

Climate Change Operations Plan

2020-2030 | VERSION 3 (UPDATED IN 2022)



DALHOUSIE
UNIVERSITY

Acknowledgements

The 3rd version of the Dalhousie Climate Change Plan was prepared by The Dalhousie Office of Sustainability. The first version was released in 2010, with advice from the President's Advisory Council on Sustainability's Sub Committee on Climate Change and input from over 200 members of the campus and broader community. This 3rd version of the Plan includes all campuses (Halifax and Agricultural). Over 1500 campus and community members provided input through surveys, workshops, and local modelling. Contextual data has been updated to include recent scientific information along with global and national policy directions. Strategies have been refined based on literature, case studies, campus and community information, and a decade of experience working on University climate strategies.

Land Acknowledgment

Dalhousie sits on the unceded territory of the Mi'kmaq people and recognizes the interconnectedness of all our relationships—to the environment and to each other—for generations to come.

We recognize that African Nova Scotians are a distinct people whose histories, legacies and contributions have enriched that part of Mi'kma'ki known as Nova Scotia for over 400 years.



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Dalhousie recognizes and reports on the UN Sustainable Development Goals through reporting frameworks. This plan addresses Goal 13 Climate Action and connects to all of the other 16 goals.



Executive Summary

The science of climate change is indisputable. It is estimated that human activities have raised global temperatures on average of 1 °C in the last century. Canadian temperature projections show more than double the global warming trend. Global climate action will be required to curb emissions to a 1.5 degree increase by 2050 as outlined in The Paris Agreement. Limiting rapid climate change will require significant and sustained reductions of greenhouse gas emissions.

Universities and colleges play an important societal role in climate-related research, teaching, and engagement. As large land and building owners, the academic sector continues to make headway in reducing GHGs and adapting to climate change in our operations. This effort needs to match the current climate challenges of today and the future.

Based on the most recent research, regulatory and funding environments, and calls for action, updated targets have been created for Version 3 of the University Climate Change Plan. Federal and provincial targets use 2005 as a baseline year for measurement. Dalhousie's plan uses 2009–2010 as reliable data is available starting at this time. The difference between Dalhousie's building square footage between 2005 and 2009 is negligible.

Dalhousie's updated targets for scope 1 and 2 emissions include 30% reduction by 2025, 55% reduction by 2030, 80% reduction by 2040, and carbon neutrality before 2050. The science and situation is changing. Therefore the plans and targets will be reviewed for updates on a three year cycle. In addition, Scope 3 emissions (indirect emissions that occur in the value chain) will be reported on and action will be taken to influence reductions. Campus related climate modelling identifies warmer, wetter, and wilder climatic conditions. Key vulnerabilities on campus include buildings and energy infrastructure, hardscapes, storm-water systems, and trees and agricultural areas. A series of climate projects have been identified for continual action.



Key Goals of the Plan

- ▶ Reducing Greenhouse Gases
- ▶ Adapting to a Changing Climate
- ▶ Increasing Climate Change Knowledge through Key Action Strategies

Figure 1. Key Action Strategies

CAMPUS ENERGY SYSTEMS	GREEN BUILDINGS	SUSTAINABLE TRANSPORT	KNOWLEDGE AND BEHAVIOUR	NATURAL ENVIRONMENT	CARBON OFFSETS AND SINKS
<ul style="list-style-type: none"> ▶ Fuel conversion ▶ Co-generation ▶ District Energy ▶ Renewables ▶ Critical Infrastructure Resilience 	<ul style="list-style-type: none"> ▶ Recommissioning ▶ Major and Minor Buildings Retrofits ▶ New Construction 	<ul style="list-style-type: none"> ▶ Transportation Demand Management ▶ Greening Fleet 	<ul style="list-style-type: none"> ▶ Operations Changes ▶ Emergency Measures and Risk Planning ▶ Design Guidelines ▶ Space Utilization ▶ ReThink Program, Curriculum, Research 	<ul style="list-style-type: none"> ▶ Green and White Roofs ▶ Native Trees and Vegetated Swales ▶ Rainwater Harvesting ▶ Agricultural Lands ▶ Porous Systems 	<ul style="list-style-type: none"> ▶ Land Procurement ▶ Renewable Energy ▶ Local Offsets

To meet the next set of climate targets, investment will need to be stepped up. This will require continued allocation from existing sources of utility savings, facilities funding and external grants plus additional use of other financial instruments such as renewable energy purchasing agreements.

Each year, Dalhousie releases a Greenhouse Gas Inventory report which highlights emissions and compare these emissions to the established Climate Change Plan baseline and targets. This annual reporting provides transparency in meeting progress.

1.0 Current Context

Climate Change and Its Projected Impacts

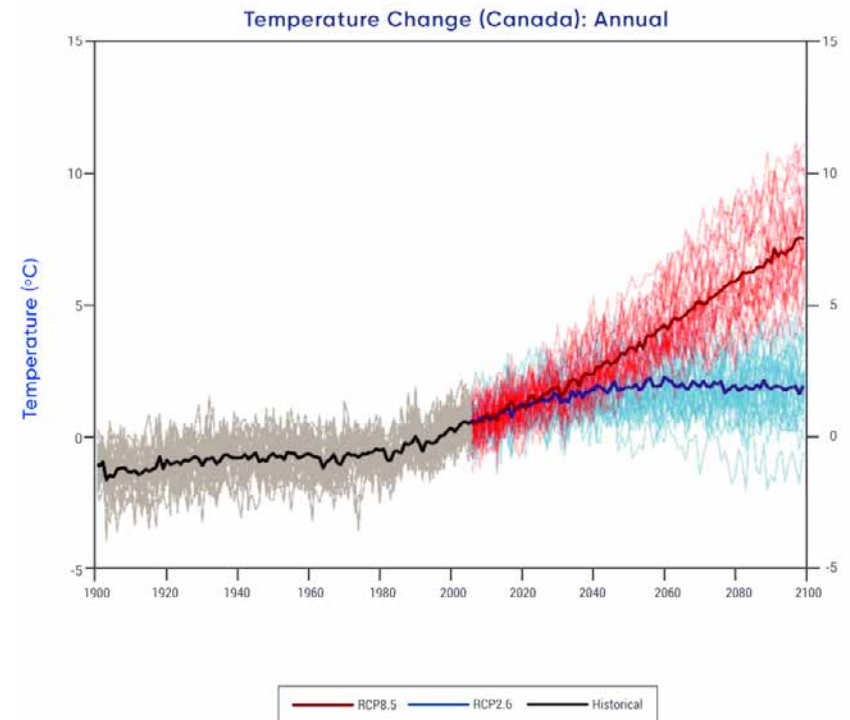
The science of climate change is indisputable. Global temperature and sea level rise, depletion of snow and ice cover, and a rise in atmospheric greenhouse gas (GHG) concentrations can be attributed in part to recent human activities. Recent IPCC reports document the magnitude of impacts are much broader and severe than noted in previous estimates.¹ Anthropogenic climate change is the product of decades of emitting GHGs such as CO₂ (carbon dioxide), CH₄ (methane), and N₂O (nitrous oxide) into the atmosphere. The build-up of GHGs in the atmosphere causes more energy to be reflected back to Earth, creating an increasing imbalance in the incoming and outgoing energy. This process produces a net warming effect and has the potential to warm the planet to temperatures never before experienced by species on earth.²

It is estimated that human activities have raised global temperatures on average of 1 °C in the last century. It is anticipated that global warming will reach 1.5 °C during the period of 2030–2052.³ For context, temperature has risen from 4 to 7 °C since the last ice age. Current temperature increases are ten times the rate of warming as compared to the ice age warm up period.⁴ These rapid climatic changes have impacts on biosphere adaptation processes.

