CLIMATE CHANGE
AT THE UNIVERSITY OF WATERLOO

ADVANCING RESEARCH
AND EDUCATION FOR
GLOBAL IMPACT
A LEADER IN GLOBAL CLIMATE ACTION
With Waterloo's Creative Minds, Diverse Expertise and Interdisciplinary Approaches, The University is Making an Impact in:

5 / Research
6 / Knowledge Translation
7 / National Leadership
8 / International Partnerships
10 / Innovation
12 / Mitigation
14 / Climate Resilience and Adaptation
17 / Education and Leadership
THE GLOBAL CLIMATE CRISIS

Climate change is one of the defining challenges of the 21st century. With global greenhouse gas emissions reaching a record high in 2018, more than 1,200 jurisdictions in 26 countries and 11,000+ scientists in 153 countries have declared a climate emergency.

The United Nations Intergovernmental Panel on Climate Change* has warned that if emissions are not rapidly and drastically reduced, climate change will “increase the likelihood of severe, pervasive, and irreversible impacts for people and ecosystems” that will persist for centuries or millennia.

The COVID-19 pandemic holds profound lessons for climate change, including the dangers of ignoring the warnings of scientific experts and the risks of delayed response. It has illuminated the global connectedness of societal disruption and inequities for vulnerable populations. The collective global response also holds immense promise to re-shape our society and economy to build resilience and avoid the worst consequences of climate change.

More than 180 countries have signed the Paris Climate Agreement** and are working together on solutions to reduce greenhouse gas emissions and keep the global temperature from rising more than 2°C above pre-industrial levels. To decarbonize global energy systems and adapt to the unprecedented impacts of climate change, urgent action and transformative research are needed.

INCREASING TEMPERATURE IN CANADA +1.7°C

Canada has warmed at more than double the global rate of +0.8°C since 1948***

DANIEL SCOTT
Professor, Geography and Environmental Management
Executive Director, IC3

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ADVANCING SOLUTIONS IN A CLIMATE CRISIS

The University of Waterloo is at the forefront of innovation and is home to transformational research and inspired learning. Climate change is a global challenge requiring urgent attention. With diverse experts and students from around the world conducting climate research across disciplines, Waterloo has the tools and foundation to meet the demands of our current climate emergency.

The University of Waterloo is recognized internationally for its innovative research and is dedicated to advancing its impact in climate research. Waterloo brings together experts from across disciplines to study the impacts of climate change, one of five research theme areas in Waterloo’s new strategic plan, and work toward solutions. With incredible researchers, centres and programs campus-wide, Waterloo is going beyond and expanding efforts in