

**FOR ENDORSEMENT AND FORWARDING**

**PUBLIC**

**CLOSED SESSION**

**TO:** Executive Committee

**SPONSOR:** Professor Scott Mabury, Vice President, University Operations  
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**DATE:** November 28, 2017 for December 5, 2017

**AGENDA ITEM:** 3(b)

**ITEM IDENTIFICATION:**

Capital Project: Greenhouse Gas Campus Retrofits Program (GGRP)

**JURISDICTIONAL INFORMATION:**

Under the *Policy on Capital Planning and Capital Projects*, “...Proposals for capital projects exceeding \$20 million must be considered by the appropriate Boards and Committees of Governing Council on the joint recommendation of the Vice President and Provost and the Vice President, University Operations. The Planning and Budget Committee will consider projects at the St. George campus and the respective Campus Affairs Committees and Campus Councils will consider projects at University of Toronto Mississauga and University of Toronto Scarborough and recommend them to the Academic Board for consideration. Normally, they will require approval of the Governing Council. Execution of such projects is approved by the Business Board.

If a project will require financing as part of the funding, the project proposal must be considered by the Business Board.”

**GOVERNANCE PATH**

**A. Project Planning Brief**

1. UTM Campus Council [for recommendation] (November 21, 2017)
2. UTSC Campus Council [for recommendation] (November 22, 2017)
3. Academic Board [for recommendation] (November 23, 2017)
4. Business Board [financing, for recommendation] (November 27, 2017)
- 5. Executive Committee [for endorsement and forwarding] (December 5, 2017)**
6. Governing Council [for approval] (December 14, 2017)

## **B. Execution of the Project**

1. Business Board [for approval] (November 27, 2017)

### **PREVIOUS ACTION TAKEN:**

No previous action taken.

### **HIGHLIGHTS**

The Greenhouse Gas Campus Retrofits Program (GGRP) is a capital grant program established by the Ministry of Advanced Education and Skills Development (MAESD) to assist postsecondary institutions in reducing their greenhouse gas (GHG) emissions and improving energy efficiency of their campuses. MAESD has worked with the Ministry of Environment and Climate Change (MOECC) to develop a detailed program that will allow the sector to contribute to Ontario's efforts to reduce GHG emissions and move towards a low-carbon economy. This program is a part of the provincial Climate Change Action Plan (CCAP) and earmarks up to \$300 million in funding for the 2017-18 fiscal year for the university sector, contingent on Cap and Trade auction proceeds; by law the proceeds must be reinvested in GHG reduction programs. The pre-public announcement to universities in September 2017 regarding the GGRP has the objective of supporting universities in their efforts to meet the provincial CCAP GHG emissions reduction targets of 37 % by 2030, and 80 % by 2050, below 1990 levels. There are three funds available to universities under the GGRP: the Retrofits Grant Fund for Cap and Trade Non-Participants, the Interest-free Loan Fund and the Innovation Grant Fund.

On November 9, 2017 MAESD released a Call for Proposals for the competitive portion of GGRP, the Innovation Grant Fund. Universities are required to respond to the Call in two stages, with the first response (single-year proposal) due on December 5, 2017 and the second response (multi-year proposal) due on December 22, 2017.

The University of Toronto will respond to the Call and will also participate in the other two funds, and hence is seeking approval for an integrated capital project envelope and borrowing under the GGRP Loan Program. It is envisioned that over the next four years, the University will complete about \$100 million in GHG emission reduction projects.

The three GGRP funds are described below:

1. **Retrofits Grant Fund for Cap and Trade Non-Participants:** provides grant funding to cap and trade non-participants to pursue GHG reducing retrofit projects, as they do not receive free allowances through the provincial Cap and Trade program. Projects under this fund are expected to be substantially completed by March 31, 2019. UTSC and UTM have each been allocated grants from this fund.
2. **Interest-Free Loan Fund:** available to all institutions, with allocations based on each institution's direct stationary GHG emissions, with interest costs subsidized by the province. Projects approved under this fund must achieve a payback period on the loan within 10 years. The loan funds are available for four years, from 2017-18 to 2020-21. This will be signed as one loan agreement between the University and the Ontario Financing Authority. Principal loan repayment funds will be derived from the savings related to the capital projects noted above.