The severity of impacts are felt differently across the globe. Increases in temperatures are associated with heat stress and an increase in vector-borne disease. Temperature and precipitation will affect food production and well-being. Particulate matter from fuel burning is associated with poor air quality and respiratory health.⁵ Ocean acidity and warming can destroy and change delicate ecosystems.⁶

Warming is more prevalent in northern latitudes and over land.⁷ Canadian temperature projections show double the global warming trend (Figure 2). Other impacts include ocean acidification, more annual precipitation, summer dry spells, and coastal and urban flooding.⁸ In Atlantic Canada, sea level rise is projected to be greater than the global mean due to regional land subsidence, and a gradual collapse in the Earth's crust due to the retreat of the North American ice sheets⁹.

Figure 2. Annual Temperature Change in Canada. Bush and Lemmen, 2019.



Global climate action will be required to curb emissions to a 1.5 °C increase by 2050 as outlined in The Paris Agreement. If temperatures rise to 2 °C, the IPCC Global Warming Report¹⁰ identifies the increasing severity of impacts. Limiting climate change will require substantial and sustained reductions of greenhouse gas emissions.¹¹

Climate Change Adaptation and Mitigation

Adaptation to climate change is the process of adjusting to the warming climate to reduce or avoid harm. Climate change mitigation involves reducing carbon emissions and enhancing carbon sinks with the aim of stabilizing GHG concentrations within a time-frame that would grant human and natural systems time to adapt to climate change.¹² Reducing climate change through mitigation strategies can help to reduce the associated risks of rapid climate change.

Climate Change Planning for Halifax and Colchester County

Halifax

Dalhousie's Halifax campuses, Studley, Sexton, and Carleton, stretch west to east across Halifax's urban peninsula. Given the University's close proximity to the Halifax harbour, rising sea levels and intensifying storm surges pose risks to residents, property, and infrastructure in the area.¹³ Extreme weather events in 2003 and 2004 prompted Halifax Regional Municipality's (HRM's) development of ClimateSMART (Sustainable Mitigation & Adaptation Risk Toolkit).

A 2010 update sought to develop and maintain management and planning tools to adapt to climate change impacts and to reduce the emission of GHG's.¹⁴

In 2012, the municipality undertook the development of a municipal climate change action plan (MCCAP). In 2019, HRM launched a renewed climate change planning process involving many sectors in the process. In 2020, after an in-depth engagement and climate modelling period, Halifax launched its updated climate plan titled HalifAct.¹⁵ Initial action focuses on retrofit and renewable energy, retrofit municipal buildings to be net-zero ready and climate resilient, electrification of transportation, net-zero standards for new buildings, risk and vulnerability assessments, capacity building for climate adaptation and sustainable financing. In 2021, the Municipality of the County of Colchester released the Community Energy and Emissions Plan highlighting a number of key strategies.¹⁶

In HRM, Dalhousie's Studley and Carleton campus are on high points on the peninsula while the downtown Sexton campus is not on the water but at lower levels of elevation (Figure 3, 4, and 5). A review of sea level rise scenarios identified a 30-meter Large Tsunami event as having impact on the Sexton campus.¹⁷ Dalhousie will connect climate change efforts with the local municipalities that the University resides in.

Coastal erosion on McNab's Island Halifax Harbour. Rochelle Owen, 2018.



Figure 3. Studley Campus Elevation Map.
Yvonne Ritchie, 2018.

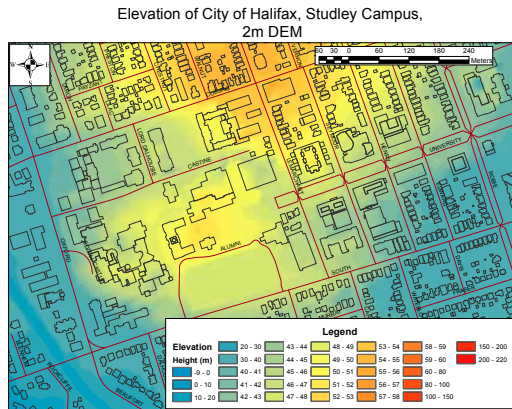


Figure 4. Carleton campus Elevation Map.
Yvonne Ritchie, 2018.

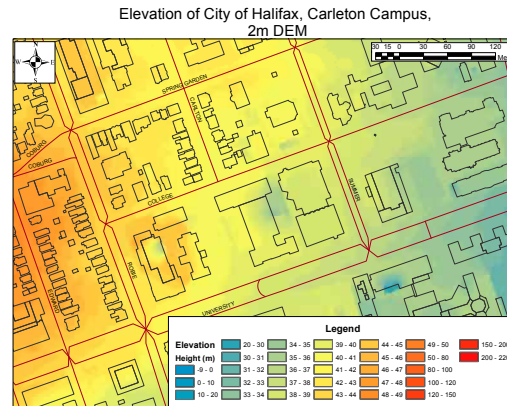


Figure 5. Sexton Campus Elevation Map.
Yvonne Ritchie, 2019.

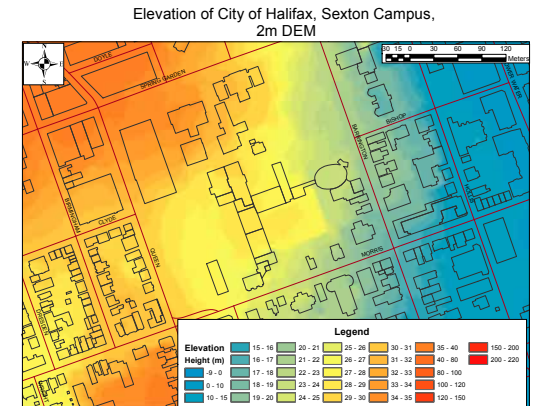
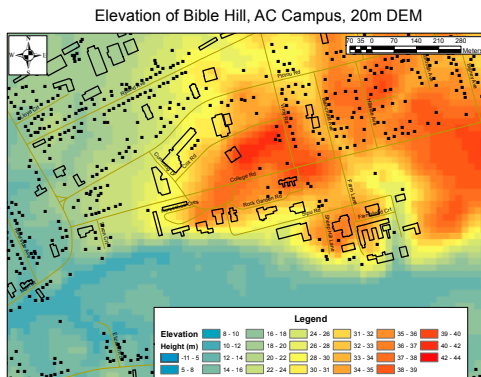


Figure 6. Agricultural Campus Elevation Map.
Yvonne Ritchie, 2018.



