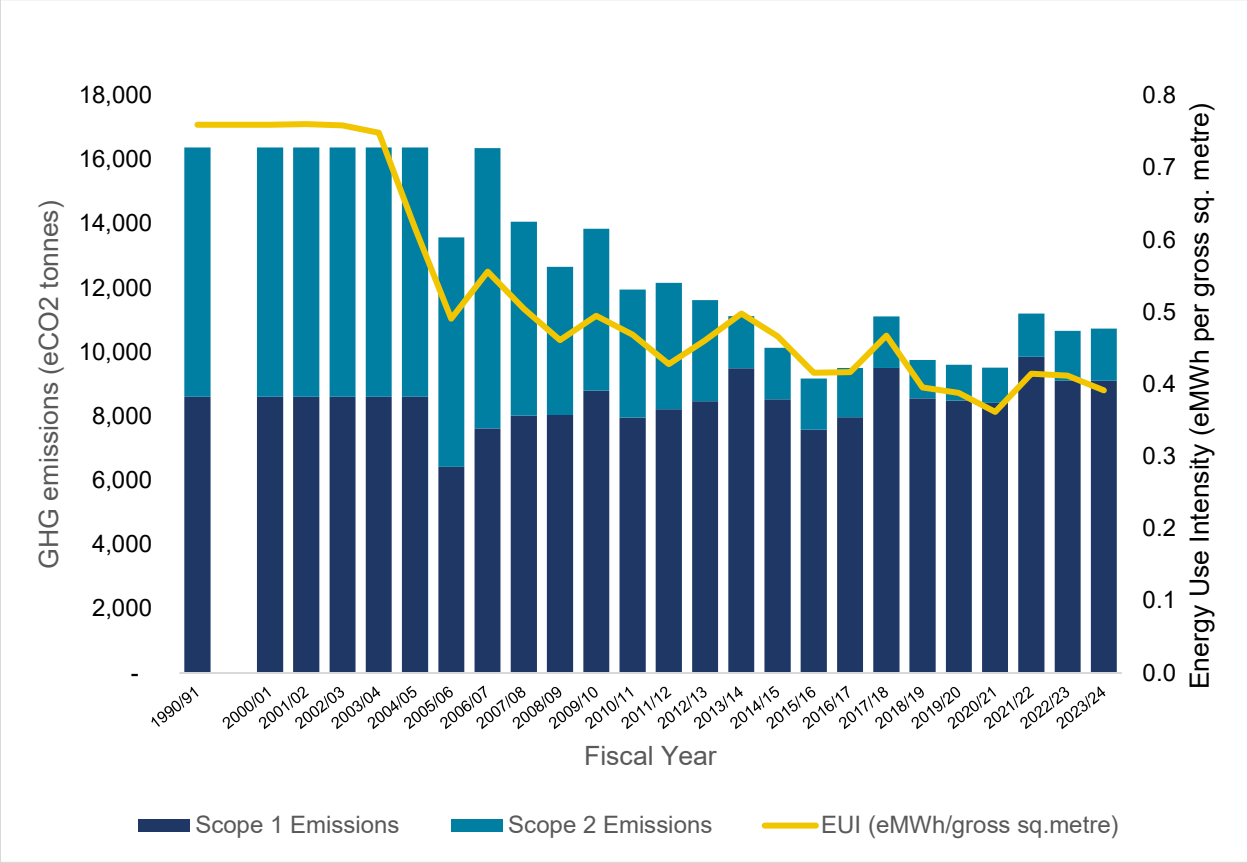
Technical: Ensure asset renewal and new construction focuses on procurement of efficient, low carbon technologies
Organizational: Develop policies for energy management and have full-time staff dedicated to the practice.
Behavioural: Increase awareness to drive behavioural change of occupants that reinforces smart energy management practices.

Updated Energy and Greenhouse Gas Targets

- While UTM has not reached this initial target, due in part to an increase in students on campus, it is taking bold steps towards the 2030 and 2043 targets.
- Reduce Greenhouse gas emissions to 39% below 1990 levels by 2030 (from 2023 Climate Positive Plan).
- Reach net zero emissions by 2043 (from 2023 Climate Positive Plan).
- Reach climate positive by 2050 – net positive energy user (from 2023 Climate Positive Plan).

