

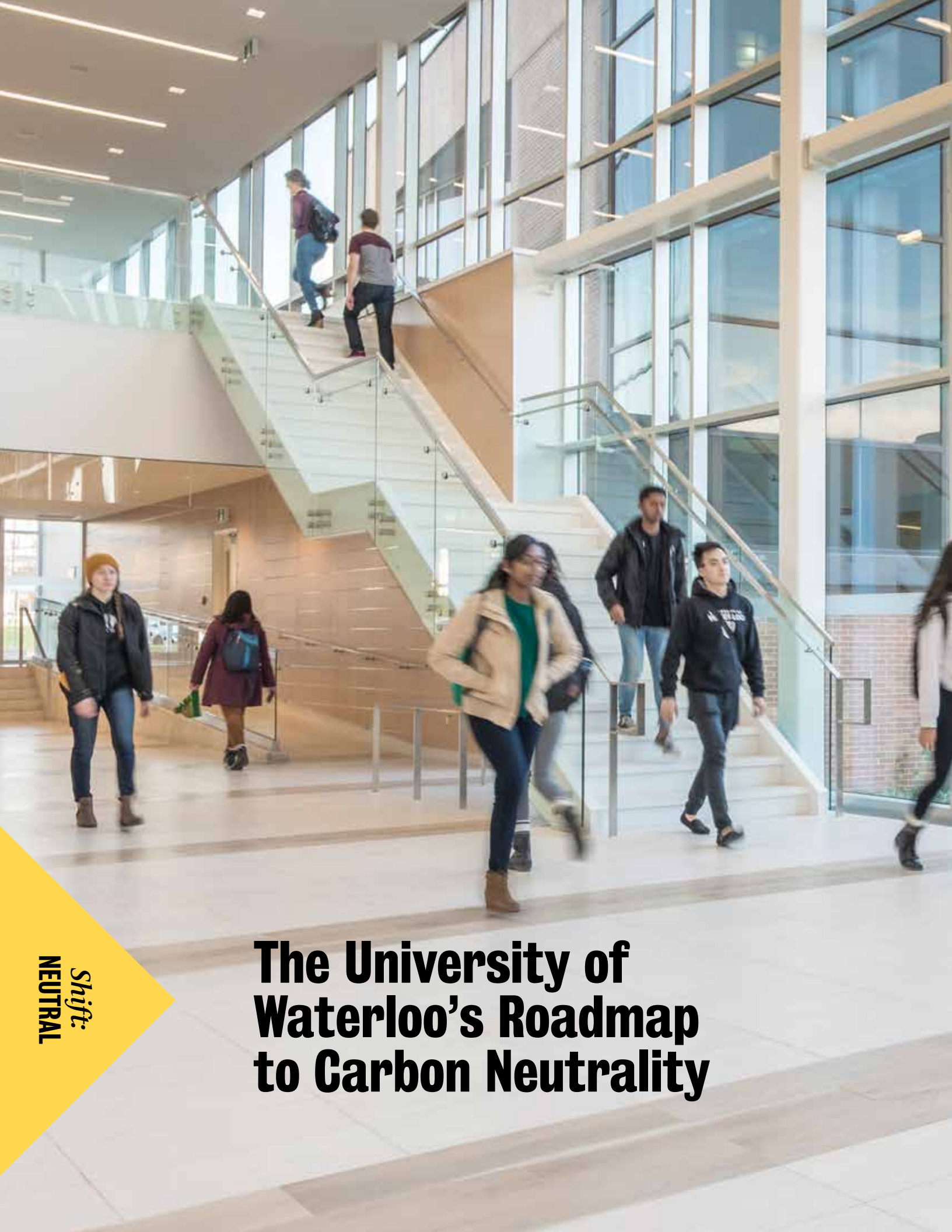


Shift: Neutral

THE UNIVERSITY OF WATERLOO'S
ROADMAP TO CARBON NEUTRALITY



UNIVERSITY OF
WATERLOO



Shift:
NEUTRAL

The University of Waterloo's Roadmap to Carbon Neutrality



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TERMS AND ACRONYMS

BAU: “Business as usual” in this report refers to the projected level of greenhouse gas emissions in future years without any additional efforts to shift or mitigate

Carbon footprint: Refers to the quantity of greenhouse gas emissions released by an actor

Carbon neutrality: Refers to a state where any greenhouse gas emissions generated are balanced by either sequestration of emissions elsewhere, or by the purchase of third-party carbon offsets

t CO₂-e: ‘tonnes of carbon dioxide equivalent’ is a method to normalize as a single measurement a range of greenhouse gases based on their relative radiative forcing, standardized to carbon dioxide and measured in tonnes

District heating/cooling: Refers to the process of generating energy at a central plant and distributing it to surrounding buildings instead of installing multiple boilers or air conditioners at each building

EF: “Emission factor” is a variable for calculating greenhouse gas emissions from a particular activity, such as burning a fuel, using electricity, or producing waste

GHG: “Greenhouse gas emissions” refers to gases released which have an increased warming effect in earth’s atmosphere. For Waterloo, these are primarily carbon dioxide (CO₂), methane (CH₄), and nitrous oxide (N₂O) and in some cases SF₆

LCC: “Lifecycle costing” is the process of identifying the total cost of an asset across its lifespan, factoring in utility consumption, maintenance, and disposal in addition to purchase price

LEED: “Leadership in Energy and Environmental Design” is a widely accepted benchmark for design and construction of sustainable buildings, third-party certified by the Canada Green Building Council

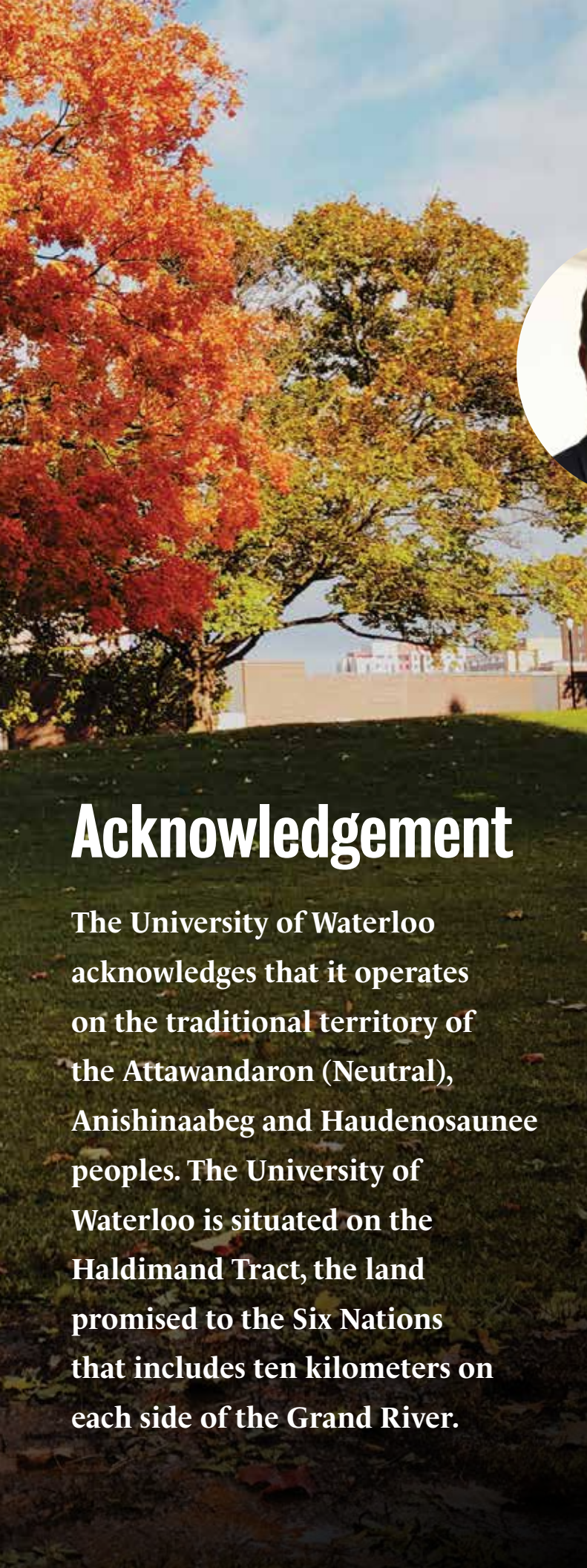
Scope 1/2/3: Refers to different types of emissions that can be linked to an organization, as defined by the GHG Protocol; Scope 1 refers to direct/on-site emissions, Scope 2 refers to indirect emissions for energy, and Scope 3 refers to other indirect emissions such as commuting, business travel, waste, embodied carbon, and supply chain

Sequestration: Refers to the process of removing carbon from the atmosphere through natural or engineered means

T & D Losses: “Transmission and Distribution Losses” refers to emissions released through the electricity transmission grid, particularly Sulfur Hexafluoride (SF₆), as well as general transmission inefficiencies. For Waterloo, this is calculated as the difference between generation and consumption emission factors within the Province of Ontario.