Colchester

Dalhousie’s Agricultural campus (AC) is located in the village of Bible Hill, NS, on a hill just outside of Truro in Colchester County (Figure 6). Truro’s location on a flood plain makes it particularly vulnerable to inland flooding. An increase in sea-levels as well as an increase in the variability and intensity of precipitation events have been felt across the community. A 2003 flood affecting the Oxford and Truro areas resulted in over \$25 million in damages, approximately 270 people being evacuated and two fatalities.¹⁸

The issue of inland and storm tide flooding is being addressed by the Town of Truro and County of Colchester with a variety of short and long-term measures. A flood-risk study conducted by a local engineering firm outlined a number of strategies including reducing upstream flows, increasing downstream flow capacities, and bolstering existing dykes, among other structural developments.¹⁹ The Mi’kmaq Conservation Group performed assessments of water utilities for three First Nations communities in NS in the area, and found strategies such as water conservation planning and installing back-up generators could be effective strategies for addressing vulnerabilities.²⁰

University Response

Universities and colleges play an important societal role in climate-related research, teaching, and engagement. As large land and building owners, the academic sector continues to make headway in reducing GHGs and adapting to climate change in our operations.

On December 11, 2009, Dalhousie's President signed the University and College's Climate Change Statement for Canada. A commitment to this statement required that within one year of signing this document, a comprehensive inventory of greenhouse gas emissions is completed and within two years of signing this document, a climate plan with targets is released. In 2010, Dalhousie released the first University Climate Change Plan. Each year, a Greenhouse Gas Inventory is published outlining progress. Every three years, mitigation and adaptation strategies are reported on through International Sustainability Tracking Assessment Rating System (STARS) and a University Progress Report. Version 3 of the Climate Change Plan (2022) builds on the work and achievement realized in the first plan. Importantly, it highlights direction for operations action for the next decade.

Permeable pavers

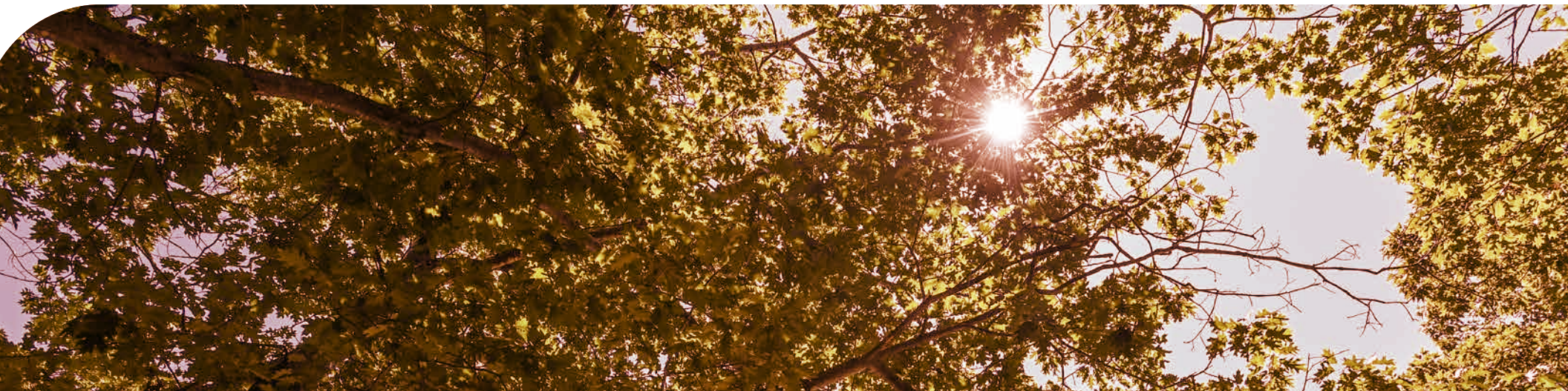


2.0 Plan Development and Management Timeline

Dalhousie operational climate change planning is an iterative process of major plan releases, ongoing research and action, and campus and community engagement (Figure 7).

Figure 7. Timeline information.

2008–2009	2010–2011	2012–2013	2014–2015	2016–2017	2018–2019	2020–2021
<ul style="list-style-type: none"> ▶ Climate change meetings ▶ Developed model for Sustainability Business Cases to fund projects ▶ Dalhousie signed University and College Presidents' Climate Change Statement of Action 	<ul style="list-style-type: none"> ▶ Ad-hoc subcommittee ▶ GHG reduction strategy workshop ▶ Vulnerability assessment survey and adaptation strategy ▶ GHG Inventory created ▶ Release of First Climate Plan 	<ul style="list-style-type: none"> ▶ AC climate model created ▶ Published academic paper on operational adaptation planning process ▶ AC climate change survey 	<ul style="list-style-type: none"> ▶ Energy Committee created ▶ Climate questions as part of Annual Sustainability Survey) over 1100 completed responses 	<ul style="list-style-type: none"> ▶ AC adaptation planning workshop 	<ul style="list-style-type: none"> ▶ Research into NS land protection as a carbon sink strategy ▶ Stormwater mapping information gathering 	<ul style="list-style-type: none"> ▶ Presentation and research on off-site renewable energy options ▶ Feedback gathered on Version 2 of the Plan ▶ Version 2 Release of the Climate Change Plan (updated every three years)
<p>ONGOING GHG Inventory reporting, Sustainability reporting, Sustainability and Climate project planning and implementation, Presentations</p>						



3.0 Vision, Principles, and Scope

Vision

Dalhousie University is an institutional model for reducing greenhouse gases and exploring carbon sinks, implementing adaptation strategies, and increasing knowledge of climate change issues of students and employees.

Principles

The guiding principles align with many principles of the HalifACT plan including equity, leadership, accountability and transparency, action focused, and integrated.

Scope

The scope of this plan focuses on University operational climate objectives. At Dalhousie, climate change focused research, teaching, governance, and student action is also taking place. Dalhousie participates in the International Sustainability Tracking Assessment Rating System (STARS). Through the STARS program, institutional-wide climate and sustainability actions are reported, and assessed for future decision-making.

The first climate change plan (2010) outlined baseline reductions for Scope 1 emissions that are directly owned and controlled by the University (onsite use of energy and refrigerants for heating, cooling, and fleet) and Scope 2 emissions that are indirect energy emissions purchased by the University (purchased electricity). In this last decade, Dalhousie and partners have invested over \$100 million dollars in sustainability projects. Many of the suggested strategies from the first climate action plan have been implemented.