Baseline Energy Consumption and Savings to Date

Since 2005, UTM has reduced its Energy Use Intensity from .62 to .41 (ekWh/m^2), a reduction of 33%. Greenhouse gas emissions have also decreased from 16,377 tons in 2005 to 11,170 in 2023, a reduction of nearly 32%, putting UTM on track to reach the target of a 39% reduction by 2030.



Many energy efficiency measures were implemented during this time period. Several impactful efficiency measures in recent years are:

- LED lighting retrofit saving over 2 million kilowatt hours of electricity and 92 tons of CO2e (March 2019).
- HVAC retrofit in the Davis building saving 151 tonnes CO2e per year (April 2019).

Energy Use and Benchmark Performance of Operations

Annual reporting is required under the regulation and allows UTM to track energy consumption over time and identify opportunities for improvement. While the weather-corrected data from Energy Star Portfolio Manager shows an overall increase in energy use of 15%, there was a 20% increase of full-time equivalent students during this time – resulting in higher campus energy demand.

	2016 Site EUI (ekWh/ft2)	2023 Site EUI (ekWh/ft2)	Provincial Median EUI	% Change
University of Toronto Mississauga	35.1	39.6	30.5[1]	**+15.3%**

1. Energy Star Average adult education facilities

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Current and Proposed Energy Conservation and Demand Management Measures

The conservation and demand management measures identified in the 2019-2024 CDM are now included within the scope of the Climate Positive Plan. Feasibility studies on decarbonization have laid out a set of energy reduction measures, associated GHG savings, cost, and timeframe for implementation. A more comprehensive list of asset renewal measures from the audit is included in Appendix A.

The measures below include those identified in the campus-wide energy audits and the Central Utilities Plant decarbonization plan described in the 2020 Utilities Master Plan. It also includes existing building commissioning (EBCx) to improve operational performance to help reach 2030 targets.

Summary of Planned Energy Efficiency Measures and Timeline

Summary of Energy Efficiency Measures	GHG Savings (tonnes CO2e)	Timeframe	Targets
Existing Building Commissioning	250	2024-2026	2030 Target (39% below 1990 levels, or 9,901 tonnes CO2e emissions)
Hot Water Boiler Electrification	650	2025-2030	
Asset Renewal Measures from Audit	904	2024-2030	
Climate Positive 2030 Target	**1804**		
Central Heating Steam Boiler Electrification	4412	2030-2043	2043 Target (net zero emissions)
Asset Renewal Measures from Audit	5489	2030-2043	
Climate Positive 2043 Target	**9901**		
Photovoltaic Installations	707	2043-2050	2050 Target (net positive emissions)
Climate Positive 2050 Target	**707 Net Positive Emissions**		

Conclusion

This CDM update fulfills the requirements stipulated in O. Reg 25/23. Broader public sector entities, including post-secondary institutions are required to report their energy data for 2022 and 2023 by July 1, 2024 via Energy Star Portfolio Manager, and provide an update on progress towards reaching the goals laid out in the 2019-2024 CDM.

This update provides details on the new climate targets for UTM and outlines the measures that have been implemented since the 2019-2024 CDM was published, and what the planned measures are, including the timeframe, cost, and associated GHG reductions.

With the publication of the Climate Positive plan in early 2024, UTM has set ambitious targets and has laid the groundwork for achieving these targets. The measures identified in the campus-wide energy audits in 2022, the large-scale electrification projects of the Central Utilities plant, and the significant increase in PV generation capacity will move UTM towards the 39% emissions reduction by 2030, net zero by 2043, and net positive by 2050.

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Management Approval:
To Ontario Ministry of Energy, this document fulfills the requirements of O. Reg 25/23 and will serve as a guide for UTM’s energy and GHG targets for over the next 5 years.