Waterloo: refers to the University of Waterloo, unless otherwise noted.

FOREWORD



Acknowledgement

The University of Waterloo acknowledges that it operates on the traditional territory of the Attawandaron (Neutral), Anishinaabeg and Haudenosaunee peoples. The University of Waterloo is situated on the Haldimand Tract, the land promised to the Six Nations that includes ten kilometers on each side of the Grand River.

Foreword

Our environment and climate have dramatically suffered at the hands of our industrial, global society. Climate change is widespread and accelerating, impacting the entire world in large-scale and minute ways that change how we live, work and look to the future. Now is the time to assess our own roles in combating climate change and taking action. The University of Waterloo is not backing down from this need.

The University of Waterloo has been actively working on initiatives that have been laid out in our Environmental Sustainability Strategy, and there has never been a stronger need to do more. This is why we have developed *Shift: Neutral*, our plan to make the University carbon neutral by 2050.

Shift: Neutral is establishing ambitious targets and implementation strategies over the coming years to significantly reduce the carbon footprint of our University.

Our institution is complex and multi-dimensional by nature, meaning our solutions must be interconnected and holistic. This roadmap touches on nine areas of influence, from net neutral growth through stringent energy efficiency requirements to offsetting emissions.


There is no one single solution that will bring the University of Waterloo to carbon neutrality on its own, just as there is no single way to tackle the climate crisis. Waterloo has a unique role in our society and a responsibility to push the boundaries of discovery. Creating a truly carbon neutral campus will set an example that we believe can and should be replicated by our students, faculty, staff, alumni, partners and the broader community. Now is the time to act. Please join us in our journey to *Shift: Neutral*.

Executive Summary:

Climate change is one of the most pressing global issues facing the world today. Impacts are already being felt and will continue to intensify, posing acute and lasting risks for communities, for business, and in particular to those who are already vulnerable.

Urgent global action to reduce greenhouse gas emissions is needed to avoid the worst impacts of climate change. Efforts are underway across many levels and many industries, but have yet to reach the scale and speed necessary according to the best available science. The post-secondary sector is no exception.

In 2017, the University of Waterloo committed, through its Environmental Sustainability Strategy, to develop a Climate and Energy Action Plan to achieve carbon neutrality by 2050.



carbon
emission
reduction

17.5%
by 2025

35%
by 2030

It also committed, through the Council of Ontario Universities, to develop a roadmap to a low-carbon campus. *Shift:* Neutral is the response to these commitments, and an important step to accelerating action on campus.

The University of Waterloo reinforces its goal to reach carbon neutrality by 2050. It further targets near-term carbon emission reductions of **17.5 per cent by 2025 and 35 per cent by 2030** across its direct (Scope 1 and 2) emissions, and will establish ongoing 5-year targets in each revision of this plan with an effort to increase its ambition and commitment.

To reach these goals, Waterloo will need to align foundational directions that increase priority, improve transparency, provide financial support, and build capacity. These require action along four distinct carbon reduction pathways:

- › Improving efficiency and reducing energy consumption
- › Integrating low-carbon energy and diversifying supply
- › Minimizing indirect emissions
- › Offsetting remaining emissions

Shift: Neutral is intended to provide a roadmap for the University of Waterloo that:

- Illustrates the types of changes that will be needed to reach carbon neutrality, in order to influence the long-term planning of campus infrastructure choices
- Aligns institutional policy and systems toward the carbon-neutral goal
- Provides a more granular level of detail for immediate initiatives within the first phase of the plan to reach the 2025 target, with other technical and infrastructure projects to be detailed in coming years

Background

A GLOBAL CHALLENGE

The world is already experiencing the effects of a changing climate: extreme weather events, increasing temperature extremes, drought and flooding, and growing stresses on natural ecosystems. These in turn are placing increased pressure on human social and economic systems.

Action has mobilized at all scales. Internationally, the Paris Agreement aims to keep global temperature increases to well below 2°C compared to pre-industrial levels, and to pursue efforts to keep below 1.5°C. To achieve the 1.5°C target, global emissions will be required to contract by 45 per cent through 2030 and achieve net zero through 2050. Federal, provincial, and municipal action plans across Canada have set a range of carbon emission reduction targets, and are developing policies, programs, and regulations to achieve these targets. These efforts are often uneven, and will continue to evolve.

Nevertheless, the commitments and actions around the world are insufficient to meet the objectives of the Paris Agreement. There has been mounting pressure for further action, from the global climate strikes to shareholder motions to coalitions of action.

The post-secondary sector has a crucial role to play. As hubs of expertise, change leaders, educators of the future, and conveners for multi-stakeholder action, universities are leveraging their unique societal role for research and knowledge mobilization. They are also making commitments to embody these in their own operations. Leading institutions in the US, Canada, and globally are setting ambitious goals towards net neutrality in their operations.

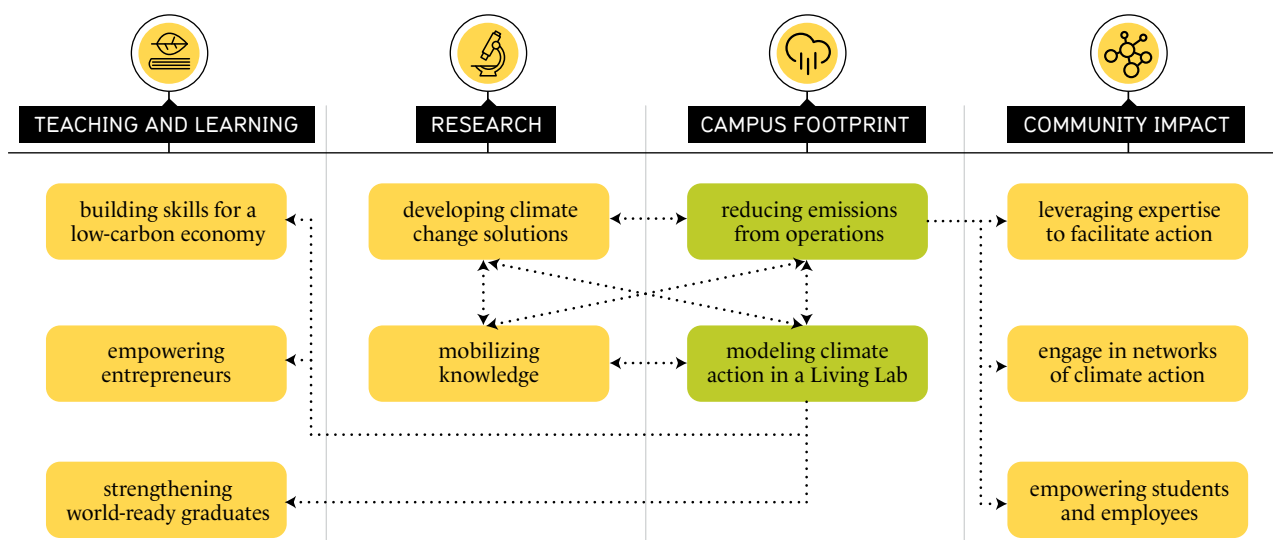
AT WATERLOO

The University of Waterloo does not start its climate action efforts from zero. The campus has a robust academic reputation for research and teaching on climate change and energy, including but not limited to:

- › The Interdisciplinary Centre on Climate Change bringing cross-campus expertise together on climate change science, mitigation, and adaptation
- › Waterloo Institute for Sustainable Energy integrating technical and policy expertise for research on sustainable and low-carbon energy systems
- › The Faculty of Environment being the largest and most programmatically diverse such Faculty/School in Canada
- › The Master of Climate Change being the first of its kind in Canada
- › Waterloo hosting the Sustainable Development Solutions Network Canada, which catalyzes cross-university partnerships to advance the UN Sustainable Development Goals
- › Waterloo ranking 5th in the world for its impact on climate change research in 2019 by Times Higher Education

These are important and unique contributions to support climate action. *Shift: Neutral* builds upon this history, focusing on the carbon footprint of campus operations as another dimension of Waterloo's response to climate change, as illustrated in **Table 1**. It ensures Waterloo can live up to the outcomes necessary across society to build a sustainable, low-carbon future.

Table 1: Dimensions of Campus Climate Action



Reduction of the campus’ carbon emissions directly advances objectives of the Environmental Sustainability Strategy, principles of Policy 53: Environmental Sustainability, and commitments through the Council of Ontario Universities. This in turn strengthens opportunities for learning, research innovation, and community impact.

Furthermore, actions to address climate change in Waterloo’s operations also intersect with and reinforce many institutional directions and priorities.

