# *Shift:* Neutral 2.0

**WATERLOO'S INTEGRATED CLIMATE, ENERGY, AND RESILIENCE PLAN**

UNIVERSITY OF WATERLOO


*Shift:* **NEUTRAL**

# Waterloo's Integrated Climate, Energy, and Resilience Plan

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# Acknowledgement

**The University of Waterloo acknowledges that much of our work takes place on the traditional territory of the Neutral, Anishinaabeg, and Haudenosaunee peoples. Our main campus is situated on the Haldimand Tract, the land granted to the Six Nations that includes six miles on each side of the Grand River. Our active work toward reconciliation takes place across our campuses through research, learning, teaching, and community building, and is co-ordinated within the Office of Indigenous Relations.**

# Executive Summary

University of Waterloo stands at a crossroads of campus development. Guided by the new Campus Plan, the coming decades will require major investments into renewal of buildings and infrastructure, and growth and modernization to meet future needs. At the same time, the world continues to accelerate, if unevenly and inconsistently, toward a clean energy future. Together, this creates an opportunity and an imperative to imagine the campus of the future as an efficient, resilient, and decarbonized community.

*Shift:*Neutral 2.0 builds on the first version of Waterloo's climate action plan. It is arranged around long-term outcomes, including net zero emissions, cost effectiveness, improvements to the quality of the campus, energy security, resilience, and the University's reputation for innovation and impact. Key performance indicators within each of these outcomes are yardsticks by which Waterloo can measure its progress and success.

DECARBONIZATION

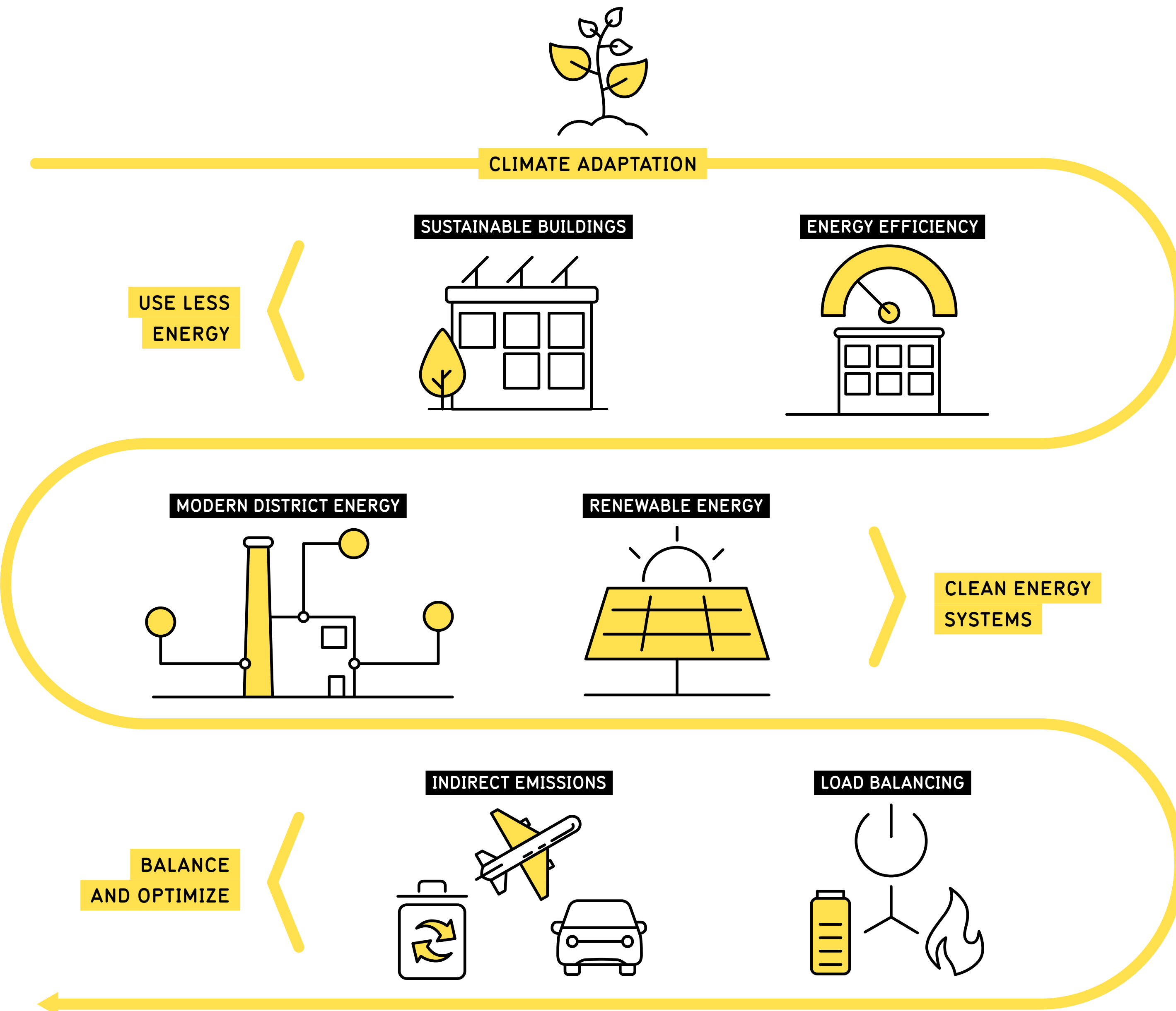
COST-EFFECTIVENESS

HIGH QUALITY SPACES

ENERGY SECURITY

RESILIENCE

REPUTATION




*Shift:*Neutral 2.0 scaffolds additional detail, further planning, and clearer actions over the coming decades. Under the themes of Sustainable Buildings, Energy Efficiency, Modern District Energy, Clean Energy, Load Balancing, and Indirect Emissions Reductions, the *Shift:*Neutral roadmap outlines the types of activities Waterloo will undertake to reduce emissions while embedding climate adaptation.

This is a multi-decade journey that will take place over three major phases, corresponding with the conversion of the current District Energy system into three nodal energy plants. Over the next five years, from 2026-2030, prioritization will be on energy efficiency measures, planning for the initial phase of district energy conversion, and piloting projects for deeper building-level renewal and renewable energy.

# Introduction

## THE BIG PICTURE

The world has changed rapidly since Waterloo launched *Shift:*Neutral, its first climate action plan, in early 2020. On the one hand, climate action has become deeply polarized along political lines, and has been overshadowed by imminent public health, affordability, and geopolitical crises. Many analyses show that efforts to reduce greenhouse gas (GHG) emissions will not be fast or significant enough to meet the goals of the Paris Agreement,[1] which aimed to limit global temperature rise between 1.5-2.0°C.

On the other hand, clean energy and decarbonization actions have expanded far beyond forecasts from five years ago.[2] Investment into clean technology has outspent that into coal, oil, and gas since 2022, the first half of 2025 saw electricity generated from renewable energy sources greater than electricity from coal for the first time in history,[3] and electric vehicles are rapidly eating into the global automotive market share.[4] Thanks to this progress, the worst trajectories of a 4°C+ warmer world are likely avoided.

**Figure 1:** Tensions in global climate action

| Rising Challenges | Promising Trends |
|---|---|
| Decline in US leadership on global climate policy, clean technology and decarbonization | Global shift to industrial policy to support clean tech jobs and emerging economic sectors |
| Heightened political polarization of climate policies and clean energy | Accelerating deployment of wind, solar, batteries and electric vehicles in many markets |
| Deep geopolitical concerns about energy security and affordability | Continued cost declines in clean energy technologies to compete with fossil fuels |
| Continued rise in total global GHG emissions consistent with 2.7-3.1°C warning | Plateauing and declining GHG emissions in many countries and avoiding >4°C trajectory |

Many of these mixed directions are also present in Canada. Changing regulatory and political landscapes have led to the rise and fall of carbon pricing, changes in energy efficiency and decarbonization incentive programs, and widening political divides. The electricity sector is straining as demand is rising significantly for the first time in over 20 years due to electrification, industry, and data centers. In Ontario, almost uniquely in a global sense, the electricity grid has and will continue to get dirtier as it relies more on gas generation through the mid-2030s, a reversal of the previous trend of becoming cleaner when coal power was eliminated.[5] This makes it more difficult for organizations, including Waterloo, to reach emissions targets at the local level.

## THE CAMPUS INFLECTION POINT

University of Waterloo is also in a moment of tremendous change. Large pressures on operational budgets, lower rates of enrolment growth, and rapid shifts in the role of the higher education sector in light of AI and political uncertainty will require Waterloo to respond and adapt in unprecedented ways.

Waterloo's physical spaces are also transforming. Technology-enabled and flexible classrooms, cutting-edge research facilities, and digitization and increased connectivity are reshaping educational and innovation opportunities. Concerted efforts around Indigenization, accessibility, decolonization, and health and wellbeing are guiding the quality and holism of spaces desired and needed by the campus community.

Many parts of Waterloo's core infrastructure – buildings, pipes, HVAC equipment, boilers, chillers, and electrical systems – date back to the 1960s and 1970s and are approaching their end of life. They will need major investment to meet the rising academic and community demands being placed on them.

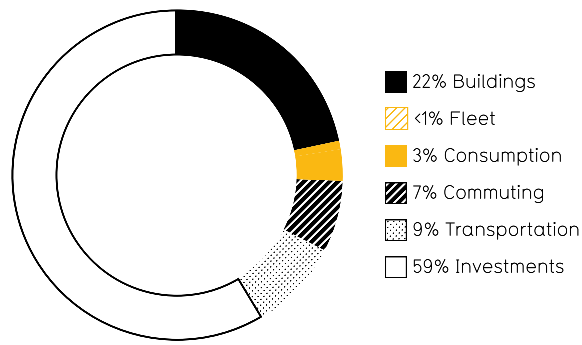
While the scale of that renewal is daunting, it is a critical opportunity to align it with future-ready energy systems for the next 50 years of development. With effective planning and coordination, Waterloo can move from risk of regulatory compliance to proactive implementation, from technological obsolescence to modernization, from rising utility bills to control over energy costs, from stranded assets to future-proofed investments, and from stakeholder dissatisfaction to engagement and leadership.

## CURRENT PERFORMANCE

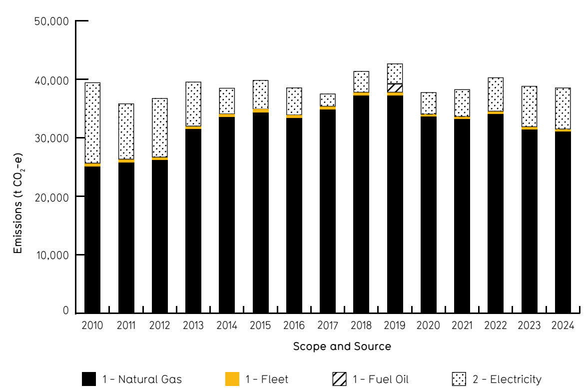
Waterloo emits GHG emissions from many sources, as illustrated in **Figure 2**. The vast majority are outside the direct control of the University, through its supply chain, travel, and investments. Referred to as "Scope 3" emissions through the GHG Protocol, these are important to manage and are being addressed through Waterloo's commitment to responsible investing, the *Shift:*Zero Waste Action Plan, the *Shift:*Mobility Sustainable Transportation Plan, and policies for sustainable procurement. A detailed breakdown of Waterloo's emissions inventory is available in **Appendix A** and as part of the annual public Environmental Sustainability Report.