Approved by:
Ahmed Azhari
Executive Director, FM&P (acting)
Managing Director, Operations, Sustainability & Asset Management
July 1, 2024

Appendix A: CDM Plan Update Requirements

Organization's Annual Energy Use and GHG Emissions

The campus-wide electricity, natural gas, and water consumption are tracked in order to identify opportunities for improvement and to ensure UTM is on track to meet its targets. In 2023, campus utilities use increased compared to previous years. The COVID pandemic, beginning in March 2020 had a significant impact on occupancy levels, thereby lowering overall utility use, which has increased since all classes have returned to in-person learning.

Year	Electricity (kWh)	Gas (m^3)	Water (m^3)
2020	35,216,818	4,303,642	197,151
2021	35,907,043	4,476,187	224,067
2022	39,961,837	5,297,973	236,430
2023	42,679,549	4,722,006	238,982

The table below tracks the annual GHG emissions and GHG intensity of the campus. Large electrification projects for the campus heating system are targeted to occur before 2030, so that UTM will be able to meet its target of 9,901 tonnes CO2e.

Year	GHG Emissions (tonnes CO2e)	Tonnes kgCO2e/sq. ft
2020	9,790	4.2
2021	10,169	4.3
2022	11,696	5.0
2023	11,170	4.7

Summary of Progress Since Implementation of Previous Plan

Asset renewal projects focused on energy efficiency have been ongoing since the implementation of the 2019-2024 framework. The table below shows the projects that have been implemented during this time period along with the estimated cost, energy and GHG savings, and the completion date. The estimated savings are over 4,000,000 kWh and over 468 tonnes CO2e annually.

Building	Name	Completion Date	Electricity (kWh/yr.)	Gas (MMBTU/yr.)	Emissions (tCO2e/yr.)
Alumni House	Heating & DHW boilers retrofit	19-Apr	not available	not available	not available
CCT	VFD replacement	19-Apr	474,930	-	19
CUP	Chiller retrofit & optimization	21-Apr	417,891	-	35
Davis	LED lighting retrofit	19-Mar	2,301,180	-	92
Davis	Windows upgrade	21-Apr	not available	not available	not available
Davis	HVAC retrofit	19-Apr	2,470	247,997	151
Davis	DHW Instantaneous HX	21-Apr	-	89	5
Kaneff	RTU replacement phase 1	19-Apr	1,003,853	-	40
Kaneff	RTU replacement phase 2	19-Apr	34,540	286	18
Oscar Peterson Hall	Heating & DHW boilers retrofit	21-Apr	-	1,305	72
RAWC	HVAC retrofit & solar pool heating	19-Apr	227,000	2,194	135
Student Centre	RTU and DHW replacement	21-Apr	-	554	31
Davis	AHU L2 L3 Replacement	Aug-24	50,450	not available	not available
CCT	Lighting Upgrade	Jan-24	19,750		8
Estimated Savings			4,114,173	250,566	468

Description of Additional Measures and Results

UTM has a multi-pronged approach to decreasing energy use and GHG emissions, and controlling utility costs. This includes not only building retrofits, but decarbonization of vehicle fleet, operations and occupant-based demand management

Vehicle fleet decarbonization

UTM has made strides for the past several years to reduce fuel use in the campus vehicle fleet by right-sizing equipment (not purchasing a pickup truck when a golf cart would be suitable) and retiring older, less-efficient vehicles. The Hospitality and Ancillary Department also purchased a Nissan Leaf for Parking services, a fully electric vehicle.

	Number of Vehicles
Gasoline-only	**22**
Diesel-only	**3**
Gasoline-electric hybrid	**0**
Diesel-electric hybrid	**0**
Plug-in hybrid	**0**
100 percent electric	**1**
Fuelled with Compressed Natural Gas (CNG)	**0**
Hydrogen fuelled	**0**
Fuelled with B20 or higher biofuel	**0**
Fuelled with locally produced, low-level biofuel	**0**

Global Adjustment Demand Management

A demand management system is in place to reduce campus demand during grid peaks. Operations staff receive notifications to curtail demand at specific times coinciding with high grid demand. Additional demand reduction strategies are in development; however, current demand reduction strategies include:

- Decreasing fan speeds on large AHUs
- Lowering shades on windows to minimize solar heat gain
- Increasing temperature setpoints temporarily

The estimated total demand reduction from demand reduction efforts is a total of 2 MW over the 5 Peak hours in 2023, resulting in over $100,000 of avoided electricity costs.