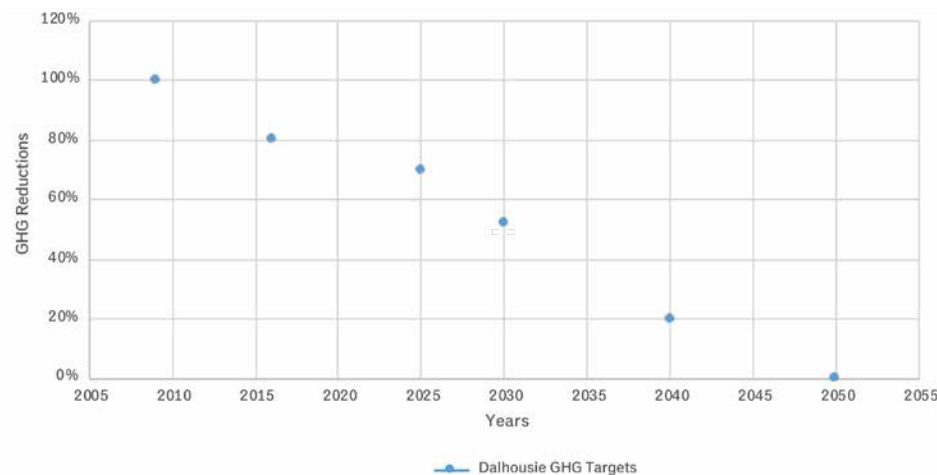
Since the release of the first plan, Dalhousie merged with the Nova Scotia Agricultural College, adding an additional campus to the climate change plan work and targets. The University also grew in building square footage and population by close to 1.5% each year (15% growth over a decade). Dalhousie has met phase 1 and 2 targets of the 2010 plan of a 20% reduction below 2009–2010 baseline year for Scope 1 and 2 emissions as documented in the annual greenhouse gas inventory. An aggressive phase 3 target of 50% below 2020 required the implementation of a Halifax district energy co-generation project and electrical grid reductions. Some of these actions are underway but are not all realized by 2020.

Based on the most recent research, current regulatory and funding environments, and calls for action, updated targets have been created for the Version 3 of the University Climate Change Plan. Federal and provincial targets use 2005 as a baseline year for measurement. Dalhousie's plan uses 2009–2010 because reliable data is available starting at this time.

The difference between Dalhousie's building square footage between 2005 and 2009 is negligible (less than 1%).

Canada has committed to reduce GHG emissions by 40% below 2005 levels by 2030.²¹ Dalhousie's updated targets for scope 1 and 2 emissions include 30% reduction by 2025, 55+% reduction by 2030, 80% reduction by 2040, and carbon neutrality before 2050. In addition, Scope 3 emissions (indirect emissions that occur in the value chain) will be reported on and action will be taken to influence reductions (Figure 8). Targets will be reevaluated as the science changes.

Figure 8. Dalhousie University GHG targets.



4.0 Benchmarking

GHG Inventory

Dalhousie's first baseline year covers the period of April 2009 - March 2010 fiscal year. The annual GHG inventory report is developed using CSA ISO 14064-1:2006(E) guidelines and is published annually on the Office of Sustainability website. The inventory covers University owned and operated facilities spread across the four campuses (Studley, Carleton, Sexton, and Agricultural). Most regulatory bodies require reporting on Scopes 1 and 2. Dalhousie is not currently mandated to meet regulatory targets; however, we have set our targets and reporting structure to be in line with regulatory programs. Greenhouse gases and other air quality parameters are reported to federal and provincial bodies for Dalhousie owned central heating plants. For educational and action purposes, Scope 3 commuting factors are also reported on in GHG reporting. Other Scope 3 emissions are calculated in annual greenhouse gas reports, as data becomes available for analysis. Broader Dalhousie University Sustainability Planning and Reporting frameworks have key performance indicators for Scope 1, Scope 2, and Scope 3 emissions.

Scope 1: Direct GHG emissions and removals

- ▶ Fuel used to create steam, hot water, cooling, and electricity generated and distributed through the district heating/ cooling networks from the central heating plants within organizational boundaries
- ▶ Fuel for on-site combustion in smaller houses and few buildings not connected to the district heating system and fuel for backup generators
- ▶ Mobile combustion of vehicle fleet
- ▶ Fugitive refrigerant losses from units on campus

Scope 2: Energy indirect GHG emissions

- ▶ Indirect emissions from the generation of imported electricity used on campus

Scope 3: Other indirect GHG emissions

- ▶ Students, staff, and faculty commuting
- ▶ Inclusion of other sources of emissions, based on internal reporting needs or intended use of the inventory

Figure 9. Quantitative summary of Dalhousie's GHG emissions for 2009–2010 baseline for Halifax and AC campuses.

EMISSIONS SUMMARY TONNES	TONNES OF CO2e
Scope 1: Stationary Combustion, Refrigerants, Mobile Combustion (Fleet)	40,122
Scope 2: Purchased Electricity	66,066
Scope 3: Commuting Travel	19,622

Climate Modelling for Halifax and Agricultural Campuses

An Environment & Climate Change Canada (ECCC) report outlined statistical climate modelling procedures and results for 14 communities in the Atlantic region. Daily maximum and minimum temperature as well as total precipitation data from 1961–1990 were downscaled using a Statistical Downscaling Model and used as input into two Global Climate Models (GCM's). The report showed that under current conditions temperatures for the Halifax area are projected to increase by approximately 4 °C by 2100, and that the growing season length is projected to increase by approximately 15% by 2100. Rainfall frequency is expected to increase by 12% by 2100, and 100-year extreme rainfall events are projected to become 50-year events.

In November of 2013, the Office of Sustainability staff, with the support of Gary Lines, developed climate scenarios using bioclimate profiles for the newly merged Agricultural campus (AC).²² These profiles were based on historical temperature and precipitation data, and were used to generate GCM's from ECCC online modelling tool at the Canadian Climate Change Scenario Network's website. The five models selected from the 65 available were chosen as the five that most accurately predicted historical data. The time periods modelled were the tri-decade periods 2020s (2011–2040), 2050s (2041–2070), and the 2080s (2071–2100). The profiles modelled were "Temperature: Mean, Max and Min", "Frequency of Precipitation", and "Accumulated Precipitation".

The models projected average temperature increases of 3.5 °C – 5 °C during the 2080's compared with baseline data, as well as increases of 3.5 °C – 4.5 °C and 3 °C – 5 °C in extreme maximum and minimum temperatures respectively over the same time period. The models projected a 16% increase in the frequency of rain events and a decrease of 20% in snow events by the 2080s, and an approximately 10% increase in accumulated precipitation by the 2080s. However due to the projected increase in evapotranspiration, the increased levels of precipitation may not offset the expected rise in water deficit and fall in water surplus. Modelling trends for all campuses showed similar themes (Table 1).