Table 2: Connection to University Directions

CONNECTION	DESCRIPTION
Strategic Plan	Exemplifies Waterloo’s willingness to engage with the most pressing global challenges, demonstrate institutional innovation, and take meaningful action on climate change
Campus Master Plan	Increases the measurable delivery on principle 4 of the Campus Master Plan, to make environmental stewardship and sustainability defining features of campus development, and in part principle 2 and 3
Capital Plan (Not yet developed)	Clarifies critical connections that would need to be made with an emergent capital plan, to ensure that campus renewal projects and funding prioritize energy-efficient and low-carbon redevelopment, and thus avoid lock-in or missed opportunities
Risk management	Enables proactive management for risk mitigation, including regulatory compliance, future-proofing of infrastructure investment against changing circumstances, and community and stakeholder relations
Financial management	Prioritizes total cost accounting to ensure that the long-term liabilities for energy and maintenance are factored into purchasing decisions, and to control energy cost pressures
Wellbeing & the Okanagan Charter	Reinforces the Okanagan Charter’s emphasis on the holistic determinants of health and wellbeing, including environmental, with particular intersections on indoor & outdoor air quality, built environment, transportation and wellbeing, and food system sustainability
Equity	Strengthens Waterloo’s commitment to equity, as accelerating climate change disproportionately impacts vulnerable communities along existing wealth, gender, and racial disparities, amplifying food and water security, air quality, extreme weather, and health risks for vulnerable populations within Canada and around the world

OPERATIONAL CONTEXT

Waterloo has made important decisions over its history that facilitated more sustainable growth. These include:

- › Centralized district heating and cooling enabled scalable development of the South Campus
- › Larger building sizes have enabled greater efficiencies
- › Heat recovery and steam pressure changes within Central Plant have improved efficiency
- › Lighting retrofits are underway
- › Phase-out of fuel oil in the Central Plant is planned
- › EV3 was the first LEED Platinum certified building on an Ontario university campus

These efforts have helped the University of Waterloo benchmark consistently below the average emissions intensity per square metre compared to other research-intensive campuses in Ontario. Despite adding over 1.5 million square feet of campus space over the past decade, Waterloo's direct emissions have remained relatively flat as the Ontario electricity sector was largely decarbonized. Most of Waterloo's emissions today come from using natural gas for heating.

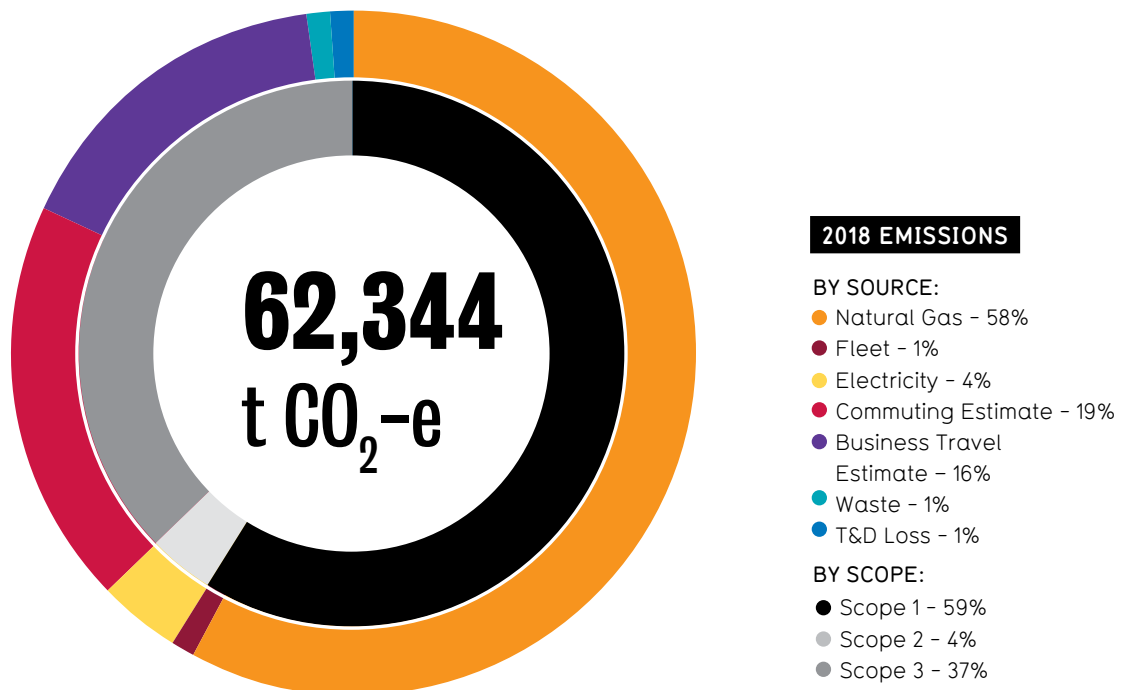


Figure 1: Emissions for Most Recent Year (2018)

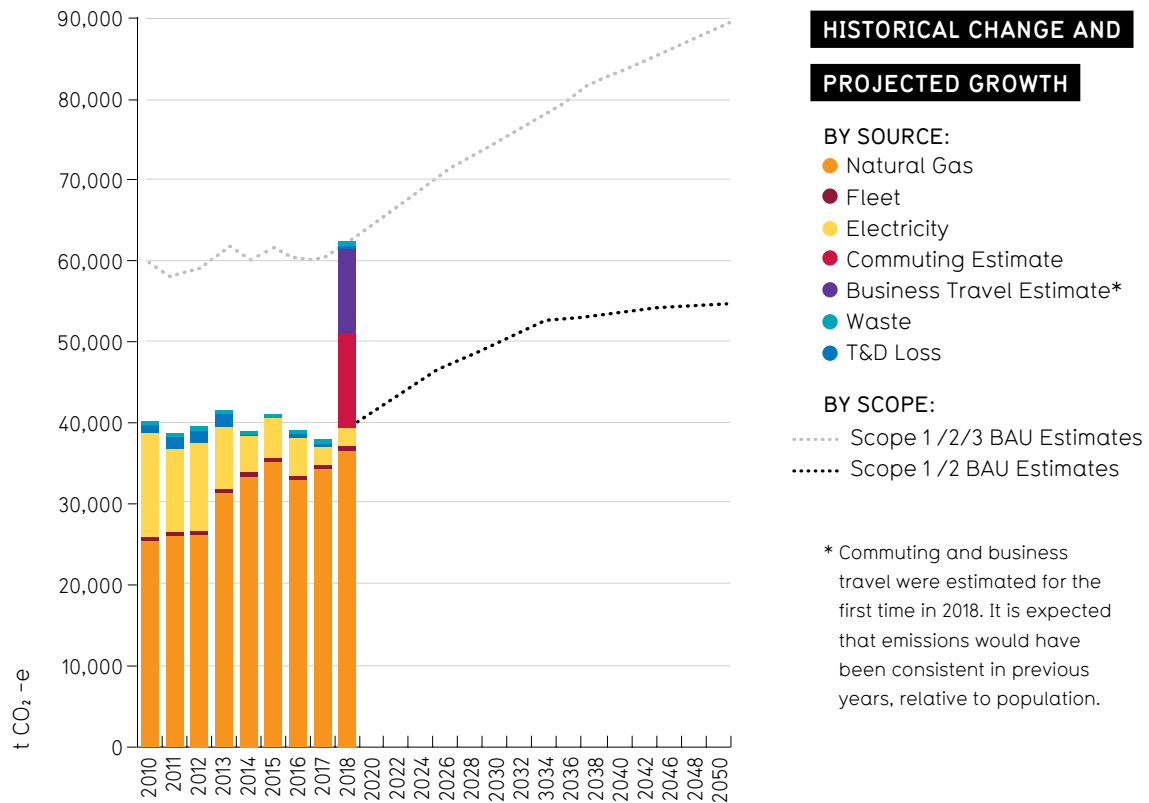


Figure 2: Historical Emissions and Projected Growth

As illustrated in **Figure 1** and **Figure 2**, Scope 1 and 2 emissions account for approximately two-thirds of Waterloo’s carbon inventory, and without further action are expected to increase as the campus grows over the coming decades.

A breakdown of Waterloo’s emissions can be found in **Appendix A**.

Three distinct pressures will influence future emissions from campus operations:

- › The University’s plateau in carbon emissions is primarily due to Ontario phasing out coal power, making electricity consumption on campus cleaner while usage increased. Future increases in campus electricity use will directly increase emissions, and the University cannot control future changes to the provincial electricity grid that would alter the carbon intensity of electricity.
- › Similar to many campuses, Waterloo’s infrastructure continues to age, and will require renewal over the lifespan of this roadmap. This offers important moments of opportunity to renew with low-carbon infrastructure and reduce the risk of “locked in” emissions.
- › Demand for action is increasing across society, and the scientific understanding of climate change demonstrates a need for increased ambition to reduce emissions over the coming decade.

A Roadmap to Carbon Neutrality

**reduction
in absolute
emissions**

17.5%
by 2025

35%
by 2030



Shift: Neutral intends to advance three fundamental objectives:

1. Achieve carbon neutrality by 2050
2. Increase the energy efficiency of the campus in a cost-effective manner
3. Provide a high-quality teaching, learning, living, and working environment

TARGETS

2050 is a long-term goal for carbon neutrality, and it is expected that there will be internal and external changes that will require continual revision and adaptation to Waterloo’s approach.

As such, the *Shift:* Neutral roadmap suggests near-term targets of a **17.5 per cent reduction in absolute emissions by 2025, and a 35 per cent reduction by 2030**. These can be utilized to build short-term momentum aligned with the 2050 goal.