Description of proposed changes to be made to assist organization in reaching goals

Establishment of an Energy Team

A key to success in energy management is ensuring all members of the organization are aligned in their objectives. As such, UTM is in the process of establishing an Energy Team that will meet regularly to review campus utility use, conduct walk-throughs of buildings, and review building automation setpoints. This team will include members of the Sustainability, Planning, and Operations divisions of the Facilities Management and Planning department.

To increase the efficacy of the Energy Team, UTM is currently working with an Energy Management Coach under the Strategic Energy Manager program.

Description of renewable energy sources

Photovoltaic

There is currently 26.4 kW of installed solar capacity at UTM. This system consists of 35 155W panels on the south wall of the Davis building and 120 175W panels on the south wall of the Instructional Centre. The estimated production of the solar panels is 5,300 kWh per year.

Solar Thermal

A large array of vacuum tube solar water heaters situated on the roof of the Recreation, Athletics, and Wellness Centre (RAWC) provides a heating source for the hot water used in the shower and laundry facilities of the building. Efforts are currently underway to resolve persistent metering issues in order to better track system output.

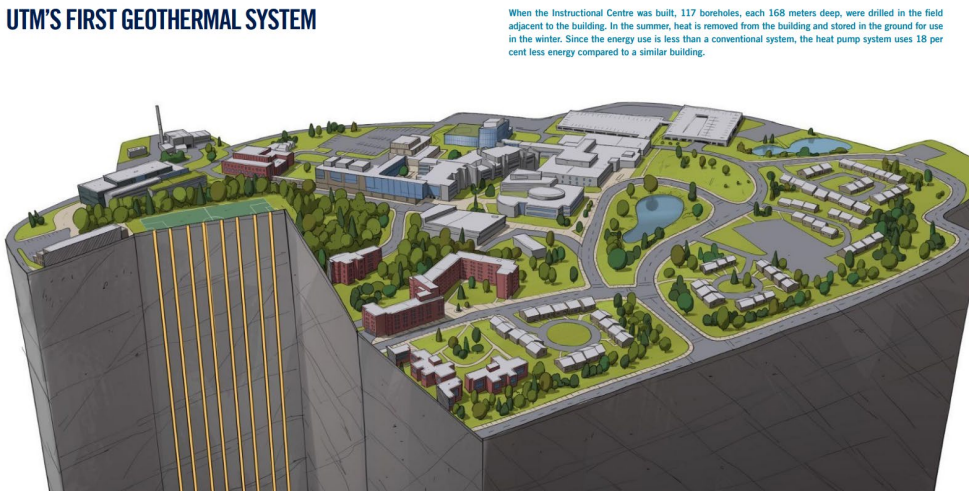
Current Renewable Energy Generation	Annual ekWh	Avoided tons GHG
Photovoltaic Generation	5,300	0.2
Solar Thermal Generation	not available	not available

* *Metering is temporarily unavailable for solar thermal systems*

Description of ground source heat pump technology, solar thermal, air source heat pump

Adoption of low carbon heating and cooling systems is already underway on campus. The Instructional Centre, constructed in 2010, is heated and cooled entirely with ground source heat pumps. When the Instructional Centre was built, 117 boreholes, each 168 meters deep, were drilled in the field adjacent to the building. In the summer, heat is removed from the building and stored in the ground for use in the winter. Since the energy use is less than a conventional system, the heat pump system uses 18 per cent less energy compared to a similar building.

The New Sciences Building, substantially completed in January 2024, is also heated and cooled with ground source heat pumps, with 100 boreholes, 320 feet deep, located underneath and adjacent to the building. Air source heat pumps are also being installed in HVAC retrofits, including in the Lislehurst residence, to replace existing gas boilers.