**Figure 2:** GHG sources (2024) and scope 1 and 2 changes over time

**Where do GHG emissions come from?**




**How have direct GHG Emissions changed?**

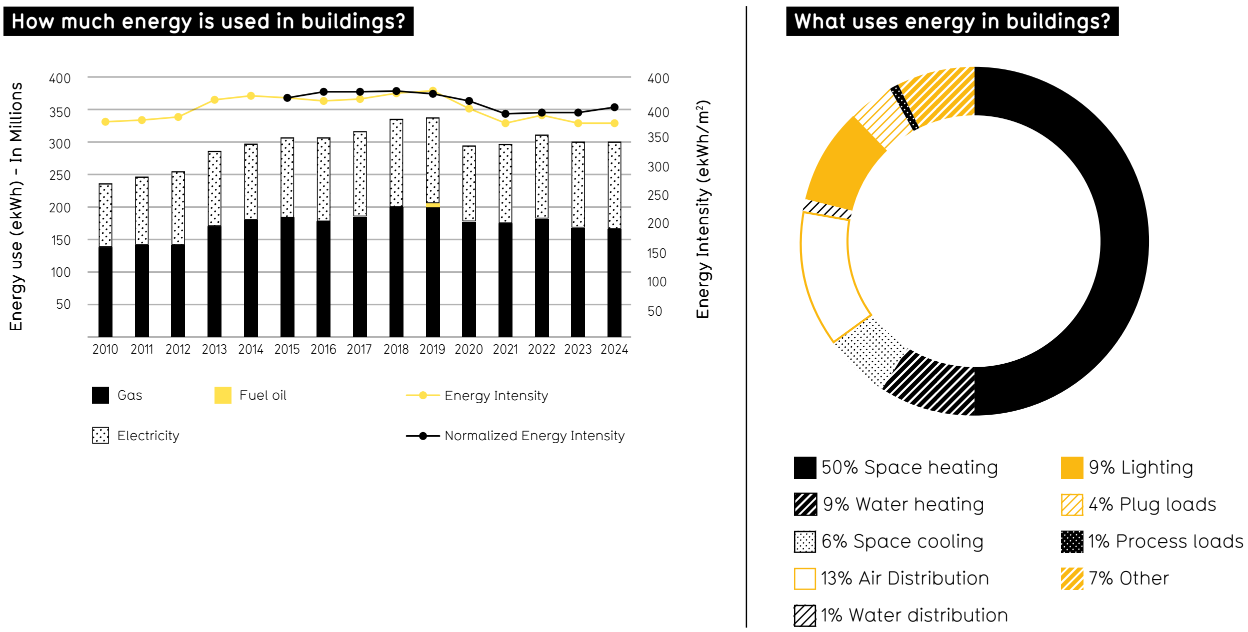



*Shift:*Neutral focuses on the most direct sources of emissions, specifically those related to campus buildings and infrastructure. These energy-related emissions had been slowly increasing from 2010 through 2019, influenced by campus growth of over 100,000 square meters during this timeframe. However, the provincial phase-out of coal power offset much of this growth, creating fewer emissions even though electricity use was increasing.

These two trends reversed in the late 2010s and early 2020s: Waterloo's investments in energy efficiency and decarbonization reduced almost 20% of emissions from gas, while Ontario's electricity grid began to get dirtier, increasing Waterloo's electricity emissions. Although the electricity grid is projected to improve in the long-term, the short-medium time horizon will lead to increasing emissions from electricity, regardless of campus action.

As a diverse campus with classroom, laboratory, residence, athletic and recreational, office, food and dining, museum, and library spaces, energy is used for many different purposes. As illustrated in **Figure 3**, an estimated half of all energy is used for space heating, with other major end-uses including water heating, space cooling, ventilation and air distribution, lighting, and the plug loads of equipment, computers, and devices.

**Figure 3:** Energy use in campus buildings




The most significant contributor to both energy use and overall GHG emissions is thermal energy for space and water heating, which is primarily supplied by gas. How the campus heats its buildings going forward will be the biggest critical path and inflection point around which *Shift:*Neutral is built, and for which all other actions and initiatives play enabling and supporting roles.

While limited in its direct GHG emissions and energy impacts, Waterloo also must expand planning for water efficiency. Rising costs and local constraints will make water conservation and reuse an increasingly important issue to address in the coming years. This is best developed through a Water Conservation Plan, but several actions within *Shift:*Neutral create important water savings benefits that should be considered.

## DEVELOPMENT PROCESS

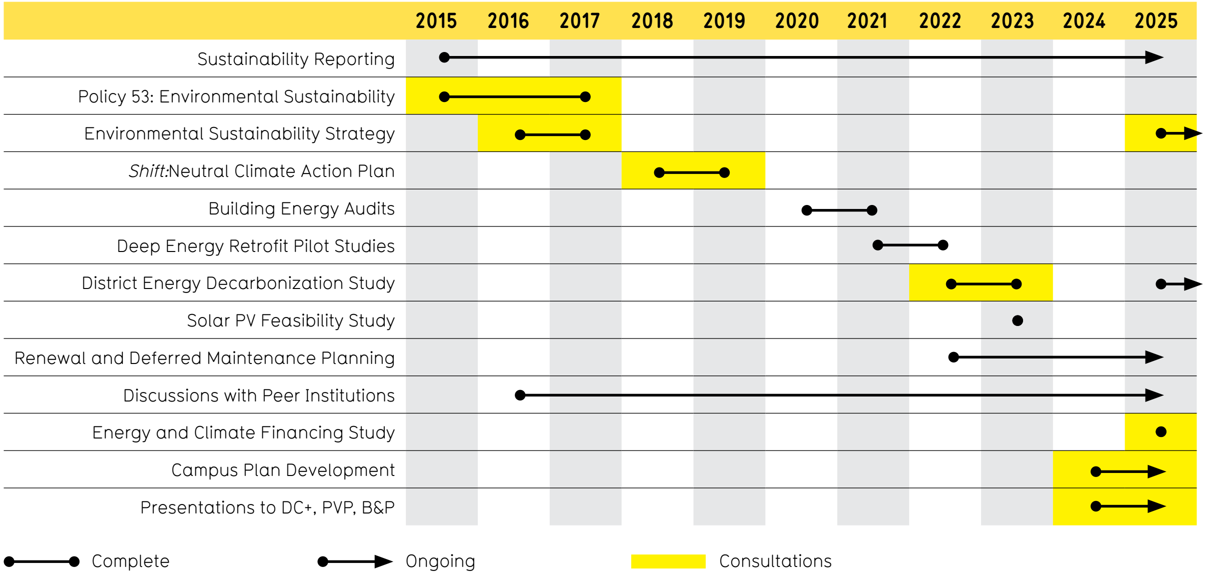
*Shift:*Neutral has evolved through significant campus feedback. In both the 2016 and 2024 campus-wide sustainability surveys, climate action and energy efficiency emerged as the top priority across employees and students. With over 1,500 responses to the survey in 2024, this signaled a clear level of support from the campus community.

The 2020 version of *Shift:*Neutral was based on a broad understanding of the systems that would need to be changed over time. *Shift:*Neutral 2.0 "scaffolds" additional detail and context, drawing in the findings and outcomes of multiple feasibility studies, audits, and consulting expertise that have been completed over the past five years, as shown in **Figure 4**.

In addition to technical assessments, there have been many conversations around campus to build support and input, including but not limited to:

- Including key units as part of the Climate and Energy Working Group,
- Facilitating consultations with faculties and other partners on feedback within the district energy decarbonization study,
- Integrating energy and climate metrics into ongoing discussions with faculties and large space owners on building condition and facilities management,
- Presenting more consistent updates and evolving planning directions to senior leadership, including Deans' Council, the President and Vice Presidents' group, and the Board of Governors and its various committees, and
- Connecting broad energy and decarbonization requirements and actions within the Campus Plan.

**Figure 4:** *Shift:*Neutral development process



# Climate Action Framework

## TARGETS AND DESIRED OUTCOMES

Change at the scale of campus energy systems is highly complex and connects to many systems. While pursuing decarbonization is the key focus for *Shift:*Neutral, it cannot be the only outcome. Waterloo's emissions reduction actions must also deliver high quality facilities that enable world-class teaching and research, strengthen energy security, and should enhance Waterloo's reputation for innovation and creativity, while being cost-effective in a resource-constrained environment.

## TABLE 1: OUTCOMES AND TARGETS

| Outcome | | Metrics | Targets |
|---|---|---|---|
| **Decarbonization** | Achieve deep GHG emissions reductions consistent with reaching carbon neutrality by 2050 across direct and indirect sources. | Total GHG Emissions | Carbon neutral by 2050<br>Interim targets:<br>15% by 2030 (Scope 1)<br>30% by 2035 (Scope 1+2) |
| **Cost-effectiveness** | Pursue cost-effective solutions and strategies, keeping lifecycle costs comparable to those under a risk-adjusted business-as-usual case. | Lifecycle Cost<br>Utilities Costs | Net present value comparable with that of risk-adjusted BAU<br>Decrease to annual utility budget against BAU |
| **High quality spaces** | Renew and modernize spaces to support teaching and research, reducing deferred maintenance and improving occupant comfort. | Facilities Condition Index (FCI)<br>Occupant Satisfaction | Reduction in FCI from BAU<br>Improvement in dashboard of satisfaction metrics from surveys, service calls, trend data, and standards. |
| **Energy security** | Reduce energy consumption and create reliable and diversified energy sources to withstand disruption and change. | Total Energy Use<br>Energy Diversification | Average 1% per year energy reduction<br>N+1 redundancy for heating<br>Renewable energy supply mix |
| **Resilience** | Improve campus preparedness and manage increasing direct and indirect climate extremes and environmental impacts. | Composite Resiliency Index | Establishment of baseline composite resiliency index |
| **Reputation** | Enhance Waterloo's reputation for innovation and empower creativity by using the campus as a Living Laboratory. | Global Rankings and Ratings | AASHE STARS Gold<br>Top 5% in QS Sustainability |

As noted below, these outcomes must be compared against a business-as-usual scenario, reflecting internal and external changes over time. And, they should also adjust for risks such as compliance and renewal to create an accurate comparison.

## GUIDING PRINCIPLES

Considering the many opportunities available to achieve these outcomes, the following broad principles have helped guide the selection of specific technologies and systems.

### Figure 5: Principles for action

**EFFICIENCY FIRST**
Reducing energy use is a priority. The most sustainable and cost-effective energy is energy that is not needed.

**LONG-TERM THINKING**
The campus is designed to last. Planning decisions should reflect the total cost of asset stewardship and long-term future-proofing.

**FEASIBILITY**
Tolerance for failure is low. Priority should be focused on proven and market-available solutions that can be deployed, operated, and maintained today.

**FLEXIBILITY**
Technology changes rapidly. Systems built today should expand opportunity for new solutions to integrate over time.

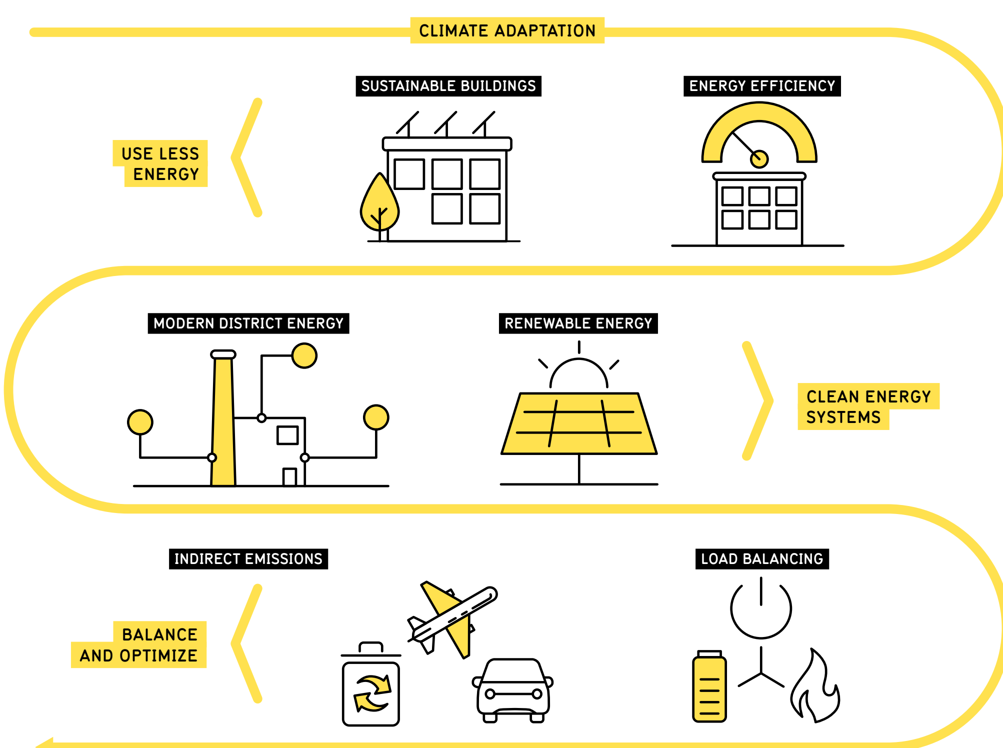
**ADAPTABILITY**
Disruption will come. Campus systems will need to prepare for changing climate risks and rising prices.