Table 1. Results of climate modelling data without any global action

All Campuses (Halifax and Agricultural)

Key Themes	<ul style="list-style-type: none"> ▶ Daily maximum temperatures are projected to rise by approximately 4 °C by 2080–2100. ▶ Growing season length is projected to increase by 15–16% by 2080–2100. ▶ Rainfall frequency is expected to increase by 10–12% and 100 year extreme rainfall events are projected to become 50 year events by 2080–2100.
Implications	<ul style="list-style-type: none"> ▶ Vulnerabilities to people (ex. heat stroke). ▶ Vulnerabilities to the built environment (ex. rain/snow/wind damage, flooding, freezing pipes, backed up storm drains). ▶ Vulnerabilities of services (ex. loss of power, impaired transportation, food availability). ▶ Higher temperatures may result in a decrease in space heating needs in the winter, and an increase in space cooling needs in the summer months. ▶ There will be an increase in the length of the growing seasons of crops. ▶ Even with increased precipitation, higher temperatures can result in an increase in water deficit.

Campus Mitigation and Adaptation

Campus mitigation and adaptation information is collected through surveys, workshops, observations, implementation of projects, mapping exercises, and sampling. Over 1500 campus members provided feedback in 2010, 2013, 2015, 2016, 2020 surveys on priority areas for climate mitigation (Table 2) and adaptation vulnerabilities (Table 3). Surveys are used periodically to gather information.

Campus energy systems are rated as a high-profile area of action. Knowledge and behaviour and sustainable transportation were rated high in some surveys and low in others while green buildings and renewable energy systems were always rated medium to high strategies. Other themes raised by respondents included the importance of waste management including food reduction, moving towards plant-based diets, public transit, water reductions, and fossil fuel divestment.

Respondents from all campuses identified energy & built infrastructures as the highest vulnerabilities.

Storm water systems and agricultural lands were rated a higher priority by members of the Agricultural campus. Low-level flooding issues are pronounced in the surrounding flood plain beside the Agricultural campus.

Table 2. Priority Areas for Climate Mitigation

Highest to Lowest Priority Actions for University GHG Reduction Efforts

High	▶ Campus Energy Systems
Medium	<ul style="list-style-type: none"> ▶ Green Building ▶ Renewable Energy ▶ Sustainable Transport ▶ Knowledge and Behaviour
Low	▶ Carbon Offsets & Sinks

Table 3. Key Climate Vulnerabilities and Impacts

Highest to Lowest Priority Vulnerabilities for the University	Vulnerabilities	Impacts
High	<ul style="list-style-type: none"> ▶ Energy Infrastructure ▶ Built Infrastructure ▶ Storm-water systems ▶ Agricultural lands 	<ul style="list-style-type: none"> ▶ University closed: Classes, research and health services cancelled ▶ Commuting and research disrupted ▶ Transportation Delays – goods (food, fuel)
Medium	<ul style="list-style-type: none"> ▶ Roadways, paved areas ▶ Trees 	<ul style="list-style-type: none"> ▶ Housing impacts – Students in residence ▶ Financial – increased funding to address impacts
Low	<ul style="list-style-type: none"> ▶ Green spaces 	

Identified vulnerabilities were further analyzed during two climate change workshops (one in Halifax and one at the Agricultural campus), mapping exercises, and adaptive management processes (Table 4).

Table 4. University Specific Climate Change Vulnerabilities and Risks

VULNERABILITY	RISK (Probability and Impact)
Energy	
▶ Downed transmission lines (most likely from severe wind events)	High
▶ Changes in laboratory environments that threaten research animal health, interrupt research, disrupt hazardous material handling	High
▶ Hypothermia if students/staff/faculty on campus without heat	Low
Built Environment	
▶ Flooding of Data Centre Services below grade	High
▶ Collapse or damage to vulnerable roofs from ice/snow	High
▶ Flooding on or around campus	High
▶ Freezing pipes causing flooding and water damage	Medium
▶ More weather impacts (precipitation, wind, freeze/thaw, ice, heat) on the building envelope and outdoor surfaces	Medium
▶ Impacts on the tunnels that supply buildings with electricity, heating, cooling	Low
Natural Environment	
▶ Damage to foliage, weakened trees (from pests and winds)	High
▶ Erosion	Medium
▶ Damage to agricultural lands	Medium
▶ Seasonal water shortages impacting campus lands and usage	Low
Transportation	
▶ Impaired transportation systems through flooded roads and lands from increase precipitation and tree fall	Medium
▶ Roads damaged in winter through increased freeze and thaw cycles	Medium
Other	
▶ Respiratory distress or heat stroke (people and animals)	Medium
▶ Falls as a result of snow/ice, with financial liability	Medium
▶ Housing impacts in surrounding community and/on campus (ex. more severe storms causing impacts to housing)	Medium-Low

5.0 Goals, Actions and Targets

Climate change strategies are framed as key goals, objectives, and actions. Goals relate to mitigation, adaptation, and education outcomes. Objectives are tangible changes needed to realize goals. Actions are specific project areas for implementation. Each action area has a specific description for GHG reduction, adaptation, and/ or education targets.

Goals

Reduce Greenhouse Gases

Adapt to a Changing Climate

Increase Climate Change Knowledge

Objectives

- ▶ Increase conservation behaviour
- ▶ Increase energy and water efficiency efforts
- ▶ Switch to low emission and renewable sources for energy and transportation
- ▶ Improve efficiency of District Energy Systems through strategies like co-generation and steam to hot water conversions
- ▶ Carbon offsets
- ▶ Increase energy security
- ▶ Outline climate risks in University plans
- ▶ Improve resiliency of natural and built systems to severe weather
- ▶ Offer experiential education programs to students and employees that increase knowledge of climate science and focus on changing behaviour on and off campus
- ▶ Increase awareness of campus climate action
- ▶ Teaching and research on climate change issues

Campus Energy Systems

- ▶ Fuel conversion
- ▶ Co-generation
- ▶ District Energy
- ▶ Renewables
- ▶ Critical Infrastructure Resilience

Green Buildings

- ▶ Recommissioning
- ▶ Major and Minor Buildings Retrofits
- ▶ New Construction

Sustainable Transport

- ▶ Transportation Demand Management
- ▶ Greening Fleet

Knowledge and Behaviour

- ▶ Operations Changes
- ▶ Emergency Measures and Risk Planning
- ▶ Design Guidelines
- ▶ Space Utilization
- ▶ ReThink Program, Curriculum, Research

Natural Environment

- ▶ Green and White roofs
- ▶ Native Trees and Vegetated Swales
- ▶ Rainwater Harvesting
- ▶ Agricultural Lands
- ▶ Porous systems

Carbon Offsets and Sinks

- ▶ Land procurement
- ▶ Renewable energy
- ▶ Local carbon offsets

Campus Energy Solutions

Actions

Fuel conversion

Explore options for lower carbon heating fuels such as renewable gas, anaerobic digestion, and other options.

Co-generation

Co-generation is a major energy efficiency strategy for district energy systems. Fuel is used in a turbine or generator to create electricity then waste heat from the combustion process is used to create hot-water and/or steam for heating or cooling. The Agricultural campus's district energy system has been recently upgraded to include a co-generation system and hot water network. Dalhousie Halifax campuses are a strong candidate for low carbon fuel fired co-generation because of consumption profiles and consistent loads, a district heating network that feeds Dalhousie and other entities, and our use of central cooling. Co-generation can provide electricity back-up in case Dalhousie is isolated from the power grid. This creates an energy secure environment for research, data services, and residents. Options analysis for co-generation implementation is ongoing.