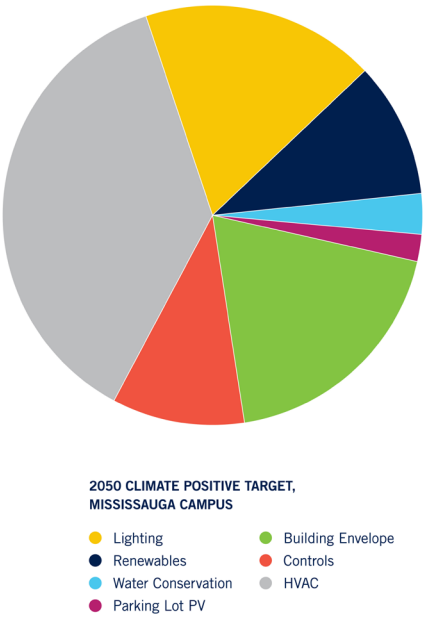


Source: Climate Positive Plan

Energy Audit Measures

The energy audits identified 240 measures that are planned to be implemented in the academic and residential buildings on campus. The measures selected target all the major end uses for energy. The measures include reducing heating load through envelope upgrades, electrification of heating systems, and optimizing control systems, and more. The Climate Positive plan outlines the categories of measures that will be implemented to achieve the 2050 targets.

2050 Climate Positive Categories of Energy Measures



Source: Climate Positive Plan

The table below provides specific examples of the measures that are planned to be implemented.

Building Type	Category of Measure	Example of Measure
Academic	HVAC	Eliminate Natural Gas Fired Humidifiers
		Install an Air Source Heat Pump
		Implement Demand Control Ventilation on ACS 1&3
		CUP Conversion from Gas to Electric Boilers
		Replace Rooftop HVAC Unit with Electric Heat Pump HVAC Unit
		Install Air Source Heat Pumps
		Install Electric Furnace
		Install Electric Garage Heaters
		Install an ERV DOAS System for the J/K/L Block AHUs
		Upgrade Heating Distribution Loop
		Install a Magnetic Bearing Chiller
		Eliminate Steam Humidification
		Install VAV Box Occupancy Controls
		Implement Heat Recovery for Block D AHUs
	Domestic Water	Install Ultra-Low Flow Faucets in Washrooms
		Install Low Flow Toilets
		Install Ultra-Low Flow Faucet Aerators in Washrooms
		Insulate DHW Piping
		Install Smart DHW Recirculation Pump
		Install Low Flow Showerheads
		Install an Electric DHW Heater Tank
		Install Heat Pump DHW Heater
	Lighting	Upgrade to LED Fixtures and Lamps
		Install Lighting Controls
	Envelope	Install High Efficiency Windows
		Repair/Replace Weather Stripping
		Increase Interior Insulation
		Install EIFS
		Improve Roof Insulation
		Caulk Window Frames
	Controls and Setpoints	Install Occupancy Sensors
		Recommission the Building Automation System
		Install a Building Automation System
		Install Occupancy Sensing Thermostat
		Reduce Unit Heater Setpoints
		Lower Pool Water Temperatures
	Energy Storage	Install Storage Battery
		Install Thermal Energy Storage
	Power Generation	Install Photovoltaic Array

Timeframe for implementation

Opportunities through to 2030

Energy Audits

There were 240 energy conservation measures identified in the campus-wide energy audits completed in 2022 that are currently being implemented. Examples include:

- Replacing aging air handling units in the Davis building with new systems equipped with energy-saving technology, such as Variable Frequency Drives on fans and heat recovery on exhaust air.
- Electrification of the gas-fired hot water boilers that serve Deerfield and Maanjiwe nendamowinan buildings.
- Replacing gas boilers with air source heat pumps in Lislehurst Residence
- Installing high efficiency windows in Communication, Culture & Technology building.

Existing Building Commissioning (EBCx)

Existing building commissioning (EBCx) of 12 buildings on campus is currently underway. EBCx includes a comprehensive review of building systems of the energy-consuming systems and operations practices to help reduce waste. The EBCx process consists of 3 phases.

1. Planning: In this phase, an in-depth review of building utility data, set-points, and sequences of operation to identify opportunities to save energy and improve occupant comfort.
2. Implementation: The identified measures are implemented, and reductions are quantified using Measurement and Verification best practices.
3. Persistence: Operations staff receive training and progress is closely monitored to ensure ongoing savings.

