FacilitiesQU

Queen's

Queen's University
Greenhouse Gas Inventory Report 2023

TABLE OF CONTENTS

SUMMARY

Queen's University in Kingston, Ontario is committed to advancing the United Nations Sustainable Development Goals, specifically to the University's role in addressing climate change. As an institution for teaching and research, Queen's has an important and unique opportunity to tackle climate change issues by supporting the efforts of innovators, and educate a future generation of decision makers.

In 2010, Queen's University signed the University and College Presidents' Climate Change Statement of Action for Canada, thereby making the commitment to reduce greenhouse gas (GHG) emissions. As part of this agreement, Queen's is required to track and report all GHG emissions. This is the fourteenth annual Greenhouse Gas Inventory Report published, which contains a summary of Queen's Scope 1&2 emissions as calculated according to the World Resources Institute (WRI) GHG Protocol for Corporate Accounting standard.

In total, Queen's emitted 38,440 tCO2e from January 1 to December 31, 2023 which is a slight decrease from 2022.

The Queen's Climate Action Plan (CAP) was developed to reduce the GHG emissions emitted by the University, with a goal of being carbon neutral by 2040. Milestone targets for 2020 and 2030 have also been set to structure an achievable timeline for carbon neutrality. The CAP's target of 35% GHG reductions by 2020 was successfully met, and Queen's is now working towards the second milestone of a 70% reduction by 2030. This report provides a breakdown of the university's emissions in 2023 as well as an overview of Queen's plan for further emission reduction.

BACKGROUND INFORMATION

Scope of Emissions

This report reviews the overall emissions associated with the operations of Queen's University, including the direct (Scope 1) and indirect (Scope 2) emissions of all Queen's facilities and operations within the province of Ontario. This encompasses leased and owned buildings both on and off campus. The report excludes any satellite offices outside of Ontario and Bader College at Herstmonceux, England.

Scope 1 emissions include all emissions directly produced by the University, most of which are caused by local energy production to heat the campus. The main contributors to Scope 1 emissions include:
- Stationary combustion from the boilers, cogeneration plant, generators, furnaces, and kitchen equipment
- Mobile combustion from various fleet vehicles and grounds maintenance equipment
- Fugitive emissions from electrical switches, fire suppression equipment, lab chemicals, and refrigerants

Scope 2 emissions include all indirect emissions associated with energy that the University purchases, including:
- The University's Main and West Campus electricity consumption
- The electricity consumption of Queen's Biological Station (QUBS)
- The electricity, heating, and cooling in all leased spaces

Scope 3 emissions include all other indirect emissions, and are comprised of 15 unique categories, such as commuting and, that are not included in the scope of this report
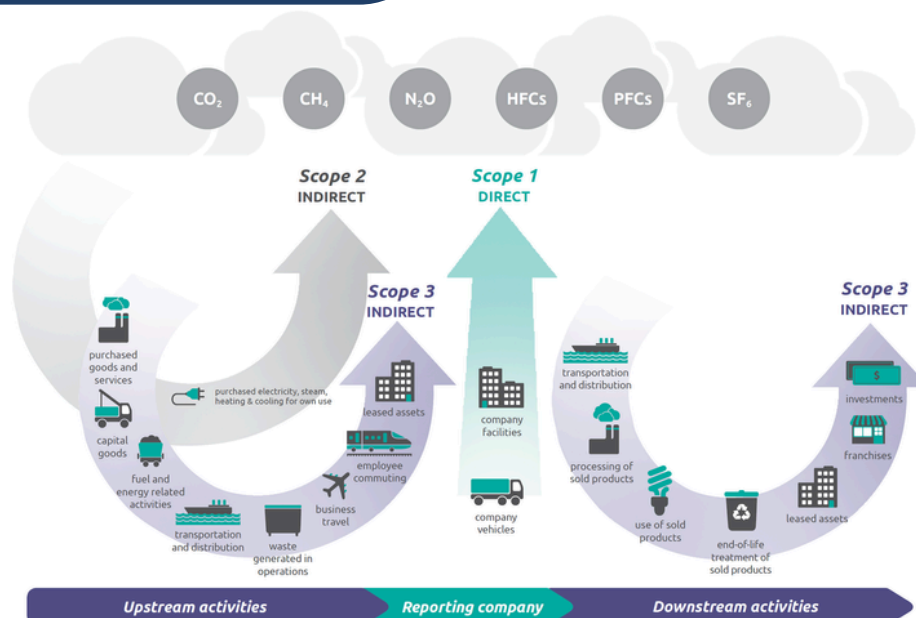
Source: *https://ghgprotocol.org/sites/default/files/standards/Corporate-Value-Chain-Accounting-Reporing-Standard_041613_2.pdf*