**Eligibility for the Loan Fund:** the MAESD submission template outlines the following categories of retrofit projects eligible for the loan fund (and provides detailed examples within each category):

- Lighting (e.g. LED, controls and sensors)

- HVAC and controls (e.g. HE boilers, furnaces, motors, chillers, pumps; real-time monitoring)
  - Building envelope (e.g. EE windows, doors, air sealing, green roof, new roof, passive building)
  - Various (battery, solar, chilled water solar PV, electric vehicle charging stations)
3. **The Innovation Grant Fund:** provides universities with an opportunity to compete for grant funding to support larger projects that reduce GHG emissions. The intention of this fund is to support projects that demonstrate innovative plans and approaches to increase campus sustainability and reduce GHG emissions, while also supporting other institutional and Strategic Mandate Agreement (SMA) priorities. The fund will be administered through a Call for Proposals; single-year project decisions will be communicated to universities in January 2018 and multi-year project decisions in early 2018. Projects selected for single-year funding are expected to be substantially completed by March 31, 2019. This fund is available to UofT as one single institution.
- a. **Single-year Project Proposals:** A maximum of one single-year funded project submission per institution can be made to draw on this fund;
  - b. **Multi-year Project Proposals:** The province will also consider multi-year projects through the Innovation Grant Fund. All multi-year project proposals will be subject to additional approvals, as there is currently no funding commitment for projects beyond 2017-18.

**Eligibility for the Innovation Grant Fund:** In order to be eligible for funding, institutions must demonstrate the following:

- That the projects fit in to an existing, broader plan for achieving sustainability and a low-carbon campus;
- That the projects also aim to support opportunities for student experiential learning, be aligned with university Strategic Mandate Agreements made with MAESD, and offer community/societal benefits. For the Innovation Grant Fund, projects that identify co-benefits in addition to demonstrating GHG reduction potential will be given preference to those proposals that only reduce GHG emissions.
- That projects pursue recognized GHG emissions reductions, as directed by the Ministry of the Environment and Climate Change (MOECC)
- May include retrofit projects, net zero upgrades, new build projects

**Fund stacking:** Institutions may combine Interest-Free Loan and/or Retrofits Grant for Non-Participants funding with a proposed Innovation Grant Fund amount to support a larger project. However, the requirements of each fund type utilized must be met.

### ***UNIVERSITY OF TORONTO GHG REDUCTION PLAN AND THE GGRP***

The University has an excellent track record of reducing utility consumption and GHGs through the execution of hundreds of water and energy reducing projects over the past decade. Aligning with provincial eligibility criteria, we have selected projects with the highest value, measured as cost per CO<sub>2</sub> metric tonne. While discrete projects are identified for our application to the Innovation Fund, projects have been chosen to integrate funding from the Innovation and Loan GGRP funds, and University operating funds, across all three campuses. Due to the accelerated nature of the GGRP program and the deadline for proposals, the proposed projects do not yet have full project planning reports. The following

are summaries of the integrated single-year and multi-year projects for St. George, UTSC and UTM for which we will be seeking GGRP funding.

Projects noted below represent all three campuses and have been developed in such a way as to allow for further funding under the multi-year Innovation Grant application. In order to accelerate the critical projects, Innovation funds will be leveraged with GGRP Interest-free Loan funds and University operating funds. We will apply these funds to multiple tri-campus projects over the GGRP Interest-free Loan period.

- Improving the efficiency of research intensive buildings through the use of automated computerized building and fume hood controls
- Introduction of DDC building controls in a number of campus buildings currently equipped with legacy systems or having no automation system at all
- Deep energy retrofits of select inefficient academic and administrative buildings focusing on improving the insulation of the building envelope and roofing systems, energy efficient windows, HVAC systems and lighting
- Installation of primary and sub-metering on all buildings currently without this technology on the campus
- Installation of renewable systems which marry photovoltaic electrical producing arrays with solar thermal array systems producing electricity and hot water simultaneously
- We will continue to progress on our current project of converting all lamps on the campus to high efficiency LED technology.

### ***SINGLE-YEAR PROJECTS***

The following are details of projects on all three campuses that fold into our proposal.

#### **St. George Campus District Energy System (DES)**

Despite the addition of over 25 buildings on St. George, less energy is used today than in the year 2000. This new funding will accelerate this activity. As with all capital projects at the campus, projects are designed to address a number of deferred maintenance, regulatory, academic, accessibility, and student experience objectives at the same time, leveraging available funding to the maximum extent possible; this same approach will be taken as we plan and execute the GGRP-related projects. MAESD has allocated St. George funding from the GGRP Interest-free Loan Fund which is available over a period of four years from April 1, 2017 to March 31, 2021. St. George has identified projects which can be completed by March 2019. In the following two years (2019-2021) St. George will seek approval for additional funds, alone or as part of collective effort by the three UofT campuses, from the multi-year GGRP Innovation Fund, will access the remaining GGRP Loan Fund and will allocate additional University operating funds.

