



Executive Summary

Overview of Energy Master Plan (EMP)



Sustainability
CARLETON UNIVERSITY



Carleton
UNIVERSITY

EXECUTIVE SUMMARY

OVERVIEW OF ENERGY MASTER PLAN (EMP)

Carleton University's Energy Master Plan (2021-2026) has a clear vision and objective – to develop a utility strategy for the campus to become carbon neutral by 2050. Building upon the university's previous energy master plans and the successful results of the initiatives implemented at various levels of the campus, this Energy Master Plan takes a holistic view of developing a strategic approach that will transform the campus' existing utility infrastructure to a low-carbon system. The master planning process considers and responds to the campus' existing utility infrastructure conditions, future capital development plan (2016 Campus Master Plan which will be updated in 2021), policies, programs, other strategic plans, and key performance drivers. The development of this plan was an iterative, collaborative process with key inputs from the university's Facilities Management and Planning (FMP) team, as well as professors and researchers. This plan outlines a carbon neutral strategy for the campus, identifies action items in the short and long-term, and provides an implementation framework that all reinforce performance reporting. This holistic roadmap will support the campus in transforming its utility infrastructure system and provide increased reliability and safety to its operation, to enable the university to continue its academic and research excellence and achieve its carbon reduction goals to becoming a carbon neutral campus by 2050.

OBJECTIVES AND GOALS

Carleton University has made a commitment to embedding continuous environmental and sustainable improvement in its operations. To build on our success and to further support these commitments, the university's objectives and purpose for this Energy Master Plan encompass the following:

1. Reduce Carleton University's Environmental Footprint:
 - Develop a phased plan to reduce GHG emissions and to meet the Government of Canada reduction targets by 2030 and become a carbon neutral campus by 2050
 - Develop a plan to expand current district energy infrastructure to support flexible campus growth
 - Utilize innovative generation, distribution and delivery technology to increase efficiency and lower our environmental impacts
2. Reduce Utility Operational Costs:
 - Optimize utility operation costs
 - Maximize the net economic benefit to Carleton by looking at renewable energy generation
 - Propose methods for substantial gains in building efficiency and thermal efficiencies within the production and distribution of building heating and cooling loads
3. Increase Reliability and Safety:
 - Increase the system redundancy and resiliency;
 - Mitigate the impact of operational failures and interruptions.

The Energy Master Plan is estimated to significantly reduce the campus' equivalent carbon emissions by 80% relative to 2005 levels, with the remaining 20% emissions to be offset via purchasing

carbon offsets, procuring renewable power purchase agreements, or developing offsite renewable system(s).

Approximately 25,600 metric tonnes of CO₂ will need to be reduced to achieve 80% reduction from 2005 levels, see Figure 1. The Energy Master Plan takes into consideration the campus' direct and indirect equivalent carbon emissions related to utility consumption; it does not include carbon emissions related to transportation and other areas including waste, food and materials.

Carleton has committed to becoming carbon neutral by 2050. By achieving that goal our impact on the environment will be significant as outlined in Figure 2.

As the consumption of natural gas on campus represents over 85% of its carbon emissions, the Energy Master Plan primarily focuses on a utility strategy that completely transforms the existing utility infrastructure on campus to a new low-carbon energy supply system. The utility strategy is to transition

the campus away from its legacy gas-based district steam heating system to a low temperature electric hot water system using electric boilers housed in three new nodal plants across the campus. In addition to resulting in deep reduction in carbon emissions, the utility strategy will also provide renewal to the aging existing utility infrastructure, enhancing the system's redundancy and resiliency to support the campus' operations. The nodal plant approach provides greater flexibility in phasing in construction and building transitions. The new low-temperature hot water system also enables greater design flexibility for the university to incorporate a wide range of efficient and renewable energy systems such as geothermal, sewage heat recovery and air source heat pump systems. The proposed utility strategy was selected after an extensive evaluation process which screened then analyzed a long list of technologies and strategies, see Figure 3. The process included the use of a performance evaluation framework incorporating criteria such as carbon emission reduction, costs, and technology integration. This was all done in collaboration with the university's stakeholders.