Method of Calculation

The quantification methods used to calculate GHG emissions for Queen's University were developed according to the WRI GHG Protocol for Corporate Accounting standard.

All fuel combustion and electricity consumption has been determined from invoice records and utility metering. These sources account for approximately 96% of Queen's GHG footprint. The remaining 4% is calculated based on estimations of non-metered sources such as fugitive releases from laboratory chemicals, refrigerant leakage, wood combustion and small fuel-consuming equipment.

Using emission factors, which are unique to each emission source, the raw data has been converted to metric tonnes of CO2 equivalent emissions (tCO2e). This allows for normalized comparison between different types of emissions sources.

The emission factors used in the calculations are based on national industry standards that tend to remain static for most fuels, with the exception of electricity. The grid emission factor used for electricity calculations fluctuates year to year depending on the Ontario electricity grid supply mix, and is published annually in Environment Canada's National Inventory Report. The Atmospheric Fund also provides estimates of the current year's grid emission factor, which is expected to change significantly in the coming years as more natural gas generation is added to Ontario's grid.

The data provided in this report was prepared by Queen's Facilities Energy & Sustainability Team. Any questions regarding the methods used to collect and calculate these values can be directed to sustain@queensu.ca.

2023 EMISSIONS OVERVIEW

Emissions Summary

Queen's University produced 32,772 tCO2e Scope 1 and 5,668 tCO2e Scope 2 emissions throughout 2023, summing to a total carbon footprint of 38,440 tCO2e. To determine Queen's net carbon footprint, the portion of emissions associated with energy exported off-site to Kingston General Hospital (KGH) was excluded.

Over three quarters of Scope 1 emissions on campus come from the Central Heating Plant (CHP) which is owned and operated by Queen's. The CHP produces steam with natural gas boilers for heating buildings, and intermittently produces electricity and steam with cogeneration turbines. In addition to serving Queen's Campus, the CHP also generates electricity and steam for KGH.

The total emissions produced by Queen's including exports to KGH in 2023 was 46,673 tCO2e. KGH demand from the plant was responsible for approximately 20% of that total, so that portion is removed from Queen's Scope 1 emissions. A summary of Queen's emissions is shown below in Table 1, including emissions normalized by population and area.

tCO2e is a metric tonne of carbon dioxide equivalents. This is a universal unit of measure that indicates the global warming potential (GWP) of each of the six greenhouse gases (CO2, CH4, N2O, HFCs, PFCs, and SF6) expressed in terms of the GWP of one unit of carbon dioxide. This enables the normalized summation of emissions from all GHGs).

	Queen's Emissions (tCO2e)
Scope 1	32,772
Scope 2	5,668
Total	**38,440**
Per Capita	1.15
Per 100 m2 Floor Space	5.27

Table 1: Summary of Queen's University's 2023 Scope 1 & 2 carbon emissions

Emissions Breakdown by Scope

Scope 1 Emissions

Scope 1 emissions are those emitted on site due primarily to energy generation and unintentional chemical release. A source by source breakdown of Queen's Scope 1 emissions is shown in Table 2. The greatest contributors to these emissions are the Central Heating Plant (CHP), which uses natural gas powered boilers to heat the campus in the winter, and stand alone heat generation in buildings that are not connected to the CHP. The remaining emissions are created by fuel combustion from the campus vehicle fleet, laboratory chemicals, and wood combustion.