## ACTION ROADMAP

*Shift:*Neutral includes seven areas of action, which are highly interdependent and mutually reinforcing. These are visualized sequentially based on the principles above, but individual projects and actions would often run in parallel. Collectively, they help the campus use less energy, convert to clean energy sources, balance energy loads, and optimize indirect emissions.

1. **Sustainable Buildings:** Waterloo will pull back its rate of growth, and ensure any new construction meets stringent sustainability standards.
2. **Energy Efficiency:** Waterloo will improve the energy efficiency of its buildings, to minimize the amount of energy that needs to be decarbonized.
3. **Modern District Energy:** Waterloo will phase in the conversion of a hot water district energy system arranged into three major nodes, phasing out gas and prioritizing geo-exchange and other low-carbon thermal energy.
4. **Renewable Energy:** Waterloo will deploy solar photovoltaics on rooftops, parking lots, and select open spaces to provide clean power.
5. **Load Balancing:** Waterloo will integrate energy storage, load controls, and fuel switching to manage costs and increase control over electric infrastructure.
6. **Indirect Emissions:** Waterloo will continue work to reduce other indirect sources of emissions from transportation, its supply chain, waste, and other sources.
7. **Climate Adaptation:** Woven through each of the above action areas, Waterloo will plan for changing climate conditions and increase resiliency.

**Figure 6:** *Shift:*Neutral action roadmap



When compiled, it is expected that these actions will have a cumulative effect that achieves steep emissions reductions by 2050. Waterloo uses a 2015 base year when setting targets, as it is representative of the historical average climate conditions that would place load on heating and cooling systems, and it is closer to the expected near-medium term emissions intensity of grid-purchased electricity. It is also important to compare campus efforts to the baseline – the alternative scenario that would occur if campus operations continued in a "business as usual" manner. This dual comparison helps clarify changes that are expected above and beyond the University's control, for better or worse, as well as internal decisions and changes that must be made explicitly and intentionally. As such, this plan includes two representative scenarios:

- **Business as Usual (BAU):** Where Waterloo makes limited further investment into energy systems and decarbonization and operates and develops the campus largely consistent with historical practices.
- ***Shift:*Neutral:** Where Waterloo fully implements the pillars and actions outlined in pages 14 through 29, focusing specifically on campus energy systems and Scope 1 and 2 emissions. Complementary planning for Scope 3 is referenced in **Section 9 on page 32**.

**Figure 7:** Estimated emissions reduction pathway ($tCO_2$-e, Scope 1 and 2)

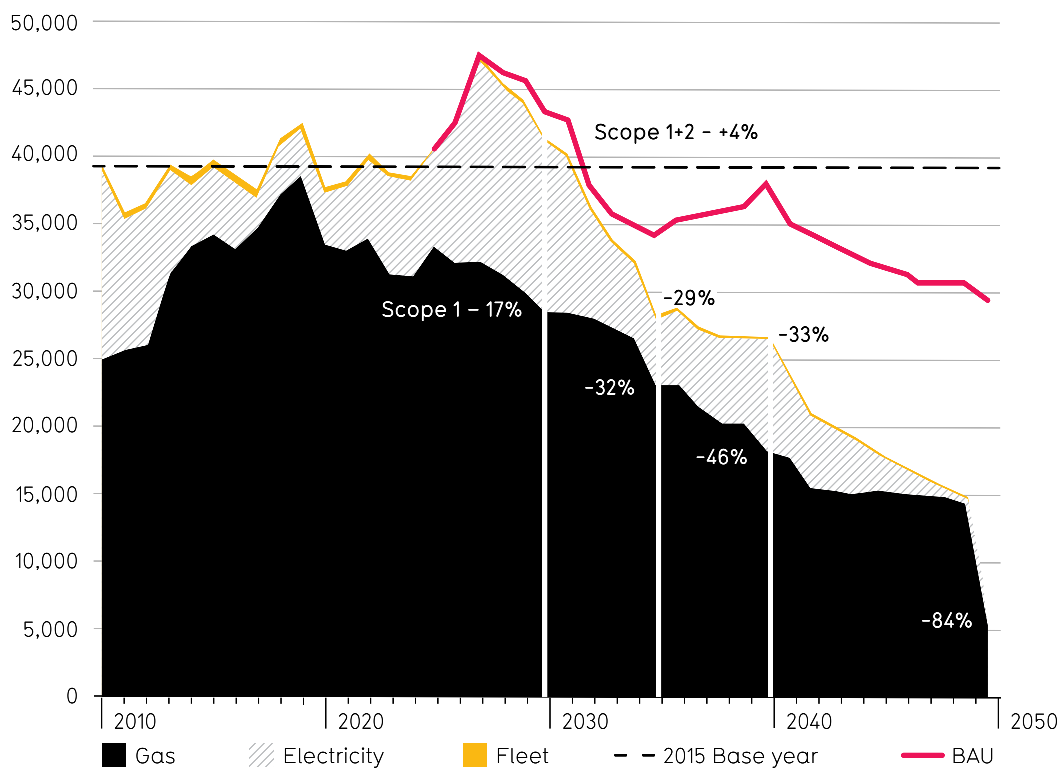
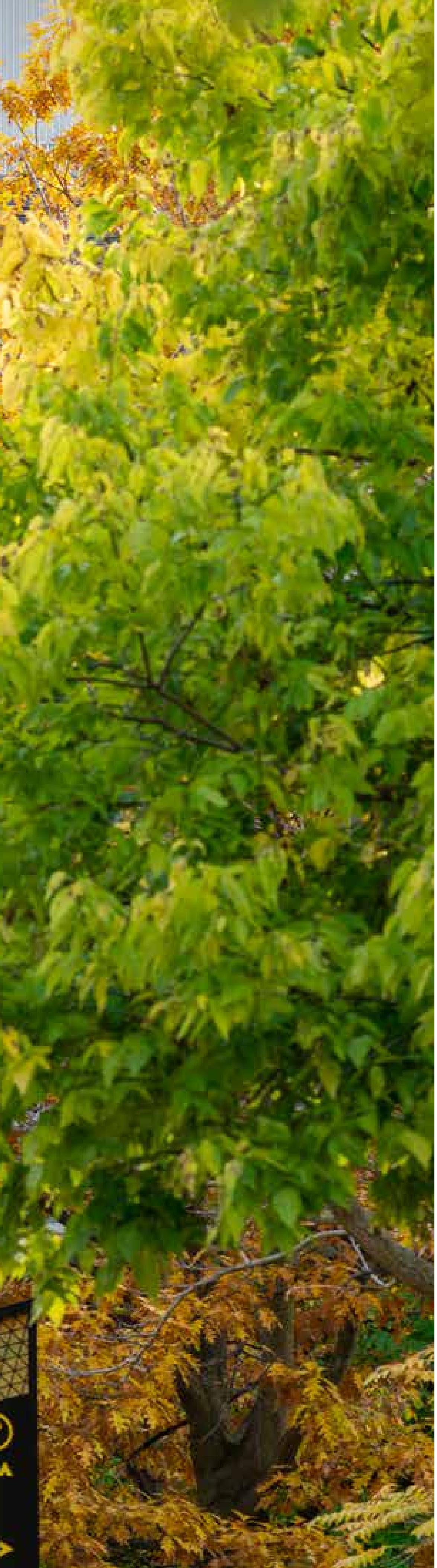



**Figure 7** illustrates estimated emissions reductions over time within the *Shift:*Neutral Scenario. Total Scope 1 and 2 emissions will increase over the next 5 years as the provincial electricity grid becomes more GHG-intensive. Implementation of energy efficiency projects, electrification, and renewables will continue to drive down energy and emissions overall, with emissions reductions accelerating as the grid becomes cleaner in the later 2030s. Additional Energy Efficiency actions will be added to this pathway over time as more opportunities are identified, further accelerating short and medium-term reductions. The roadmap above is solely intended to identify potential impacts of project implementation.

# Climate Adaptation



To date, Waterloo has not had a clear approach to climate adaptation. However, the increasing severity and frequency of climate extremes over the past several years have made it clear that there is a crucial need to consider adaptation within campus planning and climate action.

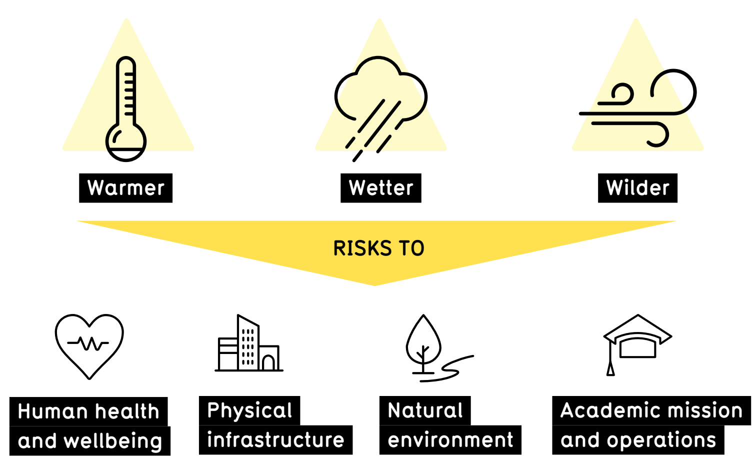
It is important to note that physical and indirect climate risks will materialize regardless of University action. In scenarios where the world takes aggressive measures to reduce GHGs, climate risks will not go away, but they remain manageable. In scenarios where emissions do not drop quickly, risks become more severe and their likelihood or frequency also increases.

Waterloo cannot meaningfully avoid or mitigate the severity of these risks, but it can reduce its vulnerability to them. This section outlines preliminary considerations to increase resiliency and preparedness generally, with specific consideration for climate mitigation and energy planning.

## PHYSICAL CLIMATE RISKS

A changing climate will pose numerous direct physical risks to University of Waterloo, and these risks can be heavily localized. As a useful organizing framework, *Shift:*Neutral 2.0 draws upon the Region of Waterloo's climate adaptation plan,[6] which describes how the local climate will be "Warmer, Wetter, and Wilder".