District Energy (DE)

Over 95% of all Dalhousie buildings on the Halifax and Agricultural campus are connected to a district energy network fed by a Central Heating Plant. Converting from steam to hot-water for campus heating can realize up to 30% energy efficiency gains. In the last decade, the Agricultural and Sexton campuses have been converted from steam to hot water. In the next decade, a focus will be on steam to hot-water conversions at the Studley and Carleton campuses.

Renewables

In the last decade, nine solar installations have been implemented on campus. In our experience, solar photo voltaic (PV) systems on campus buildings provide roughly 5-25% of the building electricity load. Adding renewable technologies to new and existing buildings and securing potentially 100% of electricity through off-campus renewable energy (such as wind and solar) is a key strategy to achieve more aggressive carbon targets.

Critical Infrastructure Resiliency

Climate change impacts such as increased and intense precipitation and wind and ice storms creates vulnerabilities for critical infrastructure services. Key strategies include burying power lines, upgrading building envelopes, assessing and implementing emergency generation/ cogeneration for key facilities, upgrading water infrastructure vulnerabilities, and relocating or renewing critical infrastructure components. Specific mentions in climate planning sessions include the Halifax Central Heating Plant (AC has been recently renewed); the Killam data centre; Dalplex roof; facilities without backup power; Jenkins Hall as a campus warming centre; and some flood-prone agricultural and campus lands used for campus teaching and research.

Targets

GHG reductions

2020–2030	36,000 tonnes
2030–2040	30,000 tonnes
2040–2050	0 tonnes
Total	66,000 tonnes

Adaptation

Power lines buried, secure energy sources, potential relocation or renewal of critical vulnerable assets.

Green Buildings

Actions

Recommissioning

Building recommissioning has started. Success from these initiatives will lead to more buildings being added to the program. Common strategies include building controls optimization, air balancing, and adding more controls such as variable frequency drives on systems. Medium to large buildings with controls infrastructure will be targeted for this strategy.

Major and Minor Buildings Retrofits

Utility analysis, energy assessments, energy committee member's knowledge, and building meter data have identified major building energy and water opportunities. Our robust efficiency program will continue to be carried out across the campuses. Each year a number of projects of all sizes are planned and implemented including larger Deep Building Retrofits to equipment change outs. Campus buildings will be used for innovative projects such as building envelope modelling and testing and applying green building certification.

New Construction

As part of the University Sustainability policy, Dalhousie strives for high performance in new construction and existing buildings. New construction must meet third-party certification standards such as LEED Gold or higher. In the last decade, the University has increased efforts to maximize and monitor energy efficiency and renewable energy. We will continue to push for excellence in green building moving us closer to net-zero standards.

Rain water cistern in IDEA building

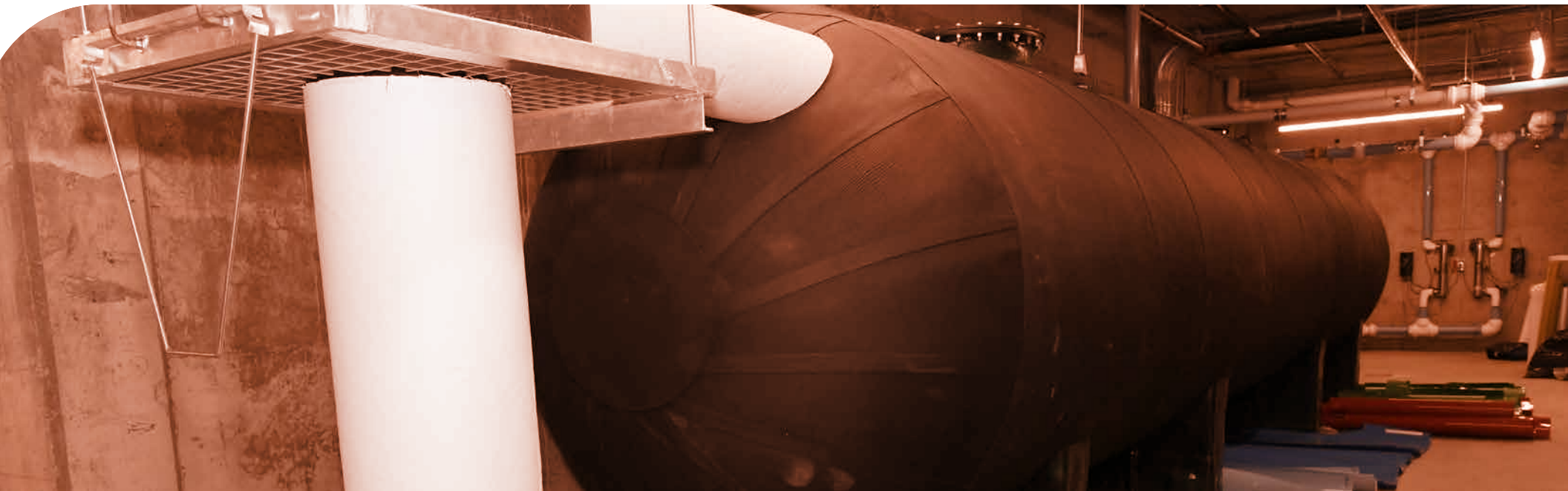
Targets

GHG reductions (offsets growth)

2020–2030	12,000 tonnes
2030–2040	12,000 tonnes
2040–2050	12,000 tonnes

Adaptation

New construction and retrofits are reflective of a changing climate. This includes incorporation of permeable landscapes, water harvesting systems, vegetative and built buffers, emergency power considerations, and more resilient envelopes and surfaces for wind, temperature differentials and water.



Sustainable Transport

Actions

Transportation Demand Management (TDM)

A number of TDM programs have been implemented including travel avoidance policies, bus passes, ride share programs, and cycling and pedestrian infrastructure and initiatives. More active transportation infrastructure and activities are being planned along with a revamp of existing programs to increase participation.

Greening Fleet

Greening fleet guidelines have been established that focuses new fleet procurement on right-sizing and low carbon emission vehicles. Longer-term plans include switching fleet to electric.