Scope 1 GHG Sources	Total Emissions (tCO2e)
Net CHP Emissions	26,130
Natural Gas Use in Buildings	5,787
Refrigerant Leakage	519
Fuel Combustion in Equipment	291
Laboratory Chemicals	0
SF6 Leakage	17
Wood Combustion	28
Scope 1 Total	**32,772**
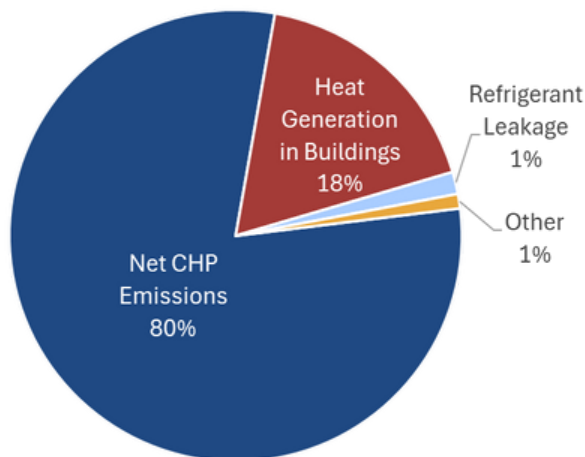
Table 2: Queen's Scope 1 emission source breakdown

Scope 2 Emissions

Scope 2 emissions are indirectly produced by the University through electricity usage in Queen's owned and leased buildings. A source by source breakdown of Queen's Scope 2 emissions is shown in Table 3.

The quantity of emissions produced by a kWh of electricity from the grid is calculated as an annual grid emissions factor, representing an average based on all forms of electricity production contributing to the provincial grid.
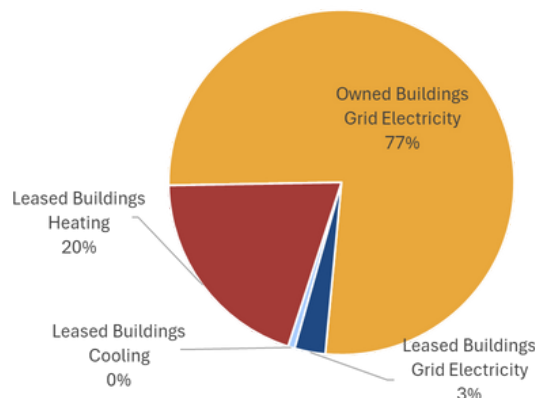

Scope 2 GHG Sources	Total Emissions (tCO2e)
Owned Buildings Grid Electricity	4,352
Leased Buildings Heating	1,117
Leased Buildings Grid Electricity	163
Leased Buildings Cooling	36
Scope 2 Total	**5,668**

Table 3: Queen's Scope 2 emission source breakdown

Emissions Over Time

From 2008 to 2023, Queen's has reduced its total GHG emissions from 57,716 tCO2e to 38,440 tCO2e. Figure 1 shows a year over year breakdown of Queen's total Scope 1 & 2 emissions. In 2020, the University was successful in reaching its goal of 35% emissions reduction from the 2008 baseline. Following this achievement, the university has experienced slightly increased carbon emissions attributed to COVID-19 ventilation measures and the addition of new campus buildings. Despite the adjustment of COVID-19 measures, 2023 has only seen a small decrease in carbon emissions compared to 2022. The lack of substantial decrease can be attributed to the opening of the new Endaayaan–Tkanónsote residence, and an increasing grid emissions factor.
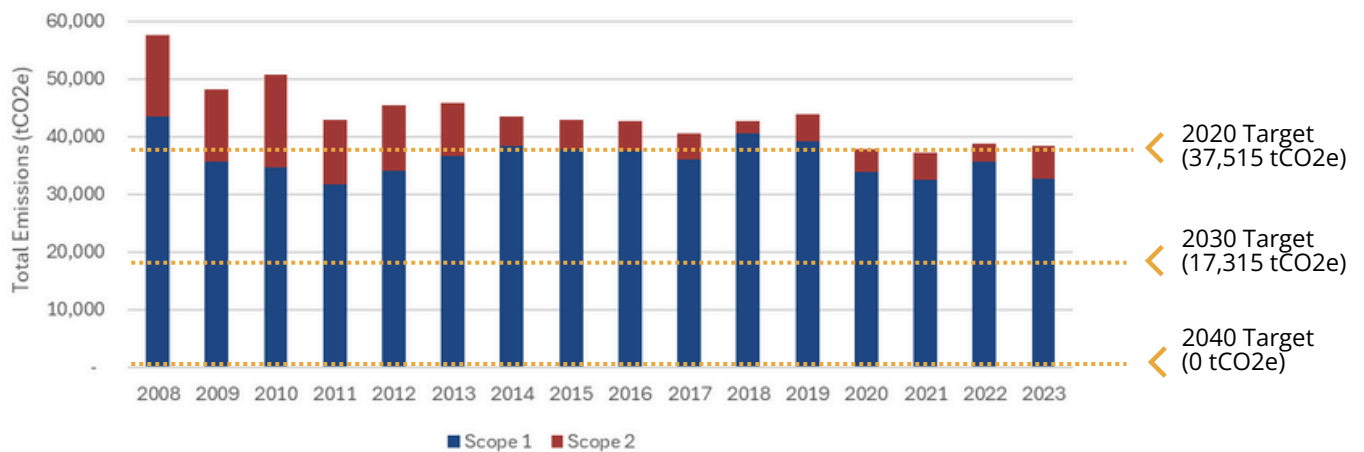