**Figure 8:** Key climate physical risks (adapted from Region of Waterloo)



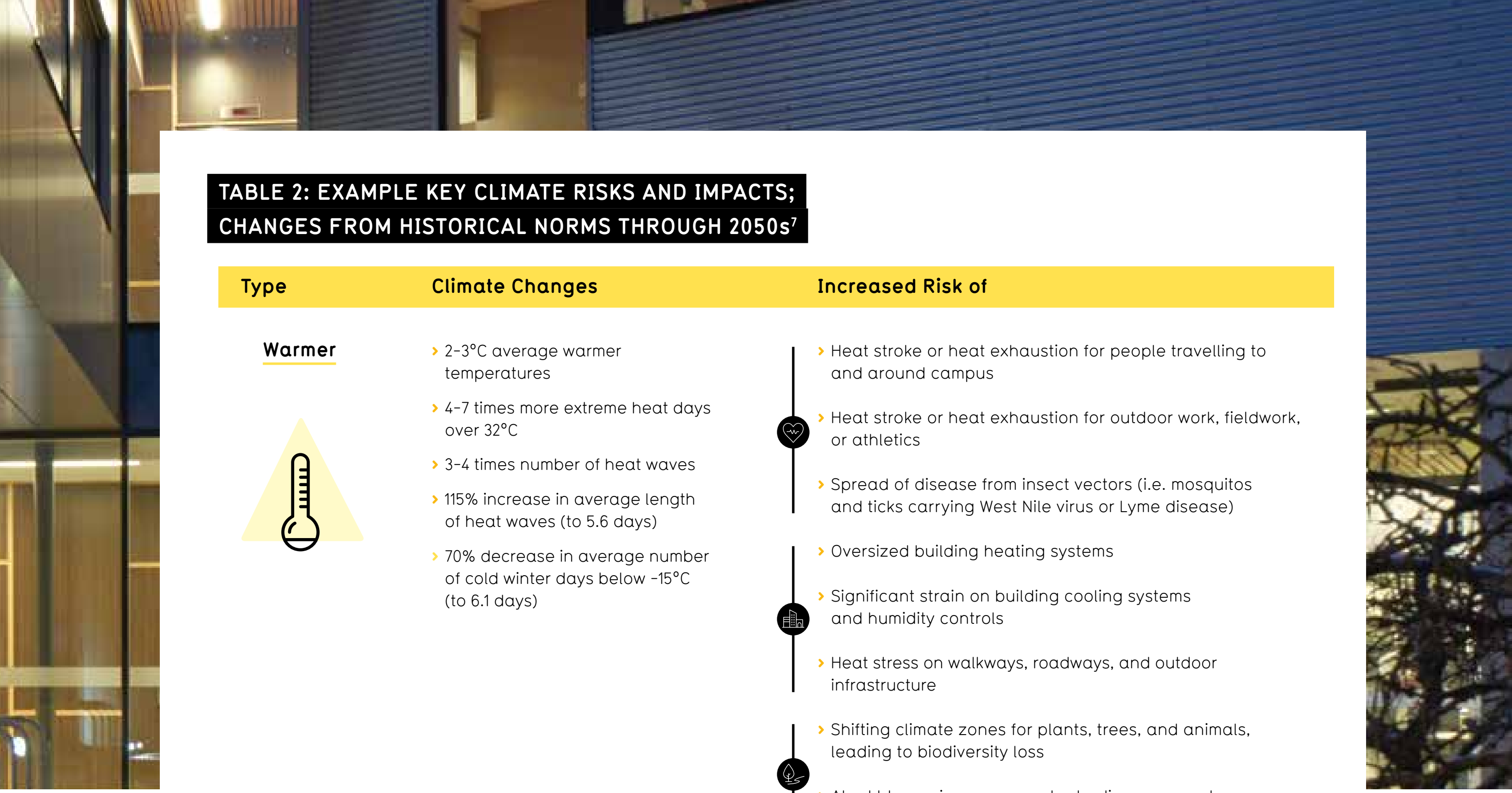

In turn, these changes to the climate create risks to human health and wellbeing, physical infrastructure, the natural environment, and the local economy. **Figure 8** illustrates a high-level visualization adapted from the Region of Waterloo's plan, focusing on the University's academic mission and financial stability in place of the local economy.

**Table 2** draws on several relevant sources to identify a subset of likely changes in the local climate, and shows examples how these could increase various risks to the campus in the categories of:

- human health and wellbeing
- built environment
- natural environment
- campus mission

In addition to, and embedded in each of the above, Waterloo is already experiencing impacts on mental health from a changing climate. This can be both a result of post-traumatic stress from dealing directly with physical climate impacts, and from deep feelings of anxiety, grief, and worry about the future. These feelings are broadly referred to as "eco anxiety", "climate grief," or some combination. Although all age categories report dealing with climate grief, there is increased reporting about the heightened impact on youth. A 2021 survey of over 10,000 youth aged 16-25 from across 10 countries, for example, found that over 95% were at least a little worried about climate change, with majorities reporting that it made them feel sad (68%), afraid (68%), anxious (63%), angry (58%), powerless (57%), and guilty (51%).[9]

Related to and somewhat distinct, there is also an emerging feeling of loss for a built and natural landscape that is becoming increasingly unrecognizable. Often referred to as "solostalgia", this can evoke deep pain for the disappearance of what was thought of as "home" by many. The breaking of economic, social, and spiritual connections with familiar physical places can have even higher impacts among Indigenous communities, farmers, and others who traditionally have stronger ties to the land.[10]



## TABLE 2: EXAMPLE KEY CLIMATE RISKS AND IMPACTS; CHANGES FROM HISTORICAL NORMS THROUGH 2050s[7]

| Type | Climate Changes | Increased Risk of |
|---|---|---|
| **Warmer** | › 2-3°C average warmer temperatures<br>› 4-7 times more extreme heat days over 32°C<br>› 3-4 times number of heat waves<br>› 115% increase in average length of heat waves (to 5.6 days)<br>› 70% decrease in average number of cold winter days below -15°C (to 6.1 days) | › Heat stroke or heat exhaustion for people travelling to and around campus<br>› Heat stroke or heat exhaustion for outdoor work, fieldwork, or athletics<br>› Spread of disease from insect vectors (i.e. mosquitos and ticks carrying West Nile virus or Lyme disease)<br>› Oversized building heating systems<br>› Significant strain on building cooling systems and humidity controls<br>› Heat stress on walkways, roadways, and outdoor infrastructure<br>› Shifting climate zones for plants, trees, and animals, leading to biodiversity loss<br>› Algal blooms in campus water bodies or spread of invasive species<br>› Larger losses of instructional time or work hours<br>› Reduced productivity during warm periods |
| **Wetter** | › From 6.8 to 8.5 heavy precipitation days (>20mm)<br>› Longer periods of drought or dryness between precipitation<br>› 40-45% increase in freezing rain events from December – February<br>› Potential snowfall increases[8] | › Slips and falls due to freezing rain<br>› Traffic accidents, bus delays, and other transportation impacts due to freezing rain<br>› Increased flooding risks in areas with poor drainage<br>› Structural strain on roof capacity<br>› Increased need for snow clearance and de-icing<br>› Increased salt into drinking water<br>› Loss of drought-intolerant plants from watering restrictions<br>› Vegetation die-offs and soil erosion due to dry/wet cycles<br>› Larger losses of instructional time due to campus closures<br>› Increasing staff requirements and costs for winter maintenance |
| **Wilder** | › 20-40% increase in wind gusts >70km/h<br>› Increased wildfire smoke and local air pollution<br>› More intense storms | › Respiratory and other illnesses from exposure to particulate matter and other pollutants<br>› Decreased indoor air quality due to ventilation limits during periods of poor outdoor air<br>› Direct physical harm from extreme weather and intense winds<br>› Damage to building envelope and outdoor assets from extreme weather<br>› Loss of power due to downed local power lines<br>› Downed trees and branches from high wind gusts and storms |

## INDIRECT CLIMATE RISKS

These same risks also impact society and the economy around the world. Although risk profiles will be different, the much wider range of climate impacts globally will also have indirect impacts on Waterloo, even if specific instances of climate change damages do not directly affect the campus or campus community.

While not meant to be exhaustive, the following are several potential examples of climate impacts that will have indirect risks to Waterloo over time:

- **Population health:** Climate change could cost the Canadian healthcare system hundreds of billions of dollars in additional expenses by end of century, through the risks identified above and more.[11] This can mean fewer resources to support other health needs from the campus community.

- **Food security:** Food systems globally are already under threat. Nationally, in 2016 almost 40% of post-secondary students were food insecure, as were about 20% of overall households.[12] In 2022, the Canadian Campus Wellbeing Survey at Waterloo flagged that over 17% of students already cut the size of meals or skip meals because they didn't have money for food.[13] As climate change impacts agriculture globally through drought, fire, and pests, there have been record increases in food prices and in some cases inability to secure some foods at all.

- **Energy security:** With increased wind and extreme weather, there is higher likelihood of disruptions to electricity infrastructure at multiple scales. Extreme heat also increases demand on the electricity system and reduces capacity. These could lead to more frequent instances of power loss, rolling brownouts, as well as increased costs.

- **Supply chain:** Waterloo's global supply chains will face pressure from climate impacts in distant areas. This could include closures due to extreme weather, shipping and transportation risks, or unavailability or heightened costs of certain commodities.[14]

- **Partnership impacts:** As Waterloo builds global academic and non-academic partnerships, global climate risks will be more important to monitor. Although sea level rise, more intense hurricanes/typhoons, and wildfires, for example, are less likely to directly affect University of Waterloo, they could very directly impact partners where Waterloo may have funding relationships, joint travel, research infrastructure, and other connections.

- **Macroeconomic stability:** At the largest scale, climate change is an accelerator of many other economic challenges and pressures. Repeated bodies of research are concluding that long-term consequences to the global economy and productivity may be far higher than previously estimated,[15] which will and are already having knock-on effects for government budgets, investments, partners, donations, and ultimately enrolment considerations for the higher-education sector.

Because these are bigger picture indirect risks to University of Waterloo, there are limited interventions that the University can take. Prudent planning, diversification, and redundancy can nevertheless reduce exposure and vulnerability as risks emerge.

## INTEGRATION IN *SHIFT:*NEUTRAL PLANNING

Emerging climate impacts and risks have been woven through the key actions within *Shift:*Neutral, under the principle of resiliency. For clarity, climate adaptation risks have influenced the prioritization of the following within the emergent framework:

- **Passive design and efficiency:** In times of power disruptions, cost spikes, and extreme heat, having well-insulated and highly efficient buildings inherently buffers the impacts to campus.

- **Redundant energy systems:** Solar PV, batteries, and fuel switching allow for increased redundancy when disruptions to a single service occurs.

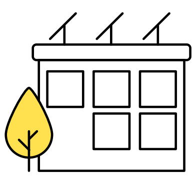
- **Energy partnership:** Strengthening planning and integration with community partners can help transfer some risk and create a diversification of energy sources and networks.
- **Greater control:** Digitization, variable speed, and demand-controlled systems give building operators more flexibility to respond to rapidly changing energy needs compared to static or pre-programmed setbacks.
- **Energy load projections:** Modelling and system design has integrated projected changes to the space heating and space cooling loads based on warmer weather, creating more likely long-term forecasts.

## ADAPTATION RECOMMENDATIONS

Beyond the energy and climate mitigation focus of *Shift:*Neutral, the following are preliminary focus areas for additional climate action planning and preparation that should be actioned in the coming years:

1. **Stormwater management:** Update stormwater management and flood mapping documentation and develop a stormwater management plan.
2. **Roof capacity:** Update evaluation of roof structural capacity and integrate consideration of increased snow loads within roof designs and replacements, aligned with CSA S502-21.
3. **Salt and ice management:** Update standard operating procedures for salt application to ensure safety while minimizing impact to drinking water and the natural environment, and identify passive snow and ice removal strategies.
4. **Outdoor shading:** Significantly expand natural or engineered shading structures throughout the campus, including through parking lots and outdoor community spaces, to reduce the heat island effect.
5. **Species planting lists:** Review and update the species planting list for trees and plants to prioritize drought tolerance, water absorption, and heat tolerance as appropriate to the planting site.
6. **Inclement weather closures:** Review and update policies and procedures for closings to include risks such as extreme heat or poor air quality.
7. **Outdoor work guidelines:** Review and update guidelines and procedures for work taking place outdoors, operations, classroom, or research purposes, to prioritize safety.
8. **Supply chain:** Identify areas of highest risk throughout the University's supply chain, and explore options for diversification for critical supplies as needed.
9. **Food system:** In addition to supply chain management, expand on-campus food production where possible, and strengthen food security support services.
10. **Partnership:** Integrate climate risk criteria across global partnerships, including areas such as considerations for travel, public health, and exposure to climate extremes.
11. **Increased mental health support:** Strengthen institutional services and resources for individuals suffering from climate anxiety and post-traumatic stresses.
12. **Connection to community:** Collaborate with community partners on adaptation planning, including through exploring use of University buildings as designated cooling or resiliency centers, as appropriate.
13. **Community resources:** Connect students and employees in timely ways to relevant community resources, including those related to housing, energy, and emergency response.
14. **Communications:** Aligned with policy review, strengthen communication to alert members of the campus community to risks as they emerge, and ensure communications reference climate connections.


# Sustainable Buildings



Waterloo currently has over 800,000 square meters of space across 150 buildings. From small residential buildings to complex and multi-purpose advanced research labs, these spaces support a range of mission-critical needs.

This pillar focuses on reducing the physical growth of the campus, redirecting investment into modernization of existing spaces, and ensuring all new construction is highly efficient and sustainable.

## Connection to principles

**EFFICIENCY FIRST**
Emphasizes building less and building better. Slowing the rate of growth and removing select existing building stock can put downward pressure on energy use.

**LONG-TERM THINKING**
Ensures all new construction is net-zero ready to avoid future transition costs and liabilities, as well as prioritizing total cost of ownership.

**FEASIBILITY**
Redirects investment from growth to maintaining and modernizing existing spaces. It will be difficult if not impossible to do both with limited capital dollars.

## BUILDING LESS AND OPTIMIZING SPACES

Waterloo has grown rapidly since its start in the late 1950s, investing significantly in new spaces. While the Campus Plan identifies areas of continued growth, it scales back significantly the rate of change seen pre-2020. *Shift:*Neutral assumes that there is less net space growth through 2050 compared to historical and business-as-usual. This has a high impact on emissions, energy use, and utility expenses, while switching capital costs toward maintenance and renewal of existing spaces.