Targets

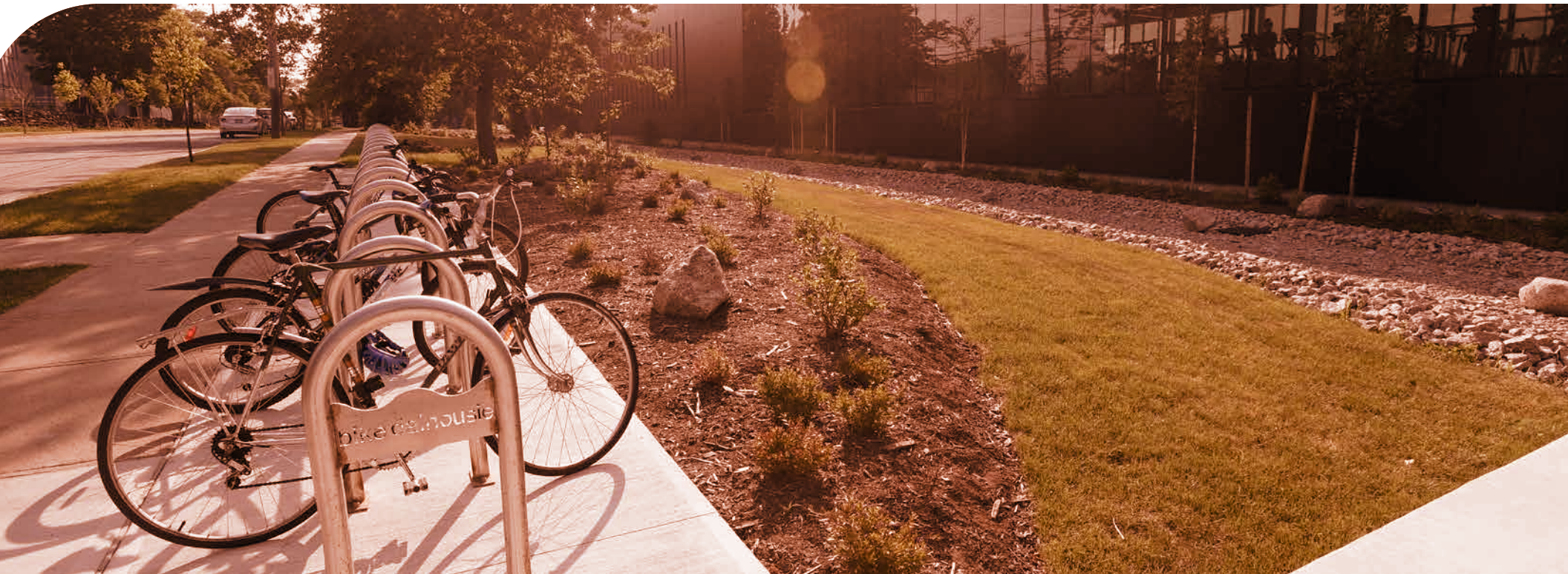
GHG reductions

2020–2030	50 tonnes
2030–2040	100 tonnes
2040–2050	0 tonnes
Total	150 tonnes

Adaptation

Supporting more cycling and walking infrastructure and corridors throughout campuses and community sustainable transportation initiatives.

Fitness Centre with Bike racks



Knowledge and Behaviour

Actions

Operations Changes

Progress has been made in establishing an energy management plan, program and information system (EMIS). Operational standards, preventative maintenance programs, and training will support energy and water efficient measures in operations.

University Plans

Embedding climate change mitigation and adaptation considerations and strategies in core university plans is important for comprehensive integration. Key plans include the University, Facilities, and Sustainability Strategic Plans; Emergency Measures; and Risk Management Plans.

Design Guidelines

Facilities Management provides design standards for building projects. Updating these standards to meet and beat energy, water and sustainability performance metrics is an important strategy.

Space Utilization

Maximizing existing space is a key strategy to avoid unnecessary building and to maximize underutilized space. Audits of space and equipment can be conducted to determine saving strategies for implementation including hybrid work.

ReThink Program

The Office of Sustainability and campus partners run regular behavioural programming under the banner of ReThink. Increase rethink program, sustainability teams, energy competitions, social marketing tools, residence eco-olympics, and employee sustainability education and events opportunities, and green labs.

Ongoing Curriculum & Research

Faculty, staff, students, and community partners are working together through class focused projects using the campus as a living laboratory. Student interns have been hired to research topics such as climate modeling, life cycle impacts of fuel types, carbon offsetting, and climate adaptation visualization. In recent years, specific focus has been placed on creating research and teaching spaces in new buildings and outdoor environments. Opportunities exist to expand on this approach creating a more cohesive program that engages more students.

Targets

GHG reductions

2020–2030	500 tonnes
2030–2040	500 tonnes
2040–2050	400 tonnes
Total	1400 tonnes

Adaptation

Knowledgeable, prepared, and proactive employees and students who react swiftly to solve energy and climate emergency issues.

Natural Environment

Actions

Green and White Roofs

Increasing precipitation, existing topography such as natural underground streams (Figure 10, 11, and 12), and built environment features may work together to exacerbate problems. Green roofs, green belts, or parks help to combat heat island effects. Green space can also function as a natural method to reduce storm water run-off from non-permeable surfaces.

Native Trees and Vegetated Swales

Green infrastructure implemented in the last decade included the planting of native tree species, rain gardens, vegetative swales, and green roofs. More natural and hybrid systems will be planned and planted in priority areas.

Rainwater Harvesting

As the climate changes, the overall climate is projected to be warmer and wilder. Scenarios may arise when precipitation will fall on less days increasing drought and run off. Dalhousie currently has three building rain cisterns for toilet flushing. There maybe an increased need for rainfall harvesting for programs like agriculture.

Agricultural Lands

Dalhousie's agricultural campus owns and leases agriculture lands. Agricultural practices can help to reduce and mitigate the impacts of climate change. Farm-based strategies are being deployed to reduce GHGs such as composting manure onsite. Program relocations maybe deployed if increasing flooding is impacting lands.

Porous Systems

Reducing impervious surfaces helps to slow down storm water. Systems like permeable pavers and permeable concrete have been installed on campus. Learnings from installations will help inform future planned installations.

Targets

GHG reductions

2020–2030	500 tonnes
2030–2040	500 tonnes
2040–2050	400 tonnes
Total	1400 tonnes

Adaptation

Diversion of storm water from storm/water sewage systems to natural and built systems; planting more resilient species.

Figure 10. Studley Campus – Historical Streams. Mike Reid, 2018.

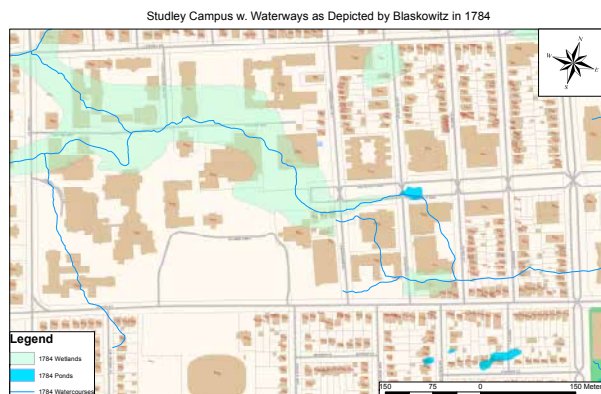
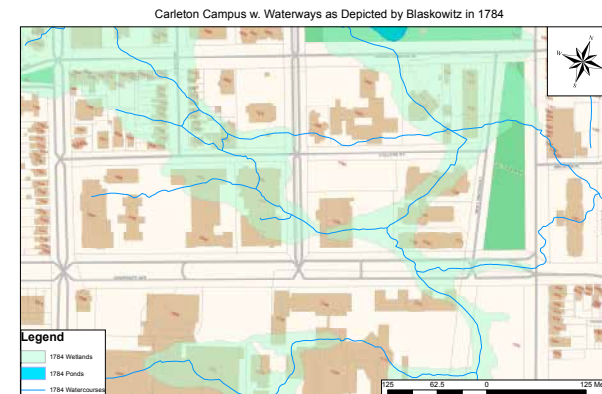


Figure 11. Carleton Campus – Historical Streams. Mike Reid, 2018.