Figure 1 - Toward Net Zero Carbon

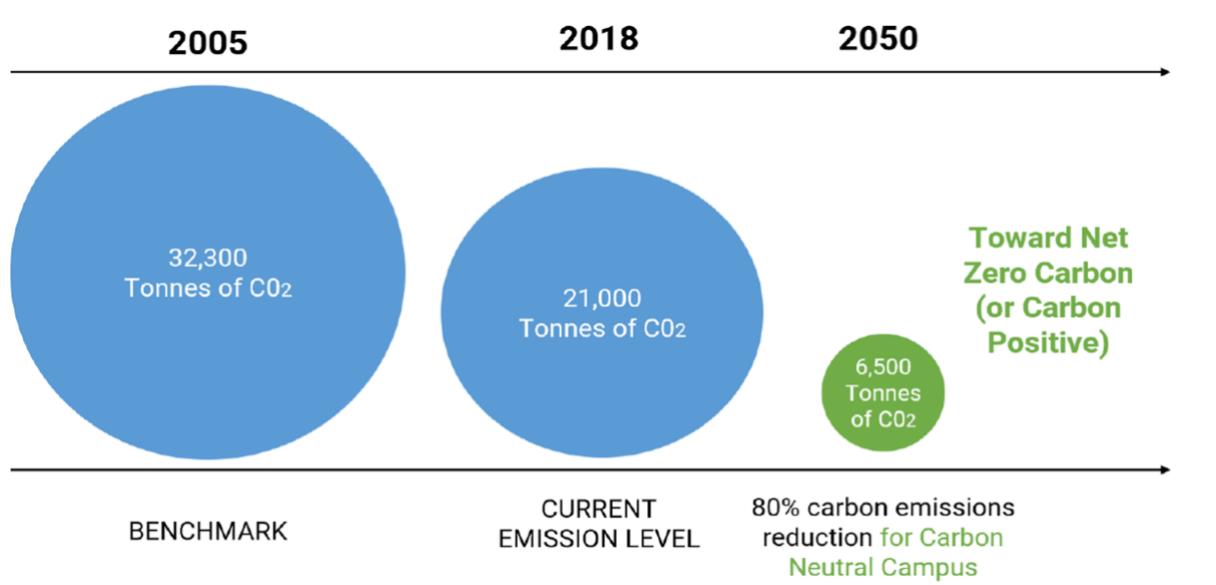


Figure 2 - Impact on the Environment

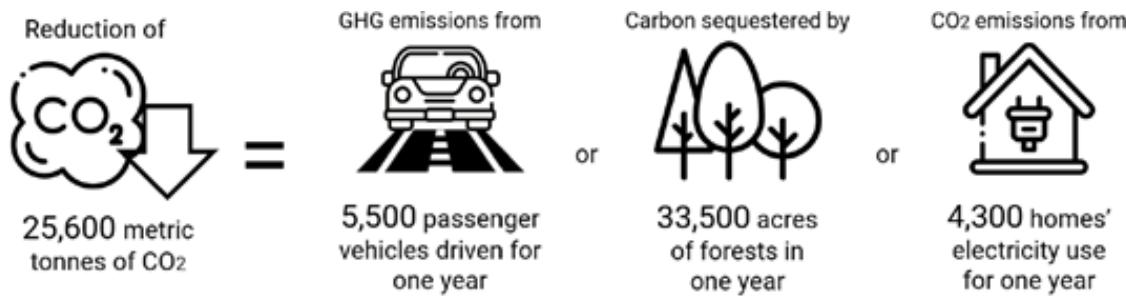
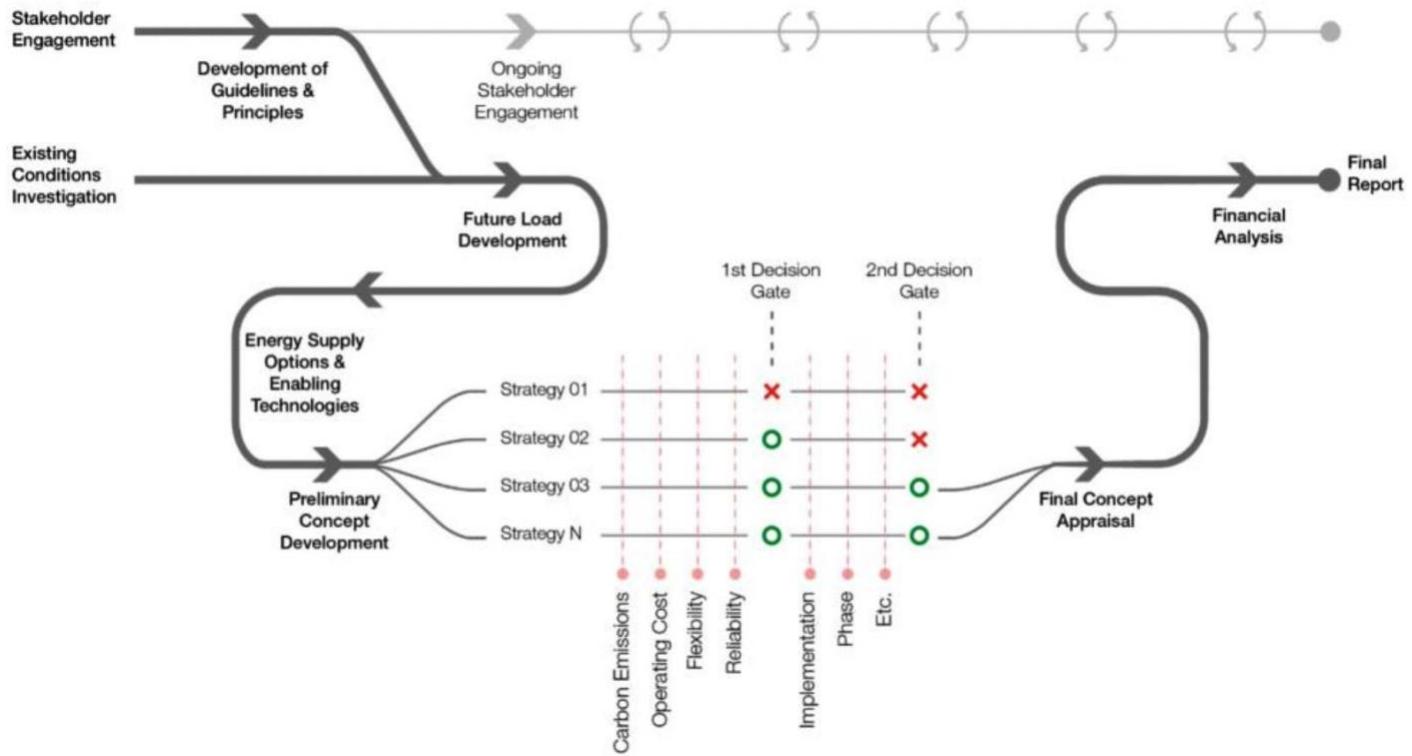