## TARGETED DEMOLITIONS

Waterloo will maintain and renew the vast majority of its buildings, preserving embodied carbon within the existing built environment. Several academic, administrative, and residential buildings, however, are identified as candidates for demolition to support operational needs. These include AL, UC, SCH, EC 1-5, V1, Minota Hagey, and UWP Beck/Eby. In most cases, these buildings would have phased replacements.

## NET ZERO CONSTRUCTION

Waterloo will design new buildings to the highest sustainability standards, pursuing steep reductions in energy use intensity as well as prioritizing low-carbon design. Shaped by the Sustainable Building Guideline, this includes passive design principles, energy performance targets, and an electrification pathway for buildings beyond the district energy system.

# Energy Efficiency

Improving the efficiency of campus buildings and infrastructure is crucial to cost-effectively achieving climate and energy targets. While it is possible to achieve decarbonization objectives solely through electrification and district energy, right-sizing energy infrastructure is important. These efficiency projects can be undertaken in some cases as standalone energy projects, but will often be bundled with renewal, modernization, and renovation projects. As noted in **Section 11 on page 35**, incentives for investment in energy efficiency through the Revolving Fund can support high-payback and quick-win projects, while projects with longer paybacks can align with campus renewal.

## Connection to principles

**EFFICIENCY FIRST**
Significantly reduces the heating demands on an electrified system and the amount of energy to be supplied by renewables.

**LONG-TERM THINKING**
Aligns major equipment and full-building retrofits with ongoing capital renewal and lifecycle planning.

**FEASIBILITY**
Utilizes well-established technologies while leaving room for new innovations and emerging technologies. Generates substantial lifecycle savings. Prioritization is given to efficiency projects with most competitive ROI to accrue savings faster.

**RESILIENCY**
More efficient buildings can withstand energy disruptions, maintain thermal comfort during extreme temperatures, and reduce energy security risks.

## CONTROLS AND OPTIMIZATION

Waterloo will continuously optimize its buildings and infrastructure, through regular fine-tuning of controls, sequences of operation, and recommissioning. All buildings will undertake a recommissioning exercise within the first three years of the plan, which can lead to 2-30% energy efficiency improvements at the building scale. As buildings naturally drift over time, this will need to be completed on regular intervals to maintain performance, comfort, and effectiveness.

## LIGHTING EFFICIENCY

Waterloo will phase out remaining fluorescent light bulbs across the campus, replacing them with high-efficiency LED bulbs. Strategies for de-lamping and lighting controls will be integrated where feasible. Although reduction of lighting loads can lead to a slight increase in emissions when looked at in isolation (as the avoided waste heat is supplied by gas), that will disappear as the district energy system decarbonizes and it frees up electrical capacity for more efficient electrification.

## APPLIANCE AND EQUIPMENT EFFICIENCY

Waterloo will update its policies to require high-efficiency appliances, electronics, and other major equipment to reduce electrical consumption from plug loads. The Sustainable Building Guideline already requires major appliances to be Energy Star Most Efficient or rated Highly Efficient by EnerGuide, while the Sustainable IT Procurement Guideline requires all servers, computers, displays, and other IT equipment to be EPEAT Gold certified. In addition, new process loads or energy-intensive equipment with large heating, cooling or power needs should be carefully selected for locations where campus infrastructure can best support the equipment and integrate and optimize as much as possible.

## HVAC UPGRADES

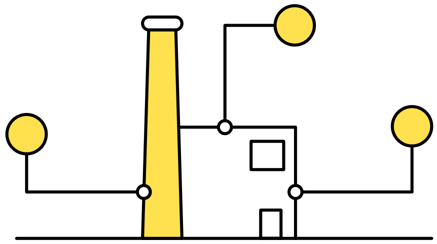
Pumps and fans across the campus are required for circulating air and moving fluids. Many of these pieces of equipment are outdated and more efficient options are available. The University will prioritize installation of variable frequency motors and pumps and will explore reduction in horsepower where appropriate to right-size equipment. Waterloo will integrate modern systems to reduce ventilation and re-conditioning needs during periods of low or no occupation, while maintaining high indoor air quality during times of high usage. This has already been piloted in certain areas of the campus and has potential to expand.

## DEEP ENERGY RETROFITS

Some building systems are also in need of much deeper overhaul and renewal. Deep energy retrofits (DER) are projects that address a whole-building approach to energy management, targeting large improvements in energy efficiency through more efficient building envelopes and right-sized and upgraded mechanical systems. Many DER projects achieve 40% or more in energy savings while improving occupant comfort and modernizing spaces. These projects are large, and are typically not completed solely for the purpose of energy efficiency. They are most effectively prioritized in buildings that are older with high renewal needs and high current energy intensities and carbon footprints.

Buildings with strong potential for deep energy retrofits include: HH, PAS, E3, LIB, MC, C2, DC, PAC, BMH, and ARC, as well as residence buildings including the UWP courts and REV.

# District Energy



Central to Waterloo's decarbonization journey is the transformation of the district energy system. Approximately 75% of energy and emissions come from the current Central Plant, which provides heating and cooling to campus buildings within and adjacent to Ring Road. The current plant distributes steam through a series of underground pipes to all connected buildings, where it is used directly or processed through a heat exchanger for space and water heating.

The Central Plant also includes a series of chillers, complemented by distributed chillers around the campus, to provide cooling.

Both of these systems will require renewal and modernization over the coming decades, and these are a critical path and inflection point in decarbonization.

## Connection to principles

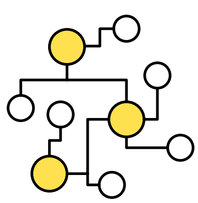
**EFFICIENCY FIRST**
While the main emphasis of this pillar is on fuel conversion, it yields extremely large efficiency benefits, moving from a steam plant with an effective 65-70% efficiency to a heat pump system which can reach 200-300% efficiency depending on operating parameters.

**LONG-TERM THINKING**
Implementation would be aligned with renewal of many existing campus systems, including tunnels, piping, boilers, and chillers, to maximize overall capital dollars.

**FEASIBILITY**
Many peer institutions and municipal district energy systems are based on a hot water medium, locally and globally. There is a strong and proven technical basis for hot water district energy systems, geo-exchange, and heat recovery, and a shifting labour market to these technologies for management. While capital costs are high compared to other decarbonization pathways such as electric steam or biomass, the steam to hot water conversion provides a much more cost-effective operation and maintenance approach.

**FLEXIBILITY**
Shifting to a lower-temperature hot water medium significantly expands the opportunities for future technology connections. In a steam system, combustion or high-cost electric resistance are the only currently available practical sources of thermal energy. Hot water enables connection with heat pumps of many kinds, as well as thermal energy storage and other emerging technologies.

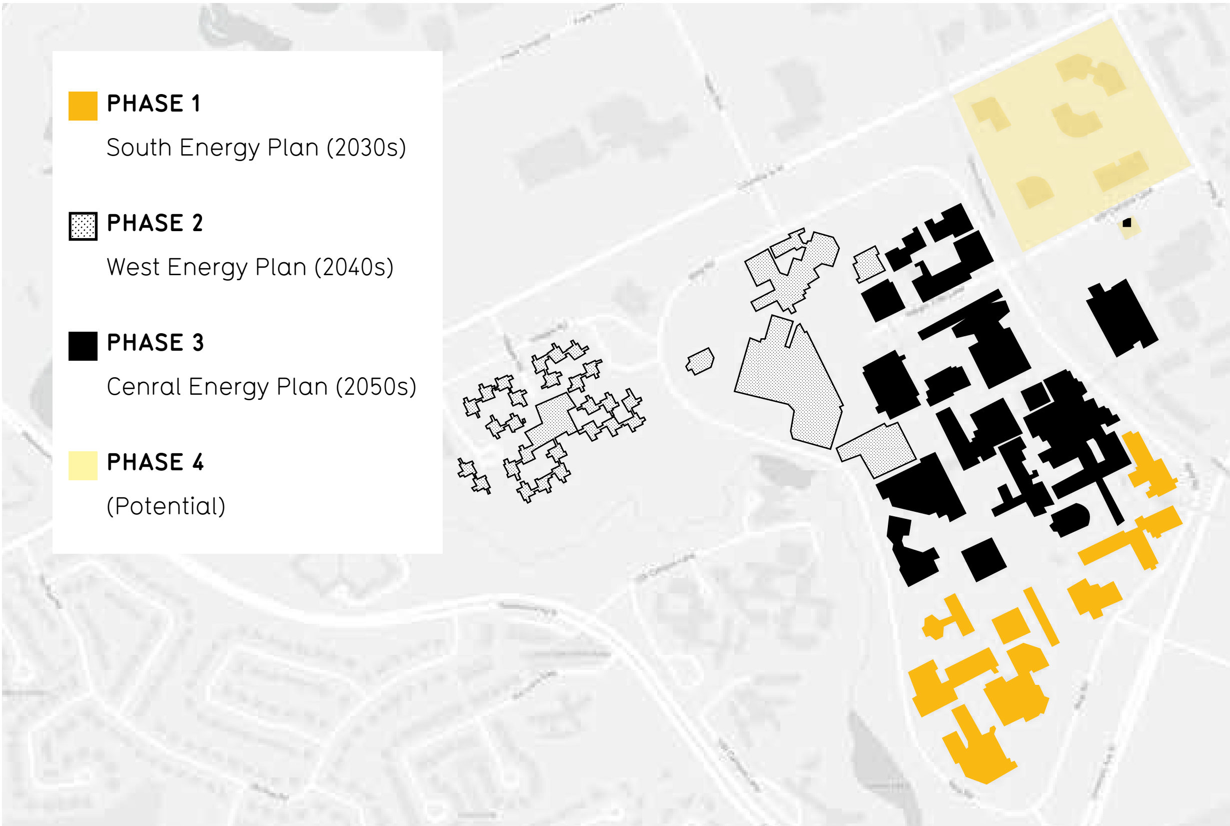
**ADAPTABILITY**
Coupled with load balancing and fuel switching strategies noted on page 31, a hot-water district energy system creates higher thermal mass to enable the system to overcome peaks or other disruptions, and can connect to thermal energy storage, with opportunities for inter-nodal support to eliminate single points of failure.



## NODAL HOT WATER DISTRICT ENERGY SYSTEM

*Shift:*Neutral plans for the transformation of the current central steam system to a nodal hot water district energy system. Given the complexity of the transition from steam to hot water, this would be phased through the development of two new energy plants, dividing the campus into three zones that utilize existing service distribution corridors. As shown in **Figure 9**, this conversion process would unfold over three phases. To complete these transitions will require modifications to the buildings, including retrofitting heat exchangers, replacing certain humidification systems, and updating air handling units and perimeter heating systems.

**Figure 9:** Nodal district energy phasing

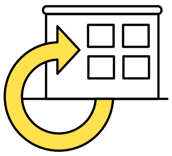



**Phase 1 – South Energy Plant:** Starting at the "bottom" of the campus and away from the current Central Plant, this conversion would support Arts, Environment, TC, and several Engineering buildings. The plan envisions a new South Energy Plant that would be positioned either at the south lawn next to TC, or in the basement of a renewed/replaced South Campus Hall. Conversions of buildings would start in the late 2020s, while construction of the plant would take place in the early-mid 2030s to come online by 2035.

**Phase 2 – West Energy Plant:** After completion of the South Energy Plant, focus would be on the West Energy Plant, servicing Health, SLC/PAC, QNC, and a future V1. Timing of construction will partially depend on phasing for Campus Housing's conversion of V1 into a West Village. The West Energy Plant would be located at either one of the renewed West Village quads, or in the basement of a new mixed-use building that would be positioned on the current UC site, which is scheduled for demolition. Although not currently planned for, this system could create opportunities for future expansion of the West Energy Plant to connect MKV and FED Hall. It is expected that conversion of buildings would generally begin in the mid-2030s with construction of the plant in the early 2040s.

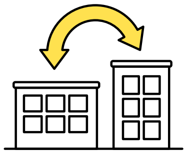
**Phase 3 – Central Energy Plant:** Finally, the remaining boilers in the Central Energy Plant would be converted to hot water for the majority of Science, Engineering, and Math buildings, as well as the Library, and NH. Throughout the conversion of the South and West Plants, existing equipment in the Central Energy Plant will need to be modified to account for reduced loads. Conversion of the connected buildings would take place throughout the 2040s and conversion of the existing Central Plant would be completed by 2050.