Table 3: Carbon Reduction Targets

BASE YEAR	2025	2030	2035-2045	2050
2015	-17.5% (Scope 1/2)	-35% (Scope 1/2)	TBC	Carbon neutral (All Scopes)

These targets cover Scope 1 and Scope 2 emissions over which the University has the most direct control, including emissions from stationary combustion, electricity use, and the campus fleet and mobile equipment. Indirect emissions from Scope 3 will continue to be tracked, mitigated, and linked to future targets.

Continual revisions of the plan on 5-year intervals will update and establish targets beyond 2030 to align with a 5 and 10 year planning horizon and strengthen ambition. This will enable flexibility and reflect changing technologies, practices, and market forces while still working toward the long-term goal.

WATERLOO'S LONG-TERM APPROACH

Achieving carbon neutrality, increasing the energy efficiency of the campus, and maintaining high-quality spaces will require changes to the operating practices of the institution, as well as investment into existing facilities. **There is no single initiative that will enable the University to meet these objectives.** A suite of policy, infrastructure, and behavioral changes will need to work together to reduce emissions through four distinct pathways:

1. Improving energy efficiency of operations
2. Using low-carbon energy sources and increasing source diversity
3. Reducing indirect emissions from campus operations
4. Offsetting emissions in the long term

Waterloo will emphasize energy efficiency measures initially, as these can generate financial returns and help “right-size” the need for low-carbon energy sources integrated over time. It will also emphasize initiatives which align campus systems to catalyze action, including prioritization, financial support, monitoring and transparency, and capacity. These are essential to meaningful action across all pathways.

Waterloo's roadmap to a low-carbon campus links each of the pathways into a high-level visualization to assist in long-term planning. As illustrated in **Figure 3**, it includes the following:

1. Net neutral growth is achieved through stringent energy efficiency requirements for all new buildings and major renovations
2. Systems are aligned to support carbon neutrality, including prioritization, financial support, monitoring and transparency, and capacity
3. Energy demand from current buildings is reduced through efficiency measures, including behavior change, scheduling, envelope upgrades, recommissioning and environmental monitoring, and lighting and equipment updates
4. Waterloo's fleet is decarbonized through optimization and accelerated adoption of low-carbon vehicles

5. With reduced energy demand, centralized infrastructure is right-sized as part of renewal, including conversion of steam to hot water
6. Advanced heat recovery fully optimizes district thermal energy between buildings, including management of simultaneous heating and cooling
7. Energy used on campus comes from low-carbon sources, including renewables and geothermal
8. In parallel, non-energy/indirect emissions from embodied carbon, business travel, commuting, and waste are reduced
9. Remaining emissions are offset or sequestered

While this suggests a sequenced approach, many of the above can be undertaken at smaller scale or in parallel to accelerate reductions.

Several principles guide Waterloo's approach:

- › **Aligning practices and systems** so all members of the institution are empowered and incentivized to take supportive action, not just building operators
- › **Future-proofing** investment decisions against energy price fluctuations, carbon pricing, stakeholder pressure, direct compliance obligations, and other transitional risks
- › **Avoiding lock-in** decisions that limit opportunity for future emissions reductions
- › **Increasing transparency** of decisions that influence carbon emissions and energy efficiency across the University
- › **Enabling flexibility** to respond to changing technologies and circumstances

It is very important to consider the joint impact of future-proofing and lock-in. **Decisions made in the short term can lead to emissions that become difficult, prohibitively expensive, or not technically feasible to reduce in the future.**

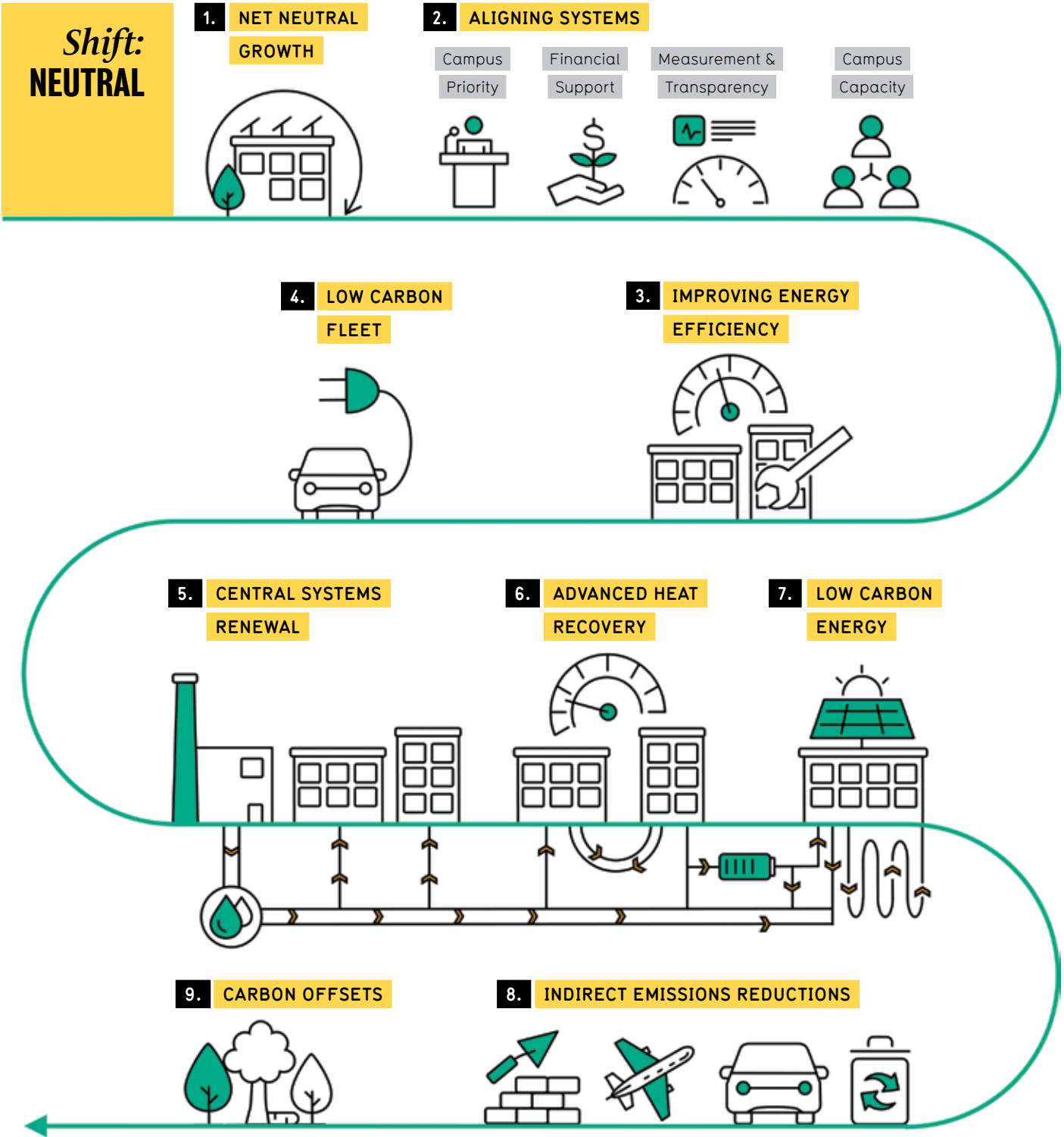


Figure 3: Roadmap to Carbon Neutrality



Shift: Neutral includes

46 specific initiatives

that help reduce emissions to reach short term targets, as well as initiatives that set up long-term success. These initiatives are classified as:

REDUCTIONS:

are initiatives taken through 2025 which tangibly avoid, mitigate, or offset emissions or improve energy efficiency.

ACTIONS:

are initiatives taken through 2025 which shape directions, enhance capacity, or increase understanding, but do not directly reduce emissions.

CONSIDERATIONS:

are ongoing initiatives which will inform future decisions and opportunities as they arise but are less specific and require further information.

These initiatives are listed throughout the document, and a synthesis can be found in **Appendix B**.

REDUCTIONS TO 2025

For clarity, Waterloo identified 12 potential reduction initiatives to meet the short-term objective of a 17.5 per cent decrease in Scope 1 and Scope 2 emissions by 2025. These are listed in **Table 4** and **Figure 4** below. Table 4 references the respective initiative number from later sections of the document. Some will need further refinement and additional assessment, so there is still room for flexibility, but these provide a reasonable pathway to the 2025 target.