Figure 3 - Master Plan Process



ALIGNMENT TO CARLETON'S EXISTING STRATEGIES

This Energy Master Plan has been developed with consideration and recognition of Carleton's other campus-wide strategies and plans. Some of these strategies include the 2020 Strategic Integrated Plan (SIP), 2018-2019 Sustainability Annual Report, 2018-2021 Energy Master Plan, and the 2016 Campus Master Plan Update.

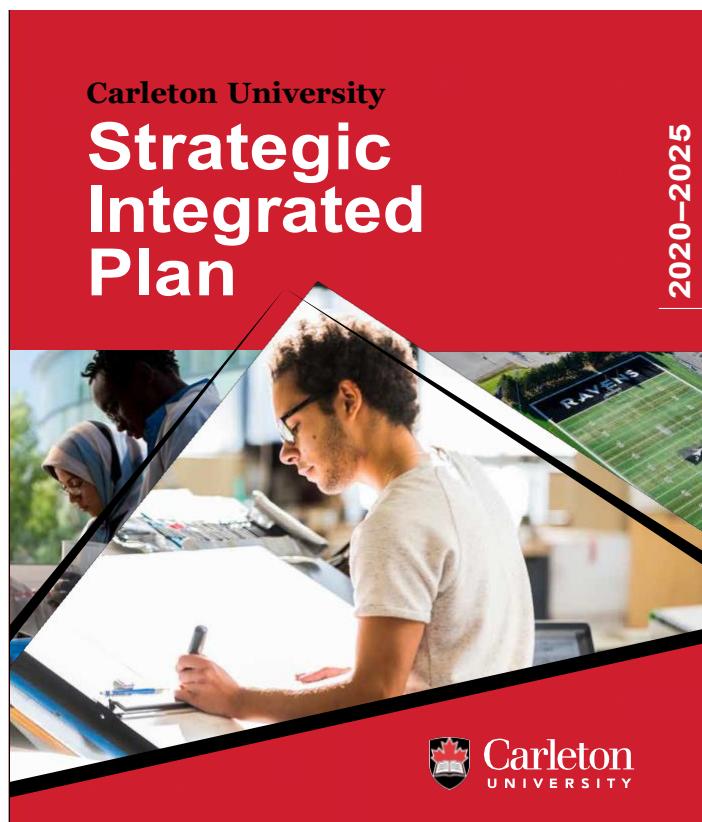
The SIP highlights three landmarks: the Rideau Canal, Bronson Avenue, and the Pasapkedjinawong (Rideau River) that converge around the campus and are used to frame Carleton University's three strategic directions:

Share Knowledge, Shape the Future
 Serve Ottawa, Serve the World
 Strive for Wellness, Strive for Sustainability
 (see Figure 4)

The Energy Master Plan supports the third strategic direction to promote and implement sustainable practices around the campus and within the university's operations. In alignment with the SIP, the Energy Master Plan is inspired by the Rideau River as a symbol to represent the resiliency and the responsibility required to curb climate change. The 2018-2019 Sustainability Annual Report highlights commitments and accomplishments from Carleton University which shaped this Energy Master Plan. Some notable achievements include 11 Green Globes-certified buildings and a 35 per cent reduction in emissions intensity

(since 2009), among others shown in Figure 4. Further information regarding sustainable initiatives adopted at the university can be found in the annual sustainability reports, as well as the Carleton Sustainability Plan. The previous Energy Master Plan (2018-2021) focused on initiatives that evaluated the future use of buildings located on the campus and existing building upgrades. Building on the foundation of the previous Energy Master Plan and to align with Carleton's goals, this new Energy Master Plan provides holistic approach and strategic directions to reduce the overall campus carbon emissions with a clear focus on the target of a 2050 carbon neutrality goal.