**Phase 4 – East Energy Plant (Potential):** As an option, the redevelopment of East Campus into a mixed-use East Village, as envisioned within the Campus Plan, leaves significant potential for the creation of an East Energy Plant. Consistent with the long-term plan to demolish and replace EC 1-5, there is potential for an East Energy Plant to emerge, which could service this area as well as existing Central Plant service to ECH, E6, E5, and PSE. This option has not currently been costed or factored into planning until a higher level of certainty emerges over the development approach and structure for this area.



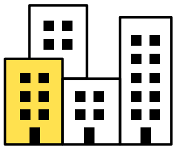
## GEO-EXCHANGE

Each of the new energy plants would be anchored on a geo-exchange system to provide primary heating and cooling. These would include multiple open-loop supply and injection wells connected to the secondary bedrock aquifer, moving water to ground-source heat pumps located in each of the plants. Because the ground maintains a relatively stable temperature year-round, this can provide a stable heat exchange medium.



## HEAT RECOVERY

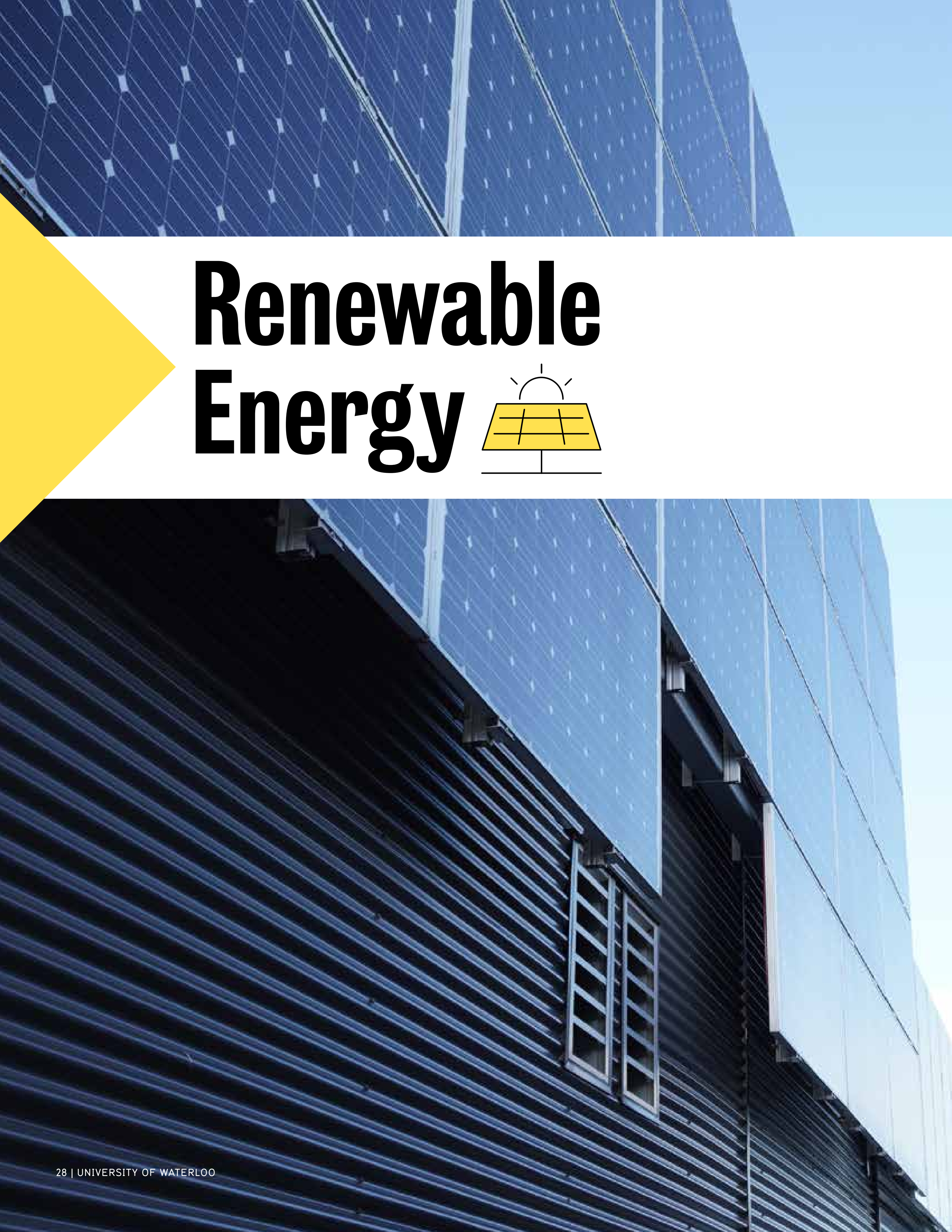
The diversity of buildings across campus creates many areas where there are simultaneous needs for heating and cooling, often year-round. Heat recovery systems, at the building level, between buildings, or at the campus scale, can harvest waste or rejected heat from some cooling process areas, and recycle it to areas with heating needs. Waterloo has already implemented a major heat recovery system between the MC data centre and QNC. Further opportunities will be explored within building HVAC systems, server rooms, wastewater, and more.



## LOCAL PARTNERSHIPS

While Waterloo operates the largest district energy system in Waterloo Region, there is active interest from other partners to expand district energy at the community scale. Waterloo will actively participate in these discussions to identify opportunities for future collaboration and system integration, should external systems be developed. Connecting campus thermal energy systems to the wider community could enhance overall efficiency, support resiliency, and leverage different forms of funding and capital.

# Renewable Energy



Waterloo has numerous renewable energy opportunities. With several large parcels of land, parking lots, and many flat rooftops, there is potential to generate a larger portion of energy on-site, reducing the exposure of the campus to energy price fluctuations and expanding on-site resiliency.

The campus will expand its installations of solar PV over the duration of *Shift:*Neutral, utilizing areas where there is suitable flat roof, parking lots, and fields not slated for development. **Figure 11** illustrates areas across the campus that may be suitable for renewable energy development, subject to individual site assessment and analysis.

## Figure 10: Areas of potential solar PV development

■ Potential Carport solar ■ Potential rooftop solar □ Potential ground-mount solar

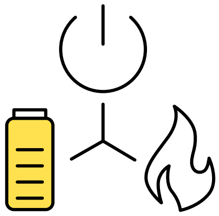
## Connection to principles

**LONG-TERM THINKING**
Installation should be coupled with planned roof renewal wherever possible to ensure compatibility and extend roof lifespan. Parking lot solar should be implemented during lot renewal.

**FEASIBILITY**
Solar is a widely deployed and proven technology, with low maintenance requirements for University operations. Solar PV systems have paybacks generally under 15 years, while also creating a buffer against utility price fluctuations, and can support peak load reductions.

**RESILIENCY**
Solar PV can provide a minimum level of power during grid disruption events and during extreme heat, including buffering direct sun exposure on parking lots.

# Balance and Optimization



Modern energy systems will require much more active management and optimization. As the grid moves increasingly toward demand-based pricing of electricity, especially for large consumers such as University of Waterloo, it is imperative for Waterloo to be able to better balance, redistribute, and otherwise manage its energy consumption. It matters almost as much about when energy is used, as how much and what type is used.

## Connection to principles

**LONG-TERM THINKING**
Load-shifting and energy storage systems provide critical services that reduce total cost of energy systems and build capacity for change, expansion, and other future needs.

**FEASIBILITY**
Controls, batteries, cold thermal storage, and fuel switching are widely used across multiple industries, with increasing deployment of hot thermal storage as well. This does increase operator complexity. Implementation of balancing and optimization solutions is crucial for long-term cost effectiveness, particularly at driving down average electricity costs.

**FLEXIBILITY**
Having buffering capacity in the system allows operators more flexibility in responding to demand and pricing changes, while also enabling more thermal energy technologies to connect to the district energy system.

**RESILIENCY**
Energy storage and fuel switching directly build in resiliency to the system, creating secondary heating sources and buffer capacity during disruption.

## LOAD REDUCTION AND PEAK SHAVING

Waterloo has limited control currently over when energy is used. Plant Operations has a longstanding practice to pre-chill water overnight so that the chillers can be under less stress during peak events, but otherwise has limited ability to reduce consumption during times of highest cost and emissions intensity. Going forward, the campus will identify opportunities through control strategies and communications to end-users to reduce demand for non-critical loads during regular and annual peak demand events, which can lead to very large cost savings.

## GAS BACKUP AND FUEL SWITCHING

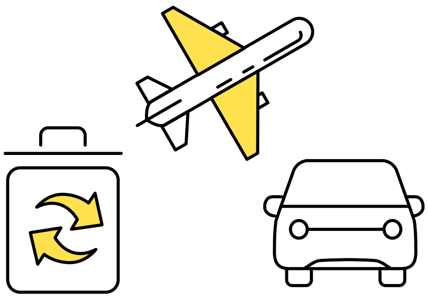
While geo-exchange will provide primary heating for the main campus, Waterloo will also integrate gas boilers for backup and redundancy, and to enable fuel switching during times of high electricity costs or extreme cold. While this will leave some residual emissions, it will be necessary to manage utility costs and avoid very high charges during periods of very high demand. Other strategies here can reduce the need for fuel switching by prioritizing efficiency, controls, and storage, but having the fuel-switching option will be an important tool for operators.

## THERMAL ENERGY STORAGE

By moving from a steam to a hot water system, Waterloo will also be able to better store thermal energy to overcome peaks or disruption. Thermal energy storage, for both heating and cooling, can provide an important buffer that puts less strain on other equipment, can avoid periods of high electricity costs, and can allow storage of excess heating and cooling to improve system balance as needed.

## BATTERY ENERGY STORAGE

Similar to thermal energy storage, batteries will be an important tool to mitigate periods of high electricity costs, provide backup power during outages to maintain critical systems, and in certain areas can absorb extra solar generation and provide other internal electricity management services.



# Indirect Emissions

The focus of *Shift:*Neutral is on reduction of emissions from the built environment – Waterloo's infrastructure and buildings. These are the vast majority of the campus' direct emissions, defined by the GHG Protocol. Other direct emissions sources include the campus fleet, which is covered by separate planning under *Shift:*Mobility and an emerging fleet plan.

Indirect sources of emissions are those which are created directly by other entities, but which are a result of activity of University of Waterloo. These are referenced in **Table 3**, organized by their respective "Scope 3" categories in the GHG Protocol, as well as a description of complementary planning and action that is underway.

## TABLE 3: SCOPE 3 INDIRECT EMISSIONS PLANNING

| Category | Description | Actions |
|---|---|---|
| **Purchased goods and services** | Includes most items procured through Waterloo's supply chain, with an emphasis on consumables such as paper, IT equipment, food, furniture, appliances, cleaning supplies, and more. | Most of these will need to be covered through a sustainable procurement guideline. Waterloo has already developed a focused guideline for IT procurement, and is also measuring food system impact. |
| **Capital goods** | Includes embodied carbon in buildings, infrastructure, and vehicles. Major contributors are cement, steel, glass, and other building materials. | Measurement and embodied carbon targets are included in the Sustainable Building Guideline, and the emphasis on the Campus Plan will be renewal and maintenance of existing buildings. |
| **Fuel and energy related activities not included in Scope 1 or 2** | This includes transmission and distribution losses from the provincial electric grid, as well as leakage from the wider natural gas system. | Reductions are directly tied to Waterloo's consumption, particularly on gas, and will decrease through implementation of *Shift*:Neutral. |
| **Upstream transportation and distribution** | Includes emissions from tier 1 suppliers to bring goods and services to University of Waterloo. It also includes any procured shuttles, buses, or other services to move people to and from or between campus. | Most of these will need to be covered through a sustainable procurement guideline. |
| **Waste from operations** | Includes waste generated in operations and sent to landfill. | Waterloo has extensive programming in place to reduce waste, and further planning will be developed through *Shift*:Zero. |
| **Business travel** | Includes employee travel for research, conferences, recruitment, and other university activities. | Waterloo has started creating measurement estimates for these sources of emissions, and will continue to monitor them and identify opportunities to reduce travel where possible. |
| **Employee commuting** | Includes employee travel to and from the University on a day-to-day basis. | Waterloo's approach to sustainable transportation is covered by *Shift*:Mobility. |
| **Downstream transportation** | Includes student travel to and from the University on a day-to-day basis, as well as student arrivals and travel for research, field work, athletics, and co-op. | Commuting emissions are covered by *Shift*:Mobility, and Waterloo is beginning to measure the impact of student travel. |
| **Investments** | Includes the impact of economic activity from financed companies in which Waterloo has direct or indirect investment, through the Pension, Endowment, and special purpose funds. | Waterloo's Responsible Investment policy and reduction targets directly speak to efforts to work with asset managers to reduce carbon intensity of the investment portfolios over time. |

# Implementation

*Shift:*Neutral represents an ambitious transformation of campus buildings and infrastructure. The scale and complexity of his transition should not be underestimated.