Table 4: Example Actions to Reach 2025 Target

Reduction project (initiative number)	t CO ₂ -e	Timing
Lighting retrofits (18)	~30	2016-2021
Fuel oil phase out (23)	*	2020
Recommissioning program (16)	~325	2021-2025
Engagement & behaviour change (29-33)	~100	2021-2025
Fleet efficiency & electrification (34-36)	~100	2021-2025
Graham Data Centre heat recovery (22)	~1,000	2023
REV ground-sourced heat pumps & renovations (37)	~1,000	2024
Indoor air quality monitoring for vivarium and labs (17)	~1,000	2021-2025
Additional findings from energy audit (14)	~1,000	2023-2025
Chemistry 2 renovations (15)	~100	2025
PROJECT REDUCTIONS	~4,655	
BAU GROWTH	~(5,600)	2015-2025
Net neutral standard for all new construction from 2020 onward (12)	~4,370	2020-2025
TOTAL DIRECT REDUCTIONS	~3,425	-8.4%
Carbon Offsets (46)	~3,700	2021-2025
TOTAL EMISSION CHANGE	~7,125	-17.5%

*The fuel oil phase-out will not directly reduce emissions on an annual basis, as it is infrequently used for backup and is not included within the University's baseline year. However, the phase-out project will avoid future occasional emission increases from fuel oil use, which for example in 2019 were approximately 400t CO₂-e. This will be significant over longer periods of time.

2015-2025 EMISSIONS (SCOPE 1 AND 2)

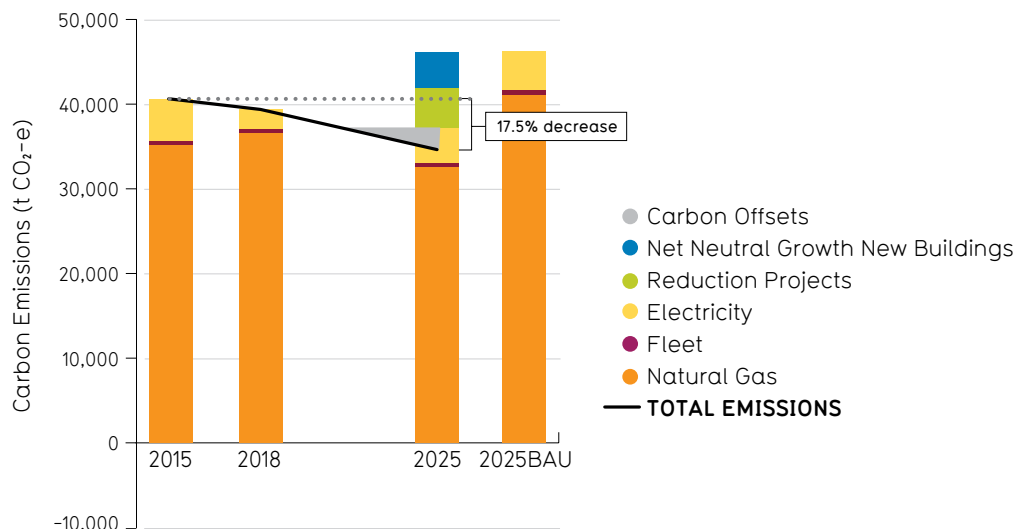


Figure 4: 2025 Emission Reductions vs BAU



INITIATIVES

Initiatives For Carbon Neutrality

ALIGNING CAMPUS SYSTEMS

To ensure that efforts can advance, Waterloo will align campus systems by:

- › Strengthening institutional prioritization through executive support and responsibility
- › Improving measurement and transparency of campus energy and emissions
- › Aligning financial systems to encourage energy efficiency and carbon reduction
- › Building capacity for implementation on operating teams



STRENGTHEN INSTITUTIONAL PRIORITIZATION

Given the scope of change embedded in a transition to carbon neutrality, robust change management efforts will be needed. This involves prioritization through clear support for action from senior leadership, consistently evaluating progress, and strengthening accountability.

1. **Action:** Draft an executive statement on climate action and the need to advance the objectives of the *Shift*: Neutral roadmap
2. **Action:** Integrate institutional key performance indicators on carbon reductions against established targets and energy efficiency, to ensure ongoing monitoring and transparency
3. **Action:** Host a Town Hall with all senior administration and members of the campus community to catalyze awareness and support for climate action, and follow up with a survey of what additional training or support is necessary for university leaders
4. **Action:** Designate a position within senior administration to support ongoing coordination, accountability, and decision-making



IMPROVE MEASUREMENT AND TRANSPARENCY



Waterloo collects, evaluates, and reports on energy consumption and emissions primarily at the aggregate level across the campus. More granular information about how, where, and when energy is consumed is crucial to long-term planning, issue management, benchmarking, and opportunity assessment. Sharing this information is necessary to strengthen responsibility and accountability of action, and empower engagement across all members of the campus.

5. **Action:** Phase in sub-metering of core utility streams across campus buildings over the next 5-8 years and integrate an energy management information system



ALIGN FINANCIAL SYSTEMS TO SUPPORT LOW-CARBON ACTION

Implementing initiatives of *Shift*: Neutral will require resources. Section 7 illustrates potential internal and external sources of funding that could be explored further. However, it is important to ensure that Waterloo's processes and systems support energy efficiency and emission reductions. For example, lifecycle costing processes require purchasing decisions to factor in the full cost of asset ownership, including utilities and maintenance, which can help prioritize efficiency and increase transparency.

6. **Action:** Establish ongoing dedicated central resources to catalyze carbon and energy efficiency measures across campus stakeholders and operators
7. **Action:** Embed lifecycle costing processes and tools into a formal University guideline, using standardized cost assumptions and integrating carbon and utility pricing "stress tests"
8. **Action:** Advocate for funding bodies to integrate energy efficiency support within granting programs, and identify key carbon and energy projects requiring external funding support
9. **Consideration:** Opportunities to pilot financial tools that would encourage energy efficiency will be considered



ENSURE CAPACITY FOR IMPLEMENTATION

Implementing and managing initiatives of *Shift*: Neutral relies on staff capacity. Waterloo will ensure its staff complement can deliver projects and initiatives in a timely, high-quality, and professional manner. In addition, Waterloo will ensure that the knowledge and skills necessary to build, renovate, and maintain low-carbon buildings and infrastructure are embedded.

10. **Action:** Ensure staff complement supports timely, high-quality, and professional project management and implementation while exploring funding resources for support
11. **Action:** Initiate a training program for facilities operators covering energy and carbon management

IMPROVING ENERGY EFFICIENCY

Early emphasis is placed on policies, infrastructure, and programs that reduce energy demand and increase energy efficiency. This includes minimizing the impact of growth, efficiency in existing buildings and central systems, behaviour change, and fleet management.



MINIMIZE IMPACT OF GROWTH

As a growing campus, Waterloo will face upward pressure on emissions from new buildings and infrastructure.

A net-neutral design standard will be pivotal to Waterloo's carbon neutrality target by significantly flattening the growth curve. Waterloo will integrate best practice for efficient and low-carbon building design, such as Passive House, Canada Green Building Council Zero-Carbon, or similar standards into its design guidelines. These will reduce emissions from BAU by an estimated 4,300 tonnes per year by 2025, and be a necessary step to reach short and long-term targets.

Waterloo also should continue to mobilize efforts and identify opportunities to optimize existing space as much as possible before adding new.

12. **Reduction:** Update design guidelines for all new buildings to net neutral thresholds or similar performance-based criteria
13. **Consideration:** Efforts to optimize space should be considered before constructing new buildings



REDUCE ENERGY CONSUMPTION OF EXISTING BUILDINGS

Reducing emissions from new construction is essential. However, reaching carbon neutrality will require a mix of energy efficiency projects across existing buildings. These can include a range of projects from controls management, equipment replacement, lighting management, environmental monitoring for ventilation, and building envelope upgrades.

To determine opportunities, Waterloo will initiate a professional energy audit of campus buildings. The energy audit will yield more detailed information about building-level energy consumption, as well as useful and practical actions for Waterloo to reduce emissions.

14. **Reduction/Action:** Complete an audit of campus buildings to determine a mix of short-term energy efficiency and carbon reduction projects (through 2025)
15. **Reduction:** Prioritize whole-building redevelopment of Chemistry 2 as a high-intensity building with constant-flow fume hoods
16. **Reduction:** Initiate a recommissioning program for top energy-consuming buildings to ensure controls and sequence of operations are operating as efficiently as possible
17. **Reduction:** Launch an environmental monitoring program to optimize and reduce air changes in labs spaces and vivarium
18. **Reduction:** Complete the ongoing high efficiency lighting retrofit by 2021
19. **Action:** Develop a checklist to integrate energy and carbon assessment and requirements into all construction or renovation projects
20. **Consideration:** Calibration and optimization of building scheduling and setpoints should be considered on an ongoing basis
21. **Consideration:** Recladding of buildings with high-performance envelopes should be considered whenever undertaking large building retrofits



MOVE ENERGY EFFICIENTLY THROUGHOUT DISTRIBUTION SYSTEMS

Waterloo has a district energy system, which creates opportunities for heat recovery and management of simultaneous heating and cooling.

Waterloo will complete a more detailed condition assessment of the Central Plant and district energy infrastructure, to better understand the opportunities for lifecycle renewal. **The Central Plant represents a key decision point in campus climate and energy management, and will either enable or restrict future emissions reductions.**

A Utility Master Plan would further develop the optimization of the Central Plant and associated distribution systems for long-term flexibility and scalability and would be coupled with the existing building and Central Plant feasibility studies referenced above, as well as the renewable energy assessment referenced below.