Figure 1: Queen's year over year Scope 1 & 2 GHG emissions and emission targets set in 2010

While Queen's observed marginally lower total emissions in 2023 compared to 2022, the University also experienced a decrease in emissions per unit of building floor space. As shown in Figure 2, there was a decrease from 5.02 tCO2e/100 m2 to 4.88 tCO2e/100 m2 from 2022 to 2023, indicating an overall improvement in energy efficiency. Even with significant campus and student growth, overall emissions have still been trending downwards, resulting in a 49.4% reduction in emissions per building area since 2008.
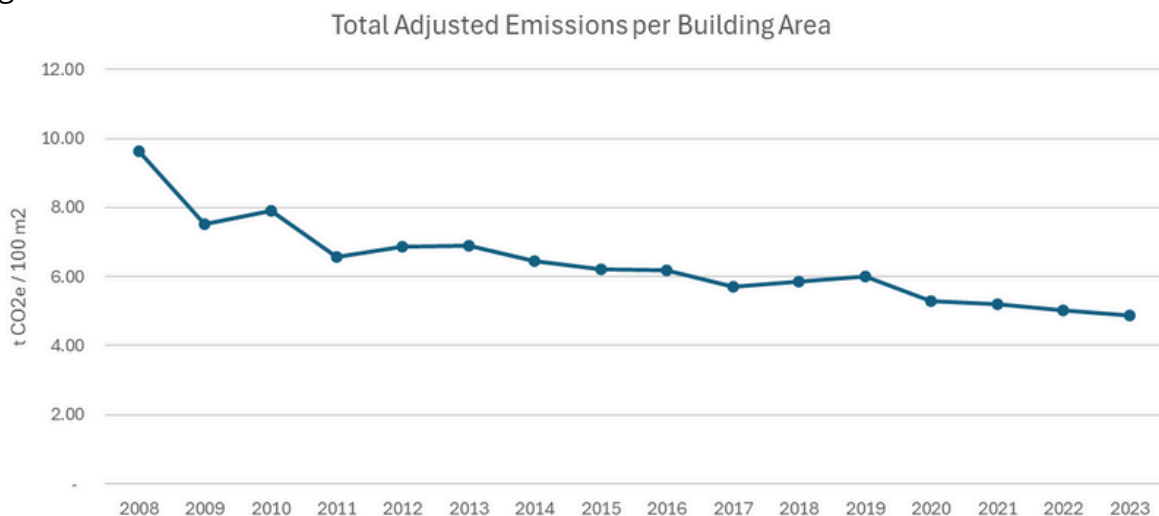

Figure 2: Queen's year over year total GHG Emissions per 100 m2 of campus building floor space

QUEEN'S CLIMATE ACTION PLAN

Outline

Queen's Climate Action Plan was established in 2016 to align with the goals set out by the University and College Presidents' Climate Change Statement of Action for Canada, signed in 2010. The three areas of focus for the original plan included reduction of point-of-use consumption, improving efficiency and fuels at the CHP, and actualizing the use of renewable energy generation. Queen's reached the goal of achieving a 35% reduction in emissions by 2020. Table 4 outlines the targets set in the Climate Action Plan.