Carbon Offsets and Sinks

Actions

Land procurement

Natural systems such as forests and oceans are carbon sinks, absorbing carbon dioxide. Some universities and colleges have offset a portion of emissions through the acquisition and/or ownership of land. To meet international carbon offset standards specific requirements need to be achieved. A recent, Office of Sustainability report, identified the conditions and costs of local land protection as a carbon sink opportunity.²³ Based on this information, campus surveys, and existing literature, carbon sink opportunities are ranked as a lower priority strategy compared to others the University can strive to implement in the next decade.

Renewable energy

Offsite renewable energy can be certified as a renewable energy credit or carbon offset. When the University purchases certified carbon offsets, renewable energy is a viable option.

Local carbon offsets

Dalhousie implemented a biomass replacement guideline that requires that all campus trees taken down be replaced with the same amount of biomass. This program since 2013 has resulted in the planting of over 400 trees. Opportunities will be explored to create a carbon off-set program based on business travel where the funding collected could fund community carbon projects.

Targets

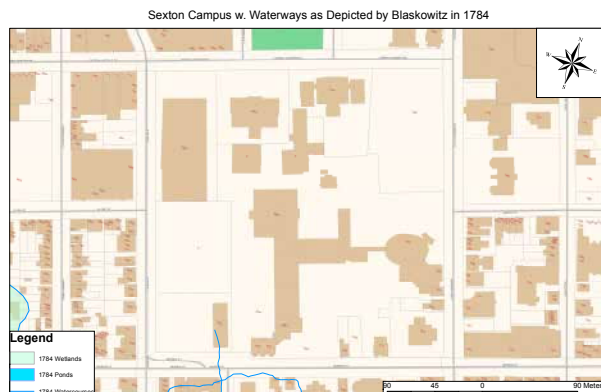
GHG reductions

2020–2030	100 tonnes
2030–2040	100 tonnes
2040–2050	15,500 tonnes
Total	15,700 tonnes

Adaptation

Explore carbon offsets that mitigate and provide adaption qualities such as shoreline restoration.

Figure 12. Sexton Campus – Historical Streams. Mike Reid, 2018.



6.0 Implementation and Evaluation

The University has been using a combination of utility savings/cost avoidance, facilities funding, and external grants to finance existing projects that support the climate change plan. To meet the next set of climate targets, investment will need to be stepped up. In the last decade, the University and partners have invested over \$100 million in sustainability projects. To meet the next set of climate targets of 2040 it is anticipated \$250 million will be needed. This will require continued investment from existing sources, requirement of higher standards in programs (ex. moving to zero-carbon building), plus additional use of other financial instruments such as energy purchasing agreements for off-site renewable energy options. New strategies will be examined such as green bonds, a climate change revolving fund, and community-based action fund based on University travel offsets.

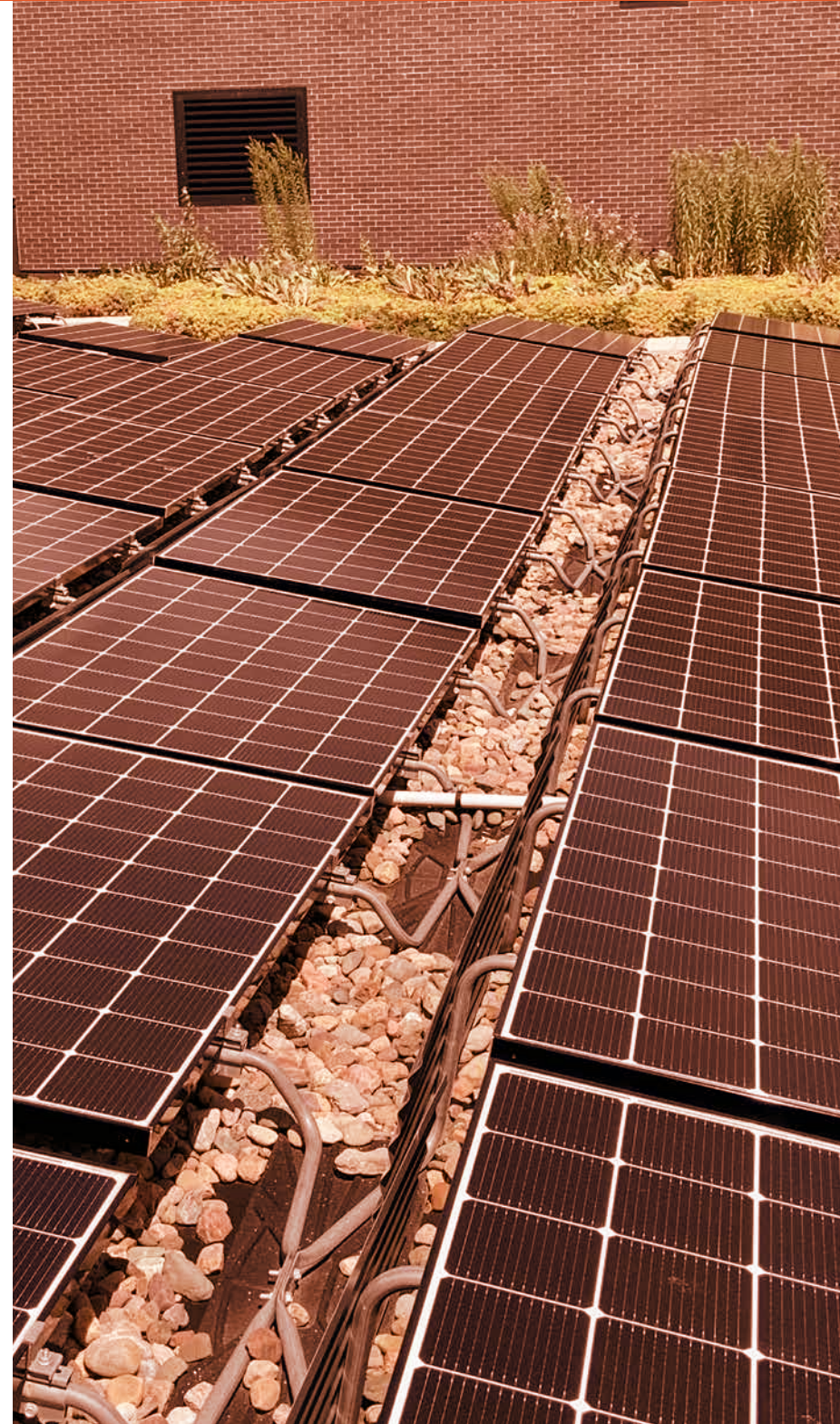
EV Station



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