22. **Reduction:** Initiate a heat recovery project from the Graham Data Centre in Math and Computers
23. **Reduction:** Continue fuel oil phase-out in the Central Plant
24. **Action:** Initiate an assessment of the district heating system and feasibility of conversion from steam to high and/or low-temperature district hot water
25. **Action:** Develop a Utility Master Plan to synthesize feasibility studies and drive long-term investment into district heating and cooling and associated infrastructure
26. **Consideration:** Heat recovery systems will be considered when making changes to HVAC equipment and infrastructure, at the building and district energy levels
27. **Consideration:** Management of simultaneous heating and cooling will be an important consideration when connecting buildings and systems to the district energy system
28. **Consideration:** Thermal and electrical energy storage systems will be considered as part of campus development to enable load-shifting, integration of renewables, and optimizing energy efficiency



ENGAGE BUILDING USERS ON ENERGY EFFICIENCY

Occupants of a building have a major role to play in determining the building's overall energy efficiency and emissions intensity. Thousands of small choices, when aggregated, can translate into substantial energy and emissions reductions at relatively low cost. Waterloo will develop targeted programs and policies to create engagement opportunities and support transitions at the department and individual level, in addition to larger infrastructure changes.

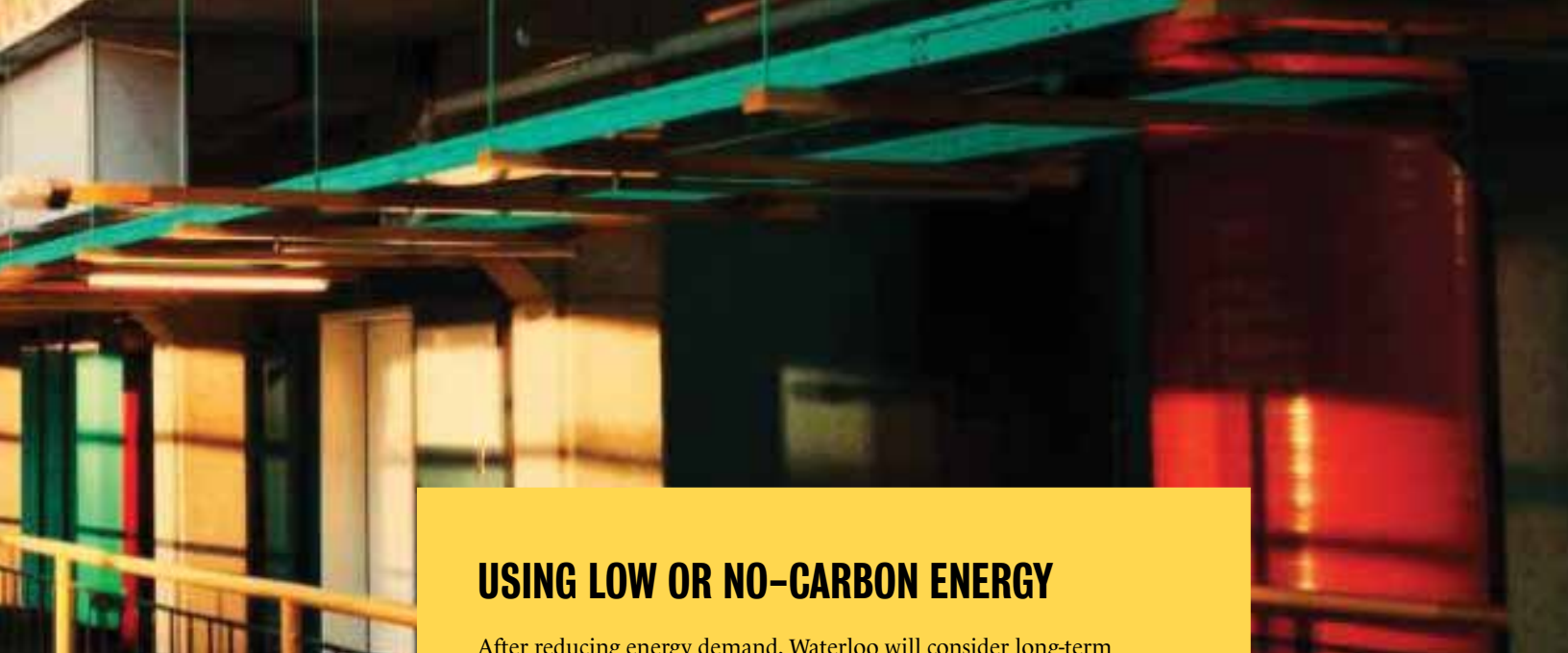
- 29. **Reduction:** Continue delivery of, and expand participation in, Green Office and Green Residences programs, and launch a Green Labs program with an emphasis on fume hood management and efficient equipment use
- 30. **Action:** Develop energy efficiency requirements for all major appliance and electronics purchases
- 31. **Action:** Launch and market a targeted incentive program for high-efficiency equipment
- 32. **Action:** Develop a visual identity to raise the visibility of energy efficiency and carbon reduction projects, and increase communication to raise awareness among campus stakeholders
- 33. **Consideration:** Stronger guidelines for shutdown procedures of lights, IT equipment, and personal computing equipment will be considered



IMPROVE FLEET VEHICLE EFFICIENCY

Waterloo owns and operates a fleet of over 130 vehicles, from golf carts through large moving trucks and landscaping equipment. While the overall proportion of campus emissions is less than 1 per cent, the fleet is highly visible.

- 34. **Reduction:** Introduce and enforce an anti-idling policy for all campus fleet vehicles
- 35. **Reduction:** Expand electric, hybrid, or hydrogen-powered vehicles within Waterloo's fleet through accelerated deployment
- 36. **Action:** Pilot data-logging tools to generate actionable information about utilization, behaviour gaps and user feedback, and suitability for electrification



USING LOW OR NO-CARBON ENERGY

After reducing energy demand, Waterloo will consider long-term planning for a more diverse energy portfolio that emphasizes low-carbon sources of energy.

The University currently benefits from low-carbon electricity that is supplied through the provincial grid. While renewable energy projects such as wind or solar photovoltaics will have limited impact on emissions, they should still be explored as a vital part of campus infrastructure to diversify electrical supply and expand resilience, to support peak demand management, and in some cases to optimize costs of energy and minimize impact of grid-based carbon intensity changes.

Almost all thermal energy on campus is produced using natural gas and generates proportionally higher emissions. Waterloo will explore other options that can provide heat in order to reduce emissions, which also creates an enormous potential for transformative technology development across Canada.



37. **Reduction:** Explore transition of REV from gas boilers to a ground source heat pump system as a pilot
38. **Action:** Conduct a feasibility study on renewable energy sources and an appropriate portfolio that would diversify Waterloo's energy supply, minimize emissions, and meet suitable portions of campus needs
39. **Consideration:** Air and ground source heat pumps will, where feasible, be considered for all new construction and for major retrofits to existing buildings or central systems
40. **Consideration:** Designated areas for potential future energy production sites, such as solar, wind, and geothermal, should be considered as part of ongoing campus master planning

REDUCING INDIRECT EMISSIONS

The short-term emphasis for *Shift: Neutral* is on minimizing direct (Scope 1 & 2) emissions that are largely from energy consumption. However, Waterloo's emissions footprint also includes several indirect emissions (Scope 3) sources which will need to be addressed and managed, including commuting, business travel, waste, embodied carbon, and the supply chain.



ENABLE LOW-CARBON COMMUTING

Commuting forms over 18 per cent of currently measured emissions, and is expected to increase along with population growth. Several external initiatives and market trends will help improve emissions over time, including changing modal shifts as a result of municipal policies, increased adoption of electric vehicles, and improved vehicle fuel economy and fuel standards. However, Waterloo will also need to take supportive action to enable sustainable commuting choices, consistent with the directions of the 2009 Campus Master Plan. An institutional Transportation Demand Management Plan will be crucial to advance these initiatives, and is beyond the scope of *Shift: Neutral*.

41. **Action:** Develop an institutional Transportation Demand Management Plan to better evaluate options for and develop programs to support low-carbon commuting



REDUCE EMISSIONS FROM BUSINESS TRAVEL

Transportation emissions are also generated through University business travel for conferences, meetings, research, or institutional development. Travel activity at Waterloo accounts for an estimated 16 per cent of current emissions, and this does not include emissions from student travel for co-op, traveling to campus, or international exchange/placements.

42. **Action:** Explore potential tools and guidelines that would reduce business travel where feasible, such as remote conferencing technology, and that would improve tracking of air travel impacts



ELIMINATE EMISSIONS FROM WASTE

Waste accounts for less than 1 per cent of all emissions, but it is a highly tangible impact area for many students and employees. Waterloo will continue with its Zero Waste Action Plan, which targets a 60 per cent diversion rate by 2025 and 90 per cent by 2035.