The University of Toronto St. George Campus academic mission has been supported for over a century by a very large district energy system (DES). This system reliably and efficiently supplies electricity, cooling and heating to the majority of buildings on the campus through a network of underground tunnels. District energy systems inherently provide resiliency, cost savings, and utility efficiency to the buildings connected to them compared to distributed systems. Specific advantages include: redundancy with much less capital investment, fewer operational staff and lower maintenance costs as less equipment and space is required. The DES also provides opportunities for highly efficient systems such as Cogeneration, Trigeration, and flue heat recovery systems not available in most stand-alone building operations. The

St. George campus buildings are a unique portfolio of structures. A vast array of building sizes, ages, designs, and uses abound on this campus. The average age of St. George campus buildings is 80 years, with 40 buildings aged 100 years or more. These buildings were not designed nor constructed with energy efficiency or carbon footprint in mind and many are designated as heritage sites. They provide distinct challenges on many fronts beyond energy efficiency including life safety, comfort, and accessibility to name a few.

The **Chiller Facility** located within the basement of the Medical Sciences Building (MSB) is a critical component of the St. George Campus DES. This very large plant provides cooling to 14 separate buildings in the south east portion of the campus. These buildings are some of the most important research facilities at the university, including MSB, CCBR, Pharmacy, Wallberg, Mining, and several other smaller research facilities. The cooling provided by this plant is crucial as it supports the University assets contained in these buildings that include world class research, specimens of both historical and investigative significance and environmentally critical equipment. Beyond research, the MSB plant supports the Gerstein Library, MacLeod Lecture Hall, and the University's largest ceremonial lecture hall, Convocation Hall. Our investigation into this cooling facility operation specifically (reviewing asset efficiency and provision of cooling and heating thermal energy to the site) has identified a number of opportunities for improvement and innovation. In addition, this project will also create Living Lab opportunities for students, offering real time view of the plant operations. The GHG reduction opportunities identified include:

i. System and Distribution Automation Upgrade

Installation of Direct Digital Controls (DDC) into the Chiller Facility will provide an opportunity to more accurately control the operations of the system and equipment, providing planning metrics, and automatically making system adjustments to site needs. The use of DDCs capable of monitoring the buildings and controlling the chiller output will tighten adherence to the actual load, minimizing current energy usage and lowering operating costs. These controls will maximize efficiency and performance of the steam turbine chiller (and electric chillers) saving both Scope 1 and 2 greenhouse gases (Scope 1 are defined as direct GHG emissions, including those from the combustion of fossil fuels (e.g. natural gas, fuel oil, propane, etc.) for comfort heating or other industrial applications; Scope 2 are emissions from consumption of purchased electricity, heat or steam.

ii. Equipment Upgrade

The MSB chilled water plant has a fairly unique combination of electrical and steam driven chillers. Most of the units in the plant are conventional electrically driven machines. The plant also boasts two absorption chillers which use waste steam from the Central Steam Plant (CSP) to create cooling. These machines ensure that the steam coming from the 6 megawatt gas turbine of the central steam plant, which produces both electricity and steam, is fully utilized in the summer months when heating of buildings is not required. The absorption chillers allow our CSP to be efficiently used as a Trigeneration operation – a highly sustainable system making use of waste heat on many levels. Unfortunately, absorption chillers have inherent inefficiencies. Recently, the advent of steam turbines, which are much more efficient than absorption machines, became readily available and have been industry-tested and proven. We plan to replace one of the older electrical chillers with a modern highly efficient machine with variable control operation. This will support

the fine-tuning of the system allowing a broad array of operating modes. A second initiative planned for this project involves the replacement of the absorption chillers with a single highly efficient steam turbine chiller. The steam turbine will save significant scope 1 greenhouse gases by meeting base load requirements for cooling.

iii. Electricity from Waste Energy

Steam is sent around the campus under high pressure. At the point of use, the steam must be reduced in pressure through the use of pressure relief valves or PRVs. The action of reducing pressure creates waste heat. We plan to harness this energy to produce electricity at the MSB chiller plant. The energy created by reducing the steam pressure will be passed through a turbine which turns into a generator and makes electricity we can use inside the building, and displaces purchased electricity from Toronto Hydro. We are using what would normally be wasted steam pressure energy to make useful electricity without compromising the performance of the steam to heat the building.

The **Central Steam Plant (CSP)** is the heart of the DES at the St. George campus. This plant provides heat to a large proportion of campus buildings, many buildings at the Federated Universities and other third parties. The plant also produces a sizable amount of electricity for the campus via a 6 MW gas turbine. Connected to this system are absorption chillers in the MSB chilled water plant that use steam heat created from the production of electricity to provide cooling during the summer months. The flue heat recovery system (SOFAME) takes the CSP operation to another level of efficiency by capturing waste heat (that otherwise goes up our large chimney) to create hot water. The hot water created by this system is the primary source of heat for the BCIT building – the fourth largest building at St. George.