The plan outlines the types of physical projects and systems that will need to change to achieve the outcomes of the plan. In addition, there are important governance and institutional changes that will be crucial to consider, internally and in collaboration with partners.

## INTERNAL GOVERNANCE AND SYSTEMS

Waterloo has identified several enabling mechanisms that will be important to achieve success. These cut across many action areas and help overcome barriers that will inhibit implementation of projects and behaviour changes.

1. **Submetering**: Waterloo will complete building-level submetering for all buildings connected to the district energy system. This is basic infrastructure to provide information to end-users, inform project opportunities, support measurement and verification, size systems appropriately, and accurately understand energy cost centers.

2. **Budget model integration:** Waterloo will explore integration of energy costs within the redeveloped budget model to ensure that the campus adequately understands and plans for total cost of energy in decision-making.

3. **Revolving fund:** Waterloo will maintain or expand funding support to the Revolving Fund, enabling cyclical deployment of resources to quick-win projects with high cost-savings potential.

4. **Capacity building:** Waterloo will expand people capacity and skills to manage project implementation, identify opportunities, and support integration of new technologies over time.

5. **Swing space:** Waterloo will identify areas of swing space that can accommodate temporary moves while buildings undergo renovation and renewal. In many areas, renovations can be completed with limited disruption to building occupants, but deeper retrofits, system upgrades, and demolition/rebuild scenarios will require additional space to support transitions.

6. **Shadow carbon price:** Although the provincial and federal carbon pricing systems are no longer in effect, Waterloo will apply a shadow carbon price to all construction and major capital projects. This is a risk management approach to future-proof investments against potential future policy changes and transitional risks, including re-instatement of carbon pricing under an emissions performance system or direct regulatory emissions reductions obligations.

7. **Lifecycle costing:** It is imperative that Waterloo evaluate all investments in buildings and infrastructure on their total cost of ownership, not solely on a first-cost basis. Waterloo will reinforce the existing Lifecycle Costing Guideline and build requirements for measurement of lifecycle costs deeper into governance and approval processes.

8. **Energy management system:** Linking together many of the above actions Waterloo will create an official energy management system (EMS), modelled after best practices such as ISO 50001. The EMS will add clarity to roles and responsibilities, processes, and governance, with a specific focus on continuous improvement.

## PARTNERSHIP AND FUNDING

The transition will also require significant financial resources. While there are operating savings and efficiencies gained through implementation of projects, and high overlap with investments already needed in capital renewal, Waterloo's current financial position leaves few options to fund projects in the way that they have been historically.

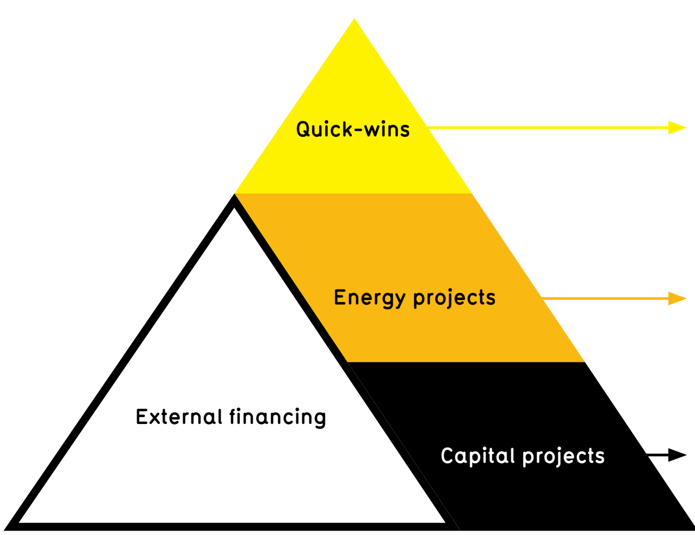
The campus will need to explore creative approaches and partnerships to make progress. **Figure 12** identifies a suite of increasingly common financing and funding mechanisms that can help deliver energy and climate-reduction projects. These range from traditional balance-sheet financing, including more innovative and holistic approaches to internal capital allocation, through various levels of external financing.

### Figure 11: Possible funding structures

| Balance sheet financing | Total cost of ownership | Imbed in DM and Renewal | Grants and incentives | Financing and green bonds | Power purchase agreements | Energy performance contracts | Energy as a service | Public private partnerships |
|---|---|---|---|---|---|---|---|---|
| Internal | | | Blended | External | | | | |

In general, as the University leans into more partnership-based approaches such as energy performance contracts, energy-as-a-service, or public-private partnerships, this involves some level of risk transfer to the partnering organization, as well as a reduction in the level of direct control or oversight. As the campus actions projects, appropriate financing approaches will need to be navigated on a case-by-case basis, while also identifying opportunities to bundle and aggregate projects for optimal impact and outcomes. As a starting point, **Figure 12** outlines a broad framework that can structure the types of projects that would be best suitable for various internal, external, and blended funding streams.

### Figure 12: Financing framework




| Description | Examples |
|---|---|
| Operations and maintenance projects with competitive (<5 year) paybacks, funded through the Revolving Fund | › Recommissioning<br>› Minor HVAC replacements and upgrades<br>› Lighting retrofits |
| Projects with medium payback and higher costs, focused mainly on energy savings and accelerating lifecycle renewal, as well as foundational projects | › Larger HVAC replacements<br>› Heat recovery<br>› Some solar PV systems<br>› Submetering<br>› Feasibility studies |
| Large projects with long or no direct energy paybacks, linked with lifecycle renewal of existing assets | › District energy plants and major equipment<br>› Geo-exchange systems<br>› Some solar PV systems<br>› Deep energy retrofits |

# Conclusion and Looking Forward

In a rapidly changing world, climate action, clean and reliable energy, and campus resilience will be of increasing importance for long-term planning and success. *Shift:*Neutral outlines the major actions that will help Waterloo reach net-zero emissions, manage costs, improve spaces, strengthen energy security, reduce climate risks, and ultimately enhance the campus' reputation for innovation and impact.

This represents a significant journey over the coming three decades, and it is highly likely that Waterloo's approach will evolve. Version 2.0 of *Shift:*Neutral guides actions between 2026-2030, and it is fully expected that version 3.0, 4.0, and beyond, will build on campus successes and learn from Waterloo's challenges, while adapting to new technologies, changing market conditions, and policy shifts.

Future versions will be phased every five years to make sure that this continuous improvement is prioritized and that *Shift:*Neutral can adapt to emerging opportunities and risks.

APPENDIX A

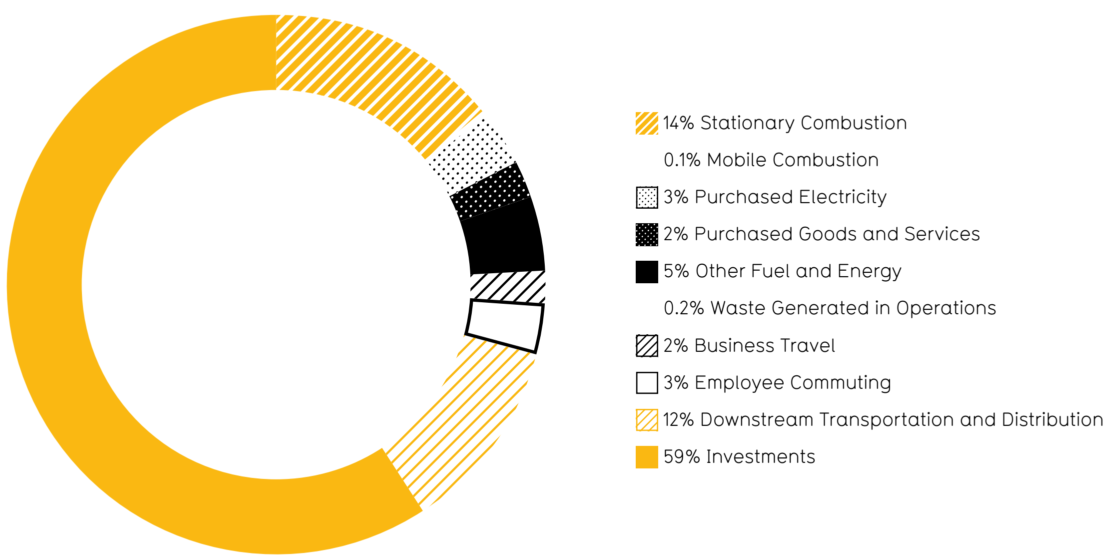
# Appendix A – Emissions Inventory

# Appendix A
# Emissions Inventory

Waterloo actively measures various sources of GHGs created directly or indirectly through campus activities. **Figure 13** illustrates the major sources of emissions, organized by GHG Protocol categories, for which there is data currently available. Ongoing efforts are being implemented to expand the measurement and accuracy of various material Scope 3 (indirect) data sources. A detailed breakdown of all identified sources of emissions, including those where measurement is not yet available, is included in **Table 4**.

Of the emissions from stationary combustion, which are the focus of *Shift:*Neutral, approximately 75% come from buildings connected to the existing district energy system.

**Figure 13:** Measured GHG Emissions, by GHG Protocol category



## TABLE 4: DETAILED GHG INVENTORY (2024)

| Emissions source | Type | GHG scope/Category | Emissions (T $CO_2$-e)* | Notes |
|---|---|---|---|---|
| **Gas** | Buildings | 1.1 – Stationary combustion | 31,174 | |
| **Fuel Oil** | Buildings | 1.1 – Stationary combustion | 11 | |
| **Gasoline** | Fleet | 1.2 – Mobile combustion | 292 | |
| **Diesel** | Fleet | 1.2 – Mobile combustion | 92 | |
| **Propane** | Fleet | 1.2 – Mobile combustion | 10 | |
| SUBTOTAL – SCOPE 1 | | | **31,578** | |
| **Electricity** | Buildings | 2 – Purchased electricity | 7,128 | This is likely an underestimate as it is based on provisional 2023 emission factors, to be adjusted in 2025 and 2026. |
| SUBTOTAL – SCOPE 2 | | | **7,128** | |
| SUBTOTAL – SCOPE 1 + 2 | | | **38,706** | |
| **Paper** | Consumption | 3.1 – Purchased goods and services | TBC | |
| **Electronics** | Consumption | 3.1 – Purchased goods and services | TBC | |
| **Appliances** | Consumption | 3.1 – Purchased goods and services | TBC | |
| **Furniture** | Consumption | 3.1 – Purchased goods and services | TBC | |
| **Cleaning Supplies** | Consumption | 3.1 – Purchased goods and services | TBC | |
| **Food** | Consumption | 3.1 – Purchased goods and services | 4,960 | Estimate based on average emission factors for various food categories. |
| **Enterprise Cloud** | Consumption | 3.1 – Purchased goods and services | TBC | |
| **Embodied Carbon** | Fleet | 3.2 – Capital goods | TBC | Depending on the number and type of vehicles purchased, this is estimated at 50-100 tonnes. |
| **Embodied Carbon** | Buildings | 3.2 – Capital goods | TBC | This will fluctuate significantly year-over-year based on construction projects. |
| **Trans. & Dist. Losses** | Buildings | 3.3 – Fuel and energy-related activities | 660 | Refers to upstream grid losses from transmission and distribution |
| **Upstream Gas Leakage** | Buildings | 3.3 – Fuel and energy-related activities | 8,878 | Refers to upstream methane leakage in extraction and transportation of gas, at estimated 2.7% leak rate. |
| **Shuttles** | Transportation | 3.4 – Upstream transportation | TBC | Includes chartered buses or shuttles |
| **Shipping** | Consumption | 3.4 – Upstream transportation | TBC | Major sources include waste hauling, food deliveries, and other tier-1 supplier deliveries. |
| **Waste** | Consumption | 3.5 – Waste generated in operations | 503 | |
| **Employee Flights** | Transportation | 3.6 – Business travel | 3,638 | Based on estimates from reimbursed flights |
| **Vehicle Mileage** | Transportation | 3.6 – Business travel | 212 | |
| **Rental Vehicles** | Transportation | 3.6 – Business travel | 368 | |
| **Employee Commuting** | Commuting | 3.7 – Employee commuting | 6,614 | |
| **Student Commuting** | Commuting | 3.9 – Downstream transportation | 9,778 | |
| **Student Arrivals** | Transportation | 3.9 – Downstream transportation | 11,741 | |
| **Student Travel** | Transportation | 3.9 – Downstream transportation | 3,289 | |
| **Pension Fund** | Investments | 3.15 – Investments | 100,187 | |
| **Endowment Fund** | Investments | 3.15 – Investments | 29,611 | |
| SUBTOTAL – SCOPE 3 (KNOWN) | | | **180,440** | |
| TOTAL – ALL SCOPES | | | **219,146** | |

*Note that subtotals and totals may not match exactly due to rounding.