EBCx measures are expected to save 250 tonnes of CO2e annually.

Opportunities through to 2043

UTM is in the planning stages of Project SHIFT, outlined in the 2023 Climate Positive Plan, a deep energy retrofit of the Central Utilities Plant. This will consist of electrification, steam to hot water conversion, controls optimization, and energy storage. The retrofits will reduce GHG emissions by more than 6,000 tonnes of CO2 equivalent. Project SHIFT will allow UTM to modernize the plant and begin to SHIFT away from fossil fuels as the primary heating source.

The construction of 2 additional central utilities plants will create a nodal network - removing single points of failure and increasing redundancy by creating a network of interconnected thermal and electric energy redistribution nodes.

Our new buildings will utilize nodal plants, with centralized electrical infrastructure, and a district ground-source heat pump system with geo-exchange borefields to meet connected buildings' thermal and electrical needs.

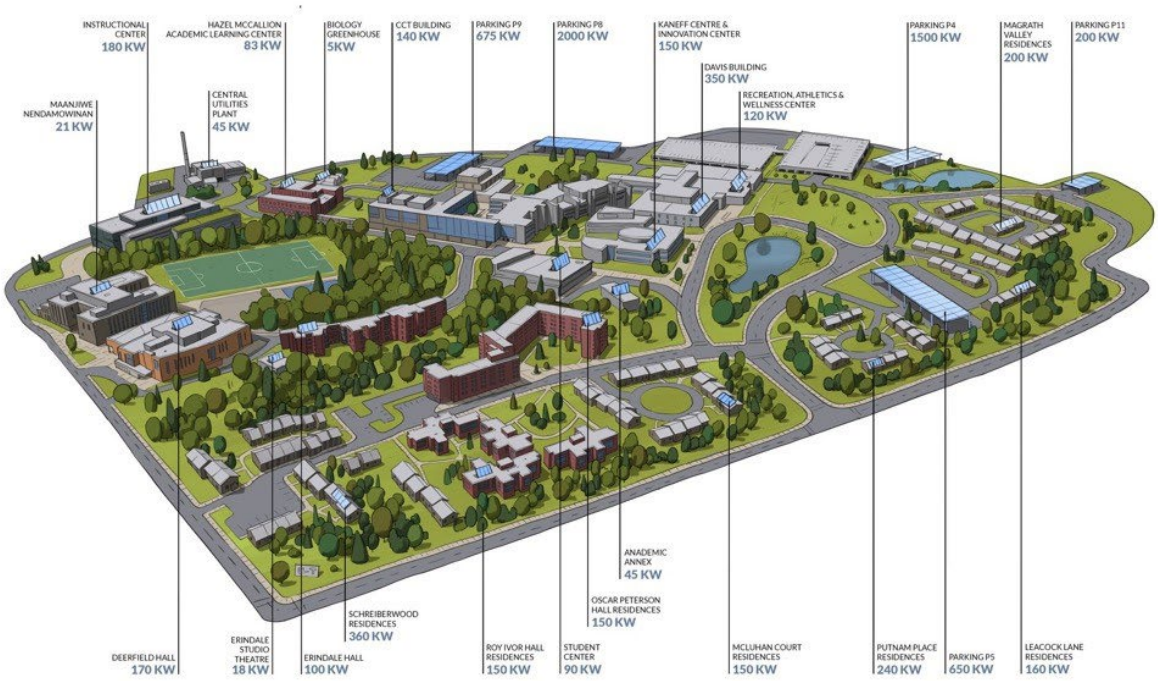
Opportunities though to 2050

Renewable energy

UTM is planning to add to its existing solar capacity of 26.4 kW by putting photovoltaic arrays on each building. The planned PV capacity is nearly 8 MW. This will be critical to UTM reaching its climate positive plan by offsetting its grid electricity with electricity from a renewable source.

Over the next several years, as these technologies become more financially feasible, we will implement these projects to realize our climate positive goals.

Expanding Solar on Campus



Source: Climate Positive Plan