Through our investigations on how to further reduce GHGs, we envision groundbreaking opportunities as part of the GGRP Innovation Grant funding program to optimize our CSP that reduce our GHGs and result in opportunities such as implementing a “Net Zero” heritage building retrofit. Specifically, we want to make the following changes to our CSP to reduce GHGs and utilize the improved efficiencies to convert the energy and carbon-intensive 91-year old Physical Geography building to a net zero facility. The GHG reduction opportunities identified as part of the single-year project proposal include:

- i. Expansion of the flue heat recovery system.  
Increase the SOFAME heat recovery system capacity where hot water is generated from waste flue gas; the increased hot water from waste heat will replace steam being sent to existing buildings. A few leading institutions in North America (UBC, Stanford, UC Davis) are converting their entire steam heating systems to hot water systems which comes with significant improvements in efficiency and reductions in GHGs; the expansion of our existing SOFAME heat recovery system will be the first step down this path;
- ii. Replacement of tube-in-shell heat exchangers with higher efficiency plate and frame technology to take advantage of the expanded hot water system;

## **UTSC**

UTSC has been allocated funding by MAESD from both the Retrofits Grant Fund for Cap and Trade Non-Participants and the Interest-free Loan Fund. UTSC will be utilizing the Retrofit Grant Fund for Cap and Trade Non-Participants to focus on GHG reduction directly via reduction of heating demand in its highest heating demand density areas. In addition, transitioning from the current medium of steam to hot water in these areas will allow for future renewable energy options. UTSC will use the Loan Fund to execute a series of electricity related demand reduction projects including LED retrofits focusing on areas with long operating hours to ensure utility recovery payback.

## **UTM**

UTM has been allocated funding by MAESD from both the Retrofits Grant Fund for Cap and Trade Non-Participants and the Interest-free Loan Fund. UTM will also allocate operating funds. UTM projects include the installation of high efficiency boilers; the replacement of low efficiency rooftop air conditioning units (RTUs) with high efficiency RTUs with Variable Frequency Drives (VFD); the installation of VFD on supply and return fans; and the installation of energy efficient windows.

## ***MULTI-YEAR PROJECTS***

The following projects represent current thinking regarding outer years. Further funding is being sought under the multi-year Innovation Grant application to continue the innovative work begun during the single-year project timeline (to March 30, 2019).

For the **Central Steam Plant**, projects include optimization of boiler draft fan drives to match the flue gas heat capture capacity; generation of electricity from wasted steam energy – electrical generation using micro-turbines to replace traditional pressure reduction units, increasing overall plant thermal efficiency.

**UTM** will continue to pursue projects, including the installation of high efficiency boilers; the replacement of low efficiency rooftop air conditioning units (RTUs) with high efficiency RTUs with Variable Frequency Drives (VFD); the installation of VFD on supply and return fans; and the installation of energy efficient windows.

At the St. George campus, the goal is to convert the heritage Physical Geography Building in to a **Net Zero Building** through overall improvement of the building's energy efficiency and the reduction of its carbon footprint. The building envelope will be substantially improved with the addition of insulation in its roof and walls; the replacement of current windows with upgraded, triple pane windows; the replacement of steam radiators with low temperature radiator units suitable for the SOFAME expansion; the installation of a large photovoltaic array on the roof; and the installation of ultra-efficient LED lighting integrated with occupancy controllers and daylighting provisions. Occupant comfort will be improved through the installation of a ventilation system and life safety equipment and systems will be installed to ensure tenant safety. The building is currently inaccessible: installation of an elevator, resizing of doorways, installation of a gender neutral washroom and improvement to lines of travel will be undertaken to meet current AODA regulations and to improve the building's overall accessibility. Finally, Living Lab opportunities will be created within this project to demonstrate best practice leadership – transforming a poor-quality, inaccessible heritage building into a modern, high-quality, low carbon footprint and accessible work environment.

**NEXT STEPS**

Project specifics will be brought back to Academic Board and Business Board for information. Confirmation of funding approved from MAESD under the Innovation Fund will also be reported for information.

**FINANCIAL IMPLICATIONS**

Discussion of overall costs and funding sources can be found in the in camera document for these projects.

**RECOMMENDATION:**

Be It Resolved

THAT the following recommendation be endorsed and forwarded to the Governing Council:

THAT the capital project for the Greenhouse Gas Campus Retrofits Program be approved in principle to be funded from the following sources:

- Greenhouse Gas Campus Retrofits Grant Fund for Cap and Trade Non-Participants
- Greenhouse Gas Campus Retrofits Innovation Grant Fund (proposal)
- Greenhouse Gas Campus Retrofits Interest-Free Loan Fund
- University of Toronto Operating Funds

**DOCUMENTATION PROVIDED:**

None.