Year	Target Emission Reduction	Actual Emission Reduction
2020	35%	35%
2030	70%	TBD
2040	100%	TBD

Table 4: Emission reduction target milestones

Some projects have already significantly reduced Queen's emissions, including the West Campus energy project which severed the steam line to West Campus eliminating heat losses along the 2.5 km path. Installing a new hot water distribution system on West Campus allowed Queen's to save 1,500 tCO2e annually from the decommissioning of that steam line. Since then, Queen's first large geothermal heating system at 355 King St. West has demonstrated the feasibility of efficient electrification of heating systems.

To continue improving the energy efficiency of Queen's buildings, there are multiple projects and policies that have been implemented. Updates to the Queen's Building Standard provide guidelines to ensure sustainability is considered for new projects and builds, eliminating fossil fuels from new designs, requiring efficient building envelopes, and heat recovery in ventilation systems. All new buildings are required to be Leadership in Energy and Environmental Design (LEED) Gold.

As noted in the Climate Action plan, updating the district steam system will be a focus to reduce emissions as heating on campus, both from the CHP and other natural gas boilers currently makes up 83.1% of all emissions.

Given the age and history of many buildings at Queen's, retrofitting and improving building envelopes and mechanical systems will be important to reducing carbon emissions. Minimizing load will help enable electrification, as well as lower cost of conversion to geothermal heating by reducing the required size of the system. Upgrading building controls, including scheduling and occupancy-based HVAC will be a primary focus moving forward to reduce energy consumption and cost - the most economical energy is the energy you do not use.

Emission Reduction Strategies

Queen's has eliminated over a third of its emissions since 2008 through a variety of clean energy projects and building upgrades. With parts of the main campus dating back as for as the mid 1800's, many of the buildings have benefitted from envelope renovations such as improved insulation and windows, as well as occupancy based controls for lighting and ventilation. Some of Queen's recent and upcoming carbon reducing projects are listed below.

LaSalle Building Recirculation - 2024

In 2024 a major energy-efficiency renovation is being performed at the LaSalle building. By reusing heated air instead of exhausting it during the winter, the new ventilation recirculation system for the old building is expected to reduce carbon emissions by 75 tCO2e/year. This represents an 80% decrease in the building's energy use for heating, one of Queen's largest sources of emissions.

### Strategic Lab Revitalization - 2023

In 2022 and 2023 a major upgrade to lab ventilation in Chernoff Hall was completed which is expected to reduce emissions by 780 tCO2e/year. This project adds occupancy sensors connected to the building automation system to match airflow to required ventilation based on lab occupancy. By managing exhaust according to need, the amount of fresh outdoor make-up air that must be heated or cooled as it is brought into the building is reduced, saving energy and emissions.

Demand Controlled Kitchen Ventilation - 2023

In cold climates commercial kitchen ventilation systems use a significant amount of energy to heat the make-up air that replaces the kitchen exhaust. In 2023 the ventilation in the Leonard Hall kitchen was upgraded to add a demand controlled system. Instead of running at full speed throughout opening hours, the system uses sensors to determine the amount of ventilation required, and vary the fan speed based on actual need. Savings are expected to be around 200 tCO2/year.