APPENDIX B

# Appendix B – 2026-30 Action Summary

This section outlines specific actions that would need to be completed throughout 2026-2030 to maintain alignment with the long-term *Shift:*Neutral roadmap. These are starting points to guide resourcing, and they will be continuously iterated during annual and cyclical planning. In many/most of the actions, it is assumed that both Plant Operations and the Sustainability Office will be heavily involved. Additional campus partners are indicated, where known.

## CLIMATE ADAPTATION

| Action | Partners |
|---|---|
| Update stormwater management and flood mapping documentation and develop a stormwater management plan. | |
| Update evaluation of roof structural capacity and integrate consideration of increased snow loads within roof designs and replacements. | |
| Update standard operating procedures for salt application to ensure safety while minimizing impact to drinking water and the natural environment. | Safety Office, Risk Management |
| Pilot interventions for additional tree canopy and shading, aligned with primary and secondary pathways in the Campus Plan. | |
| Review and update the species planting list for trees and plants to prioritize drought tolerance, water absorption, and heat tolerance. | |
| Review and update of policies and procedures for closures to include risks such as extreme heat or poor air quality. | Provost's Office, Safety Office |
| Review and update guidelines and procedures for work taking place outdoors, for operations, classroom, or research purposes. | Provost's Office, Safety Office |
| Identify areas of highest risk throughout the University's supply chain and explore options for diversification for critical supplies as needed. | Procurement Services, Food Services |
| Expand on-campus food production where possible and strengthen food security support services. | Food Services |
| Integrate climate risk evaluation criteria across global partnerships, including areas such as considerations for travel, public health, and exposure to climate extremes. | Waterloo International |
| Strengthen institutional services and resources for individuals suffering from climate anxiety and post-traumatic stresses. | Campus Wellness |
| Collaborate with community partners on adaptation planning. | Real Estate |

## SUSTAINABLE BUILDINGS

| TYPE | ACTION | PARTNERS |
|---|---|---|
| Optimizing Spaces | Develop intentional swing space to facilitate demolition and rebuilds, retrofits, and other energy-reduction projects | Space Planning |
| | Increase policy support for space use reduction, including incentives, design standards, and benchmarking | Space Planning, Provost's Office |
| Targeted Demolitions | Demolish University Club | |
| | Demolish Minota Hagey residence | Campus Housing |
| | Demolish UWP – Beck Hall | Campus Housing |
| Net-Zero Construction | Update Sustainable Building Guideline | |
| | Completion of Math 4 | Mathematics |
| | Completion of New Residence Building 26 (under construction) | Campus Housing |
| | Completion of WaterFEL | Science |
| | Completion of New Residence Building 29 | Campus Housing |
| | Completion of New Academic Building 30 | |

## ENERGY EFFICIENCY

| Type | Action | Partners |
| --- | --- | --- |
| Controls and Optimization | Recommission all campus buildings, working in phases aligned with submetering completion and building conversions | |
| | Clarify and communicate space standards and acceptable ranges for temperature, lighting, and other key energy-related features | |
| | Create partnerships with units to continuously optimize scheduling, setpoints, and setbacks for energy efficiency | Registrar's Office, Faculties, Campus Housing |
| | Develop a plan to digitize controls for areas of the campus still on pneumatic systems | |
| | Complete upgrade to a modern building automation system | |
| Lighting Efficiency | Lighting retrofits for all buildings to LED, taking a phased approach to all buildings | |
| | Identify lighting control or de-lamping strategies and implement on a case-by-case basis | |
| Appliance & Equipment Efficiency | Integrate appliance efficiency requirements in Sustainable Building Guideline and Sustainable Purchasing Guideline | |
| | Implement VFD and other efficiency measures within small HVAC systems such as pumps and fans | |
| HVAC Upgrades | Complete a feasibility study for spaces suitable for demand control ventilation, and implement three DCV projects | |
| | Upgrade major building-level HVAC equipment for CSB and other buildings as aligned with deferred capital renewal | |
| | Complete heat pump replacement for CIF | Athletics |
| Deep Energy Retrofits | Pilot a Deep Energy Retrofit, aligning with deferred capital renewal and the Campus Plan | |

## DISTRICT ENERGY

| Type | Action | Partners |
| --- | --- | --- |
| Steam to Hot Water | Complete building HVAC conversions to hot water for 50% of South Energy Plant buildings | |
| | Complete schematic design for South Energy Plant | |
| Geo-exchange | Conduct borehole testing for the South Energy Plant | |
| Heat Recovery | Complete M4 heat recovery as research computing systems are scaled and brought online | Mathematics |
| | Utilize advanced submetering to identify areas of simultaneous heating and cooling where heat recovery would be feasible | |
| Local Partnerships | Complete North Campus hospital DES feasibility Study and explore collaborative next steps | MOU group |
| | Develop MOU for future energy partnerships, as required | TBC |

## RENEWABLE ENERGY

| Type | Action | Partners |
|---|---|---|
| Rooftop PV | Complete rooftop solar photovoltaic project for CIF | Athletics |
| | Add solar to M4 when completed | Mathematics |
| | Expand structural study for campus buildings to identify suitable buildings | |
| Carport PV | Complete solar PV for M lot during redesign | Sustainable Transportation |
| | Complete solar PV for C lot | Sustainable Transportation |
| Ground Mount PV | Create site plan for Northwest Campus ground-mount solar | Real Estate |

## BALANCE AND OPTIMIZATION

| Type | Action | Partners |
|---|---|---|
| Load and Peak Shaving | Update guidelines for optimization and shutdown of personal computing equipment | IST |
| | Create an inventory of all large internal loads that can be shaved | IST, Office of Research |
| | Develop a policy and communication framework for peak load management | IST, University Relations |
| Gas Backup | Conduct a feasibility study for development of cogeneration technology within the Central Plant to manage peaks | |
| Thermal Storage | Complete thermal storage pilot project | |

## IMPLEMENTATION

| Action | Partners |
|---|---|
| Complete Submetering project and develop public energy dashboard | |
| Gradually integrate energy and utility costs within budget model | Provost |
| Expand seed funding for Revolving Fund to $2M | Provost |
| Create sufficient swing space in EC-9 / NAB1 to support transitions for South Campus Hall and Deep Energy Retrofits | Space Planning |
| Update lifecycle costing documentation to reflect shadow carbon pricing requirements | Finance |
| Update capital project templates to require lifecycle costing considerations | Finance |
| Develop a formal energy management system aligned with ISO 50001 | |

# Notes and References

[1] See, for example Climate Action Tracker, 2025. Available online at: climateactiontracker.org as well as United Nations Environment Program, *Emissions Gap Report 2025*. Available online at: unep.org/resources/emissions-gap-report-2025

[2] See, for example, analysis from the Rocky Mountain Institute comparing forecasts for clean energy technologies such as solar, wind, and electric vehicles from the International Energy Agency compared to far-higher actuals: Rocky Mountain Institute, *5 Takeaways from the Latest Global Energy Analysis*, 2025. Available online at: rmi.org/five-takeaways-from-the-latest-global-energy-analysis

[3] Ember Energy, *Solar and wind met all electricity demand growth, leading to a slight fall in fossil fuel generation*, October 2025. Available online at: ember-energy.org/latest-updates/solar-and-wind-met-all-electricity-demand-growth-in-h1-2025

[4] International Energy Agency, *Global EV Outlook 2025: Trends in electric car markets*. Available online at: iea.org/reports/global-ev-outlook-2025/trends-in-electric-car-markets-2

[5] See Ontario Independent Electricity System Operator, *Annual Planning Outlook 2025: Capacity Expansion Scenario, Costs, and Emissions*. Available online at: ieso.ca/Sector-Participants/Planning-and-Forecasting/Annual-Planning-Outlook. The IESO forecasts total electricity emissions to approximately increase 6x from their 2017 low-point through the early 2030s and then peak again in the late 2030s before declining. This is due to phased renewal and refurbishment schedules for Ontario's nuclear fleet, leading to much higher reliance on gas-fired generation for both baseload and peaking.

[6] See Region of Waterloo, *Community Climate Action Plan for Waterloo Region*, 2019. Available online at: regionofwaterloo.ca/en/living-here/resources/Environment/Community-Climate-Adaptation-Plan---Full-ACCESS.pdf

[7] Ibid. In addition, data for temperature and precipitation was also sourced from the Canadian Climate Atlas, developed by the Prairie Climate Centre and University of Winnipeg, using localized projections for the Kitchener area. This resource is available online at: climateatlas.ca/map/canada/plus30_2030_85#z=8&lat=44.35&lng=-80.3&city=447. The statistics also draw from localized climate projections developed by the Interdisciplinary Centre for Climate Change at University of Waterloo (IC3), (now Waterloo Climate Institute) for the Region of Waterloo in 2016.

[8] There is some uncertainty on the scale of snowfall impacts. While it is expected that there would be higher lake-effect winter precipitation in aggregate, there may also be a higher percentage of rain that could lower snow accumulation. See for example Ontario Ministry of Environment, Conservation and Parks, *Ontario Provincial Climate Change Impact Assessment: Technical Report*, 2023. Pp. 56-58.

[9] See: Marks, Elizabeth et. al. "Young People's Voices on Climate Anxiety, Government Betrayal and Moral Injury: A Global Phenomenon" papers.ssrn.com/sol3/papers.cfm?abstract_id=3918955

[10] See, for example, Glenn Albrecht et al., "Solostalgia: the distress caused by environmental change", *Australasian Psychiatry*, Vol. 15: Issue 1. 2007. Available online at: doi.org/10.1080/10398560701701288

[11] See, for example, the Canadian Climate Institute, *The Health Costs of Climate Change: How Canada can adapt, prepare, and save lives*, 2021. Available online at: climateinstitute.ca/reports/the-health-costs-of-climate-change

[12] Meal Exchange, *2021 National Student Food Insecurity Report*, 2021.

[13] Canadian Campus Wellbeing Survey, *University of Waterloo Executive Summary*, 2022.

[14] For a useful overall summary on global supply chain risks related to climate change, see Verena Radulovic and Sadie Frank, *Assessing the Landscape of Climate Risk and Supply Chain Resilience*, Centre for Climate and Energy Solutions, 2025. Available online at: c2es.org/document/assessing-the-landscape-of-climate-risk-and-supply-chain-resilience-a-primer-for-corporate-leaders-and-climate-risk-professionals See also The Economist, "Climate change's disruptive impact on global supply chains and the urgent call for resilience", 2025. Available online at: impact.economist.com/projects/trade-in-transition/climate_change

[15] See, for example, Institute and Faculty of Actuaries, *Emperor's New Climate Scenarios – a warning for financial services*, University of Exeter: 2023. Available online at: actuaries.org.uk/emperors-new-climate-scenarios

[16] Methodology for estimating upstream emissions from gas are taken from John Sotes, *Fugitive Methane: New guidelines determine need to curb natural gas emissions in Ontario*. The Atmospheric Fund, 2022. Available online at: taf.ca/custom/uploads/2022/05/TAF_Fugitive-methane-guidelines_2022.pdf

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