43. **Action:** Continue implementation of the Zero Waste Action Plan, which will support reductions of waste-related emissions



MINIMIZE EMBODIED CARBON

Embodied carbon refers to the carbon emissions which are released to produce materials used on the campus, in particular from construction, and can have a large impact. Depending on the type of building, embodied carbon from materials extraction through construction could account for 30 per cent or more of a building's lifecycle emissions.

- 44. **Action:** Integrate tools and resources to track embodied carbon
- 45. **Consideration:** Integration of low-carbon materials into construction will be considered as part of future building design

OFFSETTING REMAINING EMISSIONS

Once emissions have been reduced as far as possible, any remaining emissions will need to be balanced through the purchase of carbon offsets and carbon sequestration. Offsets are intended to be used sparingly over the long-run to balance emission sources which are prohibitively expensive or technically impossible to eliminate, and are not meant for immediate short-term application at scale.

To ensure consistency, credibility, and proper accounting of offsets purchased at Waterloo, the University will develop standards and guidelines to assist campus users.



- 46. **Reduction/Action:** Develop a guideline to inform the long-term purchase or integration of carbon offsets

The Living Lab

Shift: Neutral focuses primarily on operational carbon emissions. However, the initiatives listed above can be impactful when linked with the University's mission for teaching and research through the Living Laboratory.

Supporting the Living Lab approach offers direct learning opportunities in a microcosm of technological and social shifts toward a low-carbon future, and engages them with real-world constraints and limitations. It also helps research efforts collaborate with institutional action to advance scholarship through case studies, piloting of new technologies, and evaluation and analysis.

Many of the initiatives from *Shift:* Neutral will support the Living Lab efforts, including:

- › Improving data collection on building performance
- › Strengthening institutional commitment to transparency and information sharing
- › Ensuring staff have capacity to collaborate with students and researchers
- › Generating lists of challenges and problems for further exploration
- › Continuously tracking and evaluating projects and processes implemented

THE LIVING LAB



Funding and Resources

FUNDING AND RESOURCES

Reaching carbon neutrality will require dedicated resources, and it should be emphasized that there are costs to taking on many actions.

However, there are costs to business as usual as well. Waterloo's energy costs will continue to increase, as will maintenance, management, and replacement costs of existing infrastructure. Many energy management projects can reduce ongoing costs, while others have limited or very long-term payback. The lifecycle costing actions listed above are important to synthesize these costs and benefits and ensure Waterloo has the resources for implementation.

LEVERAGING INTERNAL RESOURCES

Waterloo will need to blend a creative mix of internal funding sources to properly resource the *Shift*: Neutral roadmap, including the following:

Core Funds: Through the Operating Fund or University Fund for strategic initiatives, ensuring there are resources for staffing or consulting costs, feasibility studies, and capacity-building.

Deferred Maintenance: Feasibility studies should be mapped against ongoing maintenance schedules and deferred maintenance liabilities to future-proof renewal and optimize investment.

Fund Assets: Building on the Responsible Investment Working Group's recommendation to evaluate and pilot social impact investments, Waterloo's investment funds should be explored.

Utility Billing Model: Integrating innovative financial tools and mechanisms within Waterloo's utility billing could be explored.

University Community: Last, it is worth considering opportunities for employees, students, and alumni to support campus action.

MOBILIZING EXTERNAL RESOURCES

In addition, Waterloo will need to mobilize external resources to support implementation.

Grants and Rebates: Waterloo should be prepared for funding opportunities from local, provincial, or federal funding sources, and ensure projects are identified for submission.

Campaign: Waterloo should place emphasis on the carbon neutral target and high-level actions, with more specific project funding opportunities such as:

- › Helping all new buildings cover marginal cost increases to become net-neutral/passive/zero-carbon
- › Deep energy retrofits to existing buildings that lead to net-zero
- › High-visibility renewable energy projects such as geothermal or solar systems
- › Living Lab projects that support student engagement and learning on campus
- › Signature initiatives such as the replacement of a steam plant with hot water

Research: Coupling operations and research opportunities can also connect to research funds that would support more leading-edge or higher risk research and development projects.

External Financing: Where internal funds are unavailable or where projects are very large, Waterloo should evaluate options for external financing.

Guaranteed Performance Contracts: Finally, Waterloo could consider guaranteed performance contracts with private sector partners. This model shifts risk to the third party for implementation, either through leveraging the external financing and savings, or underwriting the performance guarantee for identified projects.

Monitoring and Review

The *Shift*: Neutral roadmap will continue to evolve over time as technology advances, as stakeholders respond, as the University makes progress, and as scientific understanding of climate change increases.

The following mechanisms will support ongoing monitoring and review:

- › A tactical short-term project list will be created as an output of the existing building energy audit to expand the suite of concrete, tangible reductions taken through 2025
- › Waterloo will track implementation of the initiatives in this action plan, as well as annualized energy consumption and carbon emissions, as part of its annual Environmental Sustainability Report
- › Waterloo will integrate climate change as a key performance indicator within the Strategic Plan evaluation framework to ensure information reaches the broader University community and governance structures on a regular basis
- › Waterloo will update this document in 2025 for the next 5 year plan, including but not limited to:
 - Review of global, national, and local actions, commitments, and underlying science to ensure consistency in approach and action
 - Update on the 2025 and 2030 targets and progress made, with an intention to increase levels of commitment
 - Update of forecasts for BAU/trends
 - Establish a 2035 target
 - Update the list of projects that will help reach the 2030 and 2035 targets

APPENDIX A

**Appendix A –
Emissions Inventory (2018)**

2018 EMISSIONS PROFILE

Waterloo calculates emissions for Scope 1 (Direct), Scope 2 (Electricity), and select Scope 3 (Indirect) activities, described below in **Table 5** and **Figure 5**.

Table 5: Greenhouse Gas Sources and Quantities, 2018

Scope	Source	Emissions (Tonnes CO ₂ -e)	% of Total	Data Confidence
1	Natural Gas	36,535	58.6%	High (EF sourced from billed consumption)
1	Fleet	510	0.8%	High (EF sourced from billed fuel purchases)
2	Electricity	2,316	3.7%	High (EF sourced from billed consumption)
3	Commuting	11,700	18.8%	Medium (blended EFs sourced from extrapolated surveys)
3	Business Travel	10,300	16.5%	Low (modelled EFs with assumptions for flights, high quality for mileage but low % of total)
3	Waste	583	0.9%	High (EF sourced from weigh bills for disposal)
3	T & D Loss	409	0.7%	High (EF sourced from billed consumption)
TOTAL*		62,344		

*May not add perfectly due to rounding

For a detailed description of methodology, emission factors utilized, and explanations of change over time, visit Waterloo's Environmental Sustainability Report (uwaterloo.ca/sustainability/report)

Other sources not included:

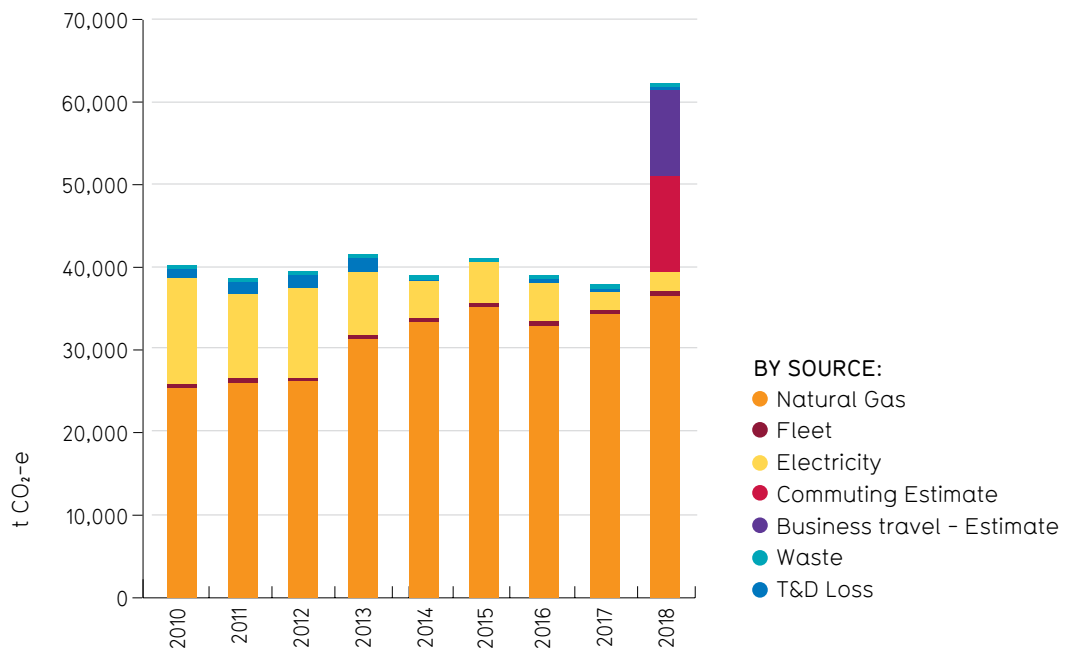
- **Fugitive emissions (Scope 1):** HFCs, SF6, and process emissions (De Minimis)
- **Fuel oil (Scope 1):** 5 tonnes (De Minimis ongoing but included in reported inventory)
- **Supply chain (Scope 3):** Expected this would be large for food, paper, clothing, electronics as significant commodities (No data)
- **Embodied carbon (Scope 3):** New construction steel & cement is very carbon intensive, but scale for the campus has not been determined (No data)
- **Water (Scope 3):** 11 tonnes (De Minimis* but included in reported inventory)

*De Minimis refers to sources which are too small to merit ongoing consideration and are usually omitted from the inventory.