Replacement of 8,000 Fluorescent Fixtures with LED - 2022 to 2025

Over a 4 year period a major project to upgrade 8,000 fluorescent fixtures to energy efficient LED is happening in 20 buildings across campus. The resulting electricity savings will reduce Queen's Scope 2 emissions by an amount that will vary depending on the annual Ontario grid emissions factor. This project only becomes more efficient as the Ontario grid emissions factor is expected to grow in the near future.
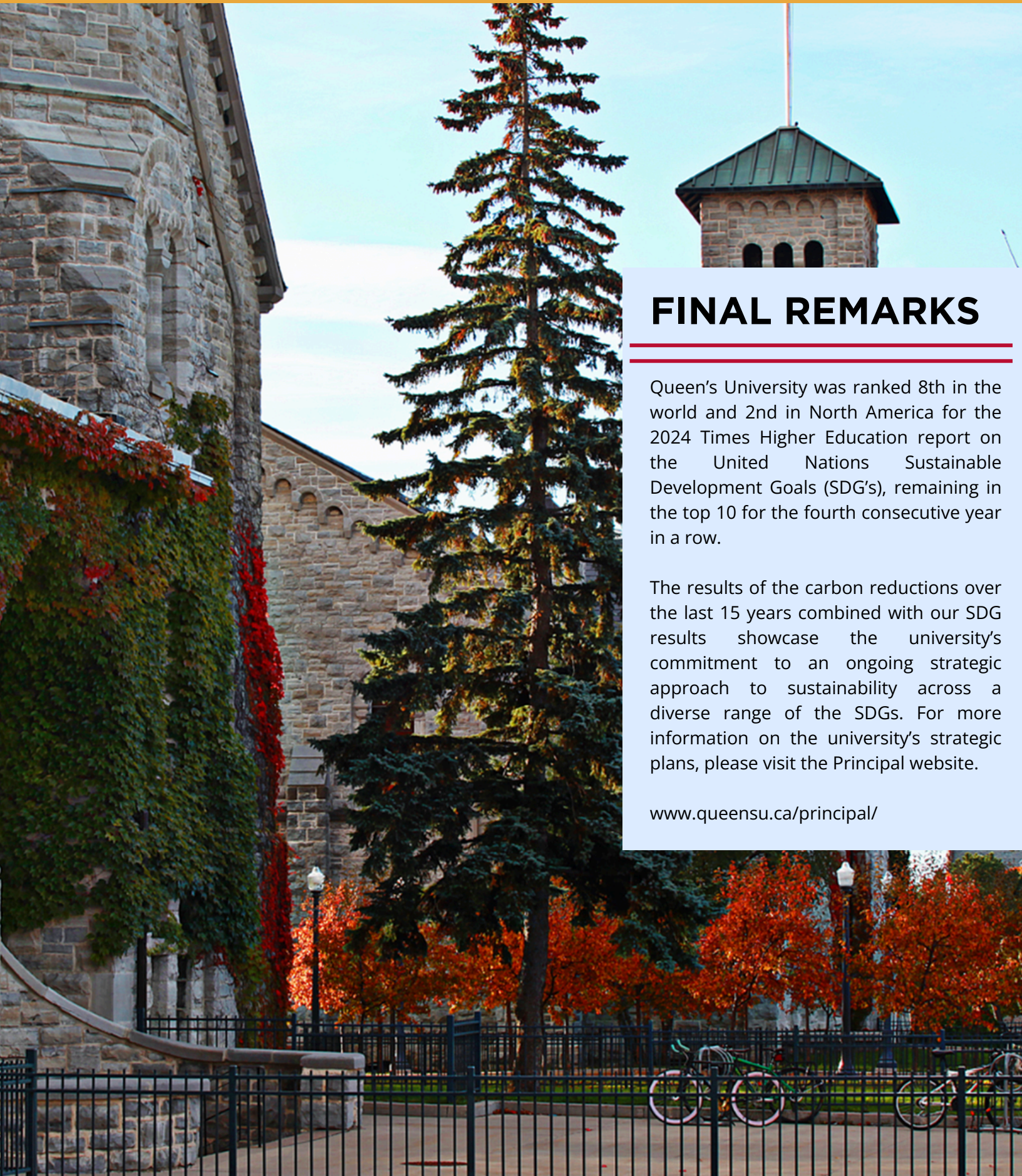
FINAL REMARKS

Queen's University was ranked 8th in the world and 2nd in North America for the 2024 Times Higher Education report on the United Nations Sustainable Development Goals (SDG's), remaining in the top 10 for the fourth consecutive year in a row.

The results of the carbon reductions over the last 15 years combined with our SDG results showcase the university's commitment to an ongoing strategic approach to sustainability across a diverse range of the SDGs. For more information on the university's strategic plans, please visit the Principal website.

www.queensu.ca/principal/