Getting to Carbon Neutral at St. George Campus

Getting to Campus at St. George
Towards a Low-Carbon Future

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Moderator:
Agenda

1. U of T's commitment for action on Climate Change
2. Review Low-Carbon Action Plan (next 5 years) and Net Zero Campus Master Plan (to 2050)
3. Project Highlights through the Sustainability Office.
4. Partnerships and Engagement.
Across the 3 campuses, we educate more than 88,000 students. That makes us the largest university in North America.

We employ more than 20,000 faculty and staff members.

Population 100,000+

Total Enrolment 91,286

Librarians 7,198

Staff Members 266

Faculty Members 156

Buildings 266

Gross Square Meters 1,790,704

Context: U of T – A City Within a City
How U of T’s Greenhouse Gas Footprint Compares

- U of T is the 3rd largest GHG emitter among institutions within Ontario’s Broader Public Sector:
  1. City of Toronto
  2. TDSB
  3. University of Toronto

[Diagram showing the comparison with other entities like District School Boards, Hospitals & Health Networks, Cities, and Universities]
U of T produces more GHG emissions than other universities and colleges in Ontario. U of T's reduction target of 59,000 tonnes alone is larger than the total annual emissions of any other university or college in Ontario. While we are efficient, we still have a significant footprint.

Comparing U of T's GHG Emission Levels with Local Industry Players

- University of Toronto
- Toyota Manufacturing
- GM Manufacturing (Oshawa)
- Ford Manufacturing (Oakville)
- Honda Manufacturing
- Sanofi Pasteur
- Toronto Pearson International
- GM Manufacturing (Oshawa)
- Toyota Manufacturing

While we are efficient, we still have a significant footprint.
Awarded Canada’s Greenest Employer 7 times.

- $8.5M green revolving fund — one of the largest in North America.
- 100+ years of district energy.
- 100+ years of district energy.
- Building on Leadership in Operational Sustainability

Since 2011, we have:

- Achieved a reduction of more than 55 thousand tonnes of GHG emissions.
- Saved over 1.25 billion litres of water (equivalent to 500 Olympic-size pools).
- Avoided over $30 million in utilities costs.
- Providing funding for significant energy reduction projects and building retrofits.
- We currently produce more than 80 per cent of our heating and 20 per cent of our electricity needs for our downtown Toronto campus.

- Avoided over $30 million in utilities costs.

Building on Leadership in Operational Sustainability
Our Commitment

The University of Toronto has set a goal to advance towards a 37% reduction in greenhouse gas emissions by 2030, from a 1990 level baseline.

“Climate change remains one of the world’s greatest challenges, and the University of Toronto community—our brilliant students and alumni, faculty and staff—are working hard to meet that challenge.”

- President Meric Gertler
Pathway to 2050: Carbon Neutral

- 80% reduction of absolute emissions
- 20% offset from university owned offsite renewables

Emissions (Metric Tons CO2e)

Year
What Our Peers Are Doing: University Benchmarking

Each university has adopted its own definition of Carbon Neutrality:

- **Scope 1**: GHG emission reduction
- **Scope 2**: Offsite renewable energy
- **Scope 3**: Reducing indirect emissions

- **Carbon Neutrality** includes:
  - Carbon offsets
  - Carbon sequestration

University Definitions:

- **UCLA**
- **U of Cambridge**
- **U of British Columbia**
- **McGill**
- **Dartmouth**
- **Cornell**
- **Harvard**
Pathway to 2050: Carbon Neutral

Target carbon neutrality by 2050, with:
- 80% reduction in absolute emissions
- 20% offsite renewable energy or offsets
- 80% reduction in absolute emissions, City of Toronto, and Federal Government
- 3rd Party Offsets

Trees

Air Travel Offset

Other

Transport

Energy

By 2050

Reduction Percent

80%

20%
We will optimize how we produce, distribute, and consume electricity and natural gas on our campuses.

Our Plan: How we plan to achieve our goal
Principle 1: Focus on Reduction

Our strategy’s primary focus should be reduction of the energy we consume. The cleanest and cheapest energy is the energy we do not consume.
**Principle 2: Balance Carbon with Cost**

We could address our carbon issue by switching to electricity because electricity is 4.5 times cleaner than gas; however, electricity costs are approximately 11 times more expensive on an equivalent energy basis.