Figure 4 - Carleton's 2020 Strategic Integration Plan



QUICK FACTS

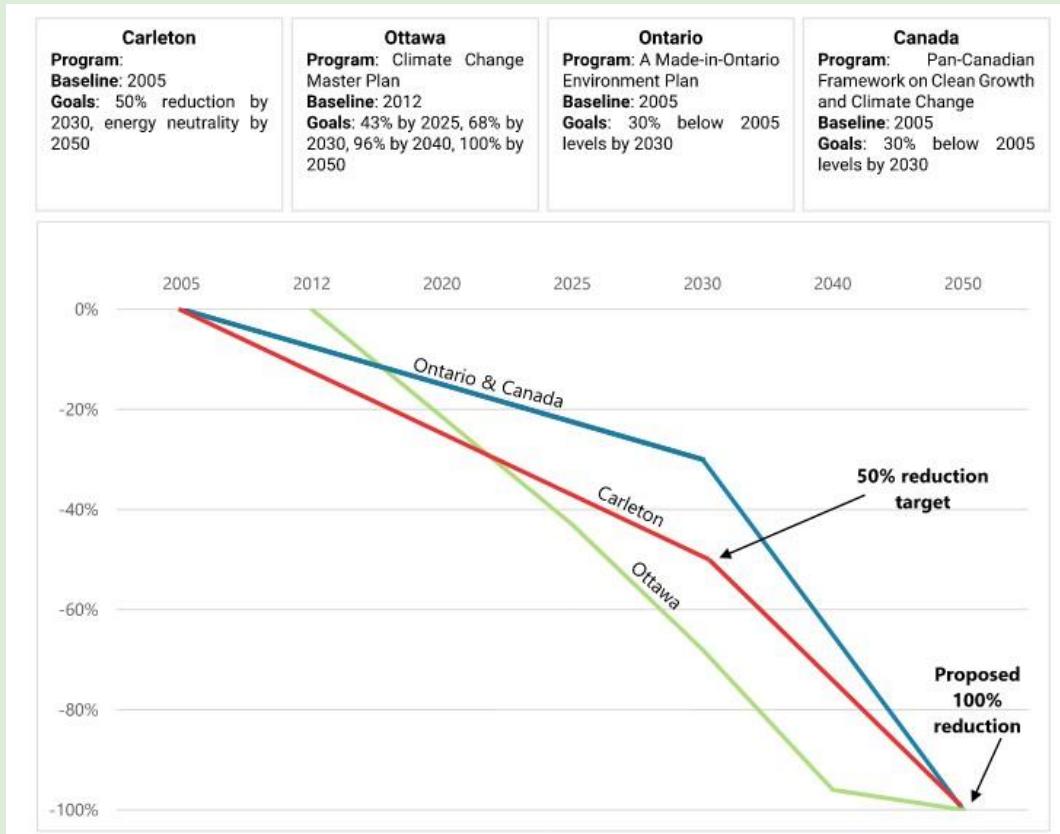


To achieve carbon neutrality, the campus will also require significant energy performance improvements to its existing buildings. In addition to building and infrastructure retrofits, the university will also need to develop more aggressive energy performance standards for future development and onsite renewable system integration.

The Energy Master Plan includes considerations and indicative performance requirement levels for building retrofits and new construction, but further analyses are required to set out definitive targets in these areas.

BENCHMARKING

A benchmarking exercise was completed against local, provincial, and federal policies, as well as peer universities. The exercise focused only on Scope 1 and Scope 2 emissions and target 2030 or 2050 which is in alignment with the Paris Agreement. Carleton University's commitment to be carbon neutral by 2050 is in alignment with many of the policies and universities investigated.



Onsite Renewable Energy | Second Nature – The Presidents' Climate Leadership Commitments <https://secondnature.org/signatory-handbook/frequently-asked-questions/>

In today's continuously changing world with rapid technological breakthroughs and advancement, changing business and economic landscape, and social and geopolitical uncertainties, a long-term strategic plan such as the Energy Master Plan will need to be updated periodically in the future to respond to the unpredictable and inevitable changes. The Energy Master Plan and the proposed

climate-neutral strategy was developed based on a holistic evaluation of key performance drivers, benefits, cost and risks. It is a pragmatic, bold step forward for Carleton University and the academic community at-large, paving the way for other similar institutions to respond to the climate emergency and providing a leading academic environment for students and research.

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