In 2018, Waterloo added emissions from commuting and business travel based on new measurement and preliminary data available. It is expected that commuting and business travel emissions would have been comparable in prior years, gradually increasing alongside population growth, and would likely do the same in a BAU scenario.

Business travel includes mileage claims and flights, the latter being over 95 per cent of that portion of emissions. Flights are at the moment an order-of-magnitude estimate given very preliminary data. They are included here for context and will need to be further refined.

Figure 5: Historical Emissions, 2010-2018



APPENDIX B

Appendix B – Summary of Initiatives

TARGETS

Base Year	2025	2030	2035-45	2050
2015	-17.5% (Scope 1/2)	-35% (Scope 1/2)	TBC	Carbon neutral (All Scopes)

ALIGNING INSTITUTIONAL SYSTEMS

This section summarizes the initiatives listed throughout the document, and includes suggested timing for completion as well as key stakeholders who will lead and support implementation.

Area	Initiative	Timing	Leads and Supports
Strengthen institutional prioritization	1. Action: Draft an executive statement on climate action and the need to advance the objectives of the <i>Shift:</i> Neutral roadmap	2020	President's Office, Sustainability Office
	2. Action: Integrate institutional key performance indicators on carbon reductions against established targets and energy efficiency, to ensure ongoing monitoring and transparency	2020	IAP, Executive Council
	3. Action: Host a Town Hall with all senior administration and members of the campus community to catalyze awareness and support for climate action, and follow up with a survey of what additional training or support is necessary for university leaders	2020	Sustainability Office, Executive Council, IAP
	4. Action: Designate a position within senior administration to support ongoing coordination, accountability, and decision-making	2022	Executive Council
Increase monitoring and transparency	5. Action: Phase in submetering of core utility streams across campus buildings over the next 5-8 years and integrate an energy management information system	2025	Plant Operations, Housing
Align financial incentives	6. Action: Establish ongoing dedicated central resources to catalyze carbon and energy efficiency measures across campus stakeholders and operators	2020	Sustainability Office, Plant Operations, Provost's Office
	7. Action: Embed lifecycle costing processes and tools into a formal University guideline, using standardized cost assumptions and integrating carbon and utility pricing "stress tests"	2020	Sustainability Office, Plant Operations, Procurement
	8. Action: Advocate for funding bodies to integrate energy efficiency support within granting programs, and identify key carbon and energy projects requiring external funding support	2025	University Relations
	9. Consideration: Opportunities to pilot financial tools that would encourage energy efficiency will be considered	2022	Sustainability Office
Ensure capacity	10. Action: Ensure staff complement supports timely, high-quality, and professional project management and implementation while exploring funding resources for support	2025	Plant Operations
	11. Action: Initiate a training program for facilities operators covering energy and carbon management	2022	Sustainability Office, Plant Operations

IMPROVING ENERGY EFFICIENCY

Area	Initiative	Timing	Leads and Supports
Minimize impact of growth	12. Reduction: Update design guidelines for all buildings to net-neutral thresholds or similar performance-based criteria	2020	Plant Operations
	13. Consideration: Efforts to optimize space should be considered before constructing new buildings		Space Planning, Faculties
Reduce energy consumption of existing buildings	14. Action/Reduction: Complete an audit of campus buildings to determine a mix of short-term energy efficiency and carbon reduction projects (through 2025)	2020	Plant Operations, Sustainability Office, Housing
	15. Reduction: Prioritize whole-building redevelopment of Chemistry 2 as a high-intensity building with constant-flow fume hoods	2025	Plant Operations
	16. Reduction: Initiate a recommissioning program for top energy-consuming buildings to ensure controls and sequence of operations are operating as efficiently as possible	2021-2025	Plant Operations
	17. Reduction: Launch an environmental monitoring program to optimize and reduce air changes in labs spaces and vivarium	2022 - 2025	Plant Operations
	18. Reduction: Complete the ongoing high efficiency lighting retrofit by 2021	2021	Plant Operations
	19. Action: Develop a checklist to integrate energy and carbon assessment and requirements into all construction or renovation projects	2021	Plant Operations, Sustainability Office
	20. Consideration: Calibration and optimization of building scheduling and setpoints should be considered on an ongoing basis		Plant Operations
Move energy efficiently through the distribution system	21. Consideration: Recladding of buildings with high-performance envelopes should be considered whenever undertaking large building retrofits		Faculties, Plant Operations, Space Planning
	22. Reduction: Initiate a heat recovery project from the Graham Data Centre in Math and Computers	2024	Plant Operations
	23. Reduction: Continue fuel oil phase-out in the Central Plant	2025	Plant Operations
	24. Action: Initiate an assessment of the district heating system and feasibility of conversion from steam to high and/or low-temperature district hot water	2021	Plant Operations, Sustainability Office
	25. Action: Develop a Utility Master Plan to synthesize feasibility studies and drive long-term investment into district heating & cooling and associated infrastructure.	2023	Plant Operations, Sustainability Office
	26. Consideration: Heat recovery systems will be considered when making changes to HVAC equipment and infrastructure, at the building and district energy levels		Plant Operations
	27. Consideration: Management of simultaneous heating and cooling will be an important consideration when connecting buildings and systems to the district energy system		Plant Operations
	28. Consideration: Thermal and electrical energy storage systems will be considered as part of campus development to enable load-shifting, integration of renewables, and optimizing energy efficiency		Plant Operations

Area	Initiative	Timing	Leads and Supports
Engage building users	29. Reduction: Continue delivery of, and expand participation in, Green Office and Green Residences programs, and launch a Green Labs program with an emphasis on fume hood management and efficient equipment use	2022	Sustainability Office
	30. Action: Develop energy efficiency requirements for all major appliance and electronics purchases	2022	Sustainability Office, Plant Operations, Procurement
	31. Action: Launch and market a targeted incentive program for high-efficiency equipment	2022	Plant Operations, Sustainability Office
	32. Action: Develop a visual identity to raise the visibility of energy efficiency and carbon reduction projects	2020	Sustainability Office, Marketing
	33. Consideration: Stronger guidelines for shutdown procedures of IT equipment and personal computing equipment will be considered		Plant Operations, Information Systems & Technology
Improve fleet vehicle efficiency	34. Reduction: Introduce and enforce an anti-idling policy for all campus fleet vehicles		Plant Operations, Secretariat
	35. Reduction: Expand electric, hybrid, or hydrogen-powered vehicles within Waterloo's fleet through accelerated deployment	2025	Plant Operations, Vehicle Owners
	36. Action: Pilot data-logging tools to generate actionable information about utilization, behaviour gaps and user feedback, and suitability for electrification	2022	Plant Operations, Sustainability Office

LOW OR NO-CARBON ENERGY

Area	Initiative	Timing	Leads and Supports
	37. Reduction: Explore transition of REV from gas boilers to a ground source heat pump system as a pilot	2025	Plant Operations, Housing
	38. Action: Conduct a feasibility study on renewable energy sources and an appropriate portfolio that would diversify Waterloo's energy supply, minimize emissions, and meet suitable portions of campus needs	2022	Plant Operations, Sustainability Office
	39. Consideration: Air and ground source heat pumps will, where feasible, be considered for all new construction and for major retrofits to existing buildings or central systems		Plant Operations
	40. Consideration: Designated areas for potential future energy production sites, such as solar, wind, and geothermal should be considered as part of ongoing campus master planning		Plant Operations

REDUCE INDIRECT EMISSION SOURCES

Area	Initiative	Timing	Leads and Supports
Enable low-carbon commuting	41. Action: Develop an institutional Transportation Demand Management Plan to better evaluate options for and develop programs to support low-carbon commuting	2023	Parking Services, Sustainability Office
Reduce emissions from business travel	42. Action: Explore potential tools and guidelines that would reduce business travel where feasible, such as remote conferencing technology, and that would improve tracking of air travel impacts	2022	Sustainability Office, Finance, Faculties, Information Systems and Technology
Eliminate emissions from waste	43. Action: Continue implementation of the Zero Waste Action Plan, which will support reductions of waste-related emissions	2025	Waste steering committee
Minimize embodied carbon	44. Action: Integrate tools and resources to track embodied carbon	2022	Sustainability Office, Plant Operations
	45. Consideration: Integration of low-carbon materials into construction will be considered as part of future building design		Plant Operations

OFFSET REMAINING EMISSIONS

Area	Initiative	Timing	Leads and Supports
Offset Emissions	46. Action/Reduction: Develop a guideline to inform the long-term purchase or integration of carbon offsets	2022	Sustainability Office, Finance, Secretariat



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