<table>
<thead>
<tr>
<th>Commodity</th>
<th>kg / ekWh</th>
<th>$ / ekWh</th>
<th>GHG Emissions kg / ekWh</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural Gas</td>
<td>0.1776</td>
<td>0.0148</td>
<td>0.1776</td>
</tr>
<tr>
<td>Electricity</td>
<td>0.0400</td>
<td>0.1615</td>
<td>0.0400</td>
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**Carbon Reduction Framework: Principle 2**
Principle 3: Reach Beyond Our Own Assets

On the St. George Campus, approximately 12% of our emissions come from assets we do not directly own or influence. Our carbon plan must incorporate reductions of these emissions. Partner with these organizations to reduce emissions.

<table>
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<tr>
<th>UofT Assets</th>
<th>Federated Colleges</th>
<th>External</th>
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<tbody>
<tr>
<td>88%</td>
<td>7%</td>
<td>5%</td>
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St. George GHG Emissions

Carbon Reduction Framework: Principle 3
Principle 4: Fostering Innovative Solutions

- Implement innovative solutions to our carbon challenges
- Leverage the Campus as a Living Lab model to foster partnerships with our academic community to achieve carbon reductions
- Develop external partnerships to implement innovative solutions to our carbon challenges
Campus Emissions – Now and Future Targets

- 2050 Goals:
  - 19,391 tonnes
  - 80% reduction in carbon emissions
  - 20% reduction from on/offsite renewables

- 2030 Goal:
  - 73,684 tonnes

- 2024 Goal:
  - 82,551 tonnes

- Now:
  - 14,255 tonnes

Carbon Neutrality by 2050

Campus Emissions - Now and Future Targets
Net Zero Campus Master Plan Objectives

Commitment to reduce Green House Gas emissions (by 37% below 1990’s emission by the year 2030) will require transformational changes of the campus utility infrastructure.

Significant new campus growth will require expansion of the campus utility infrastructure in terms of:
- Reliability
- Resilience
- Redundancy

Existing campus utility infrastructure is aged and requires renewal to support the university campus in its pursuit of academic and research excellence.

University of Toronto

Growth

Net Zero

Renew
Future Climate Projections and Impacts

Limited/No Global Emissions Reduction

Outcomes from different simulations vary

Moderate Global Emissions Reduction

Timeframe is 2050 (2046 to 2065)

RCP 8.5 is used as the emission scenario

Temperature, humidity, wind speed and rainfall changes are localized through shift factors on CWEC Toronto weather file

Future climate data from computer models of atmospheric carbon dioxide under different reduction scenarios

Future Climate Projections and Impacts
Future Climate Change Impact

Energy Modelling Results between TMY and morphed weather files

- Peak Cooling Demand [MW]: +10%
- Annual Cooling Consumption [MWh]: +23%
- Peak Heating Demand [MW]: -7%
- Annual Heating Consumption [MWh]: -0.6%

Outdoor dry bulb temp
CURRENT + PLANNED DEVELOPMENTS

CONSIDERATION 3: FUTURE GROWTH
What does a Net Zero Carbon Campus Look Like?
TECHNOLOGIES REVIEWED

Biomass

Deep Geothermal

Micro (modular) Nuclear

Hydrogen Fuel Cells
This option is heavily dependent on maturity of the Hydrogen market

This option is heavily dependent on maturity of the MMR/SMR technology, rules and regulation, public perspective, and more

Multiple enabling technologies available (GSHP, ASHP, WWHR, Electric Boilers). Best option based on known and reliable technology
SHORTLISTED STRATEGIES OVERVIEW

Alt. 1: Inter-Nodal Central Plant
- Local Air Source Heat Pump
- Local Steam Boiler
- Nodal Plant
- Central Steam/HW Plant

Alt. 2: Nodal Focused
Nodal Plant

Alt. 3: Local Generation Focused
Local Steam Boiler

Diagram:

Local Generation Focused
- Nodal Plant
- Central Steam/HW Plant

Nodal Focused
- Central Steam/HW Plant

Inter-Nodal Central Plant
- Nodal Plant
- Central Steam/HW Plant
EQUIVALENT CARBON EMISSION – YEAR 2050

Emissions offset associated with Large Scale University Owned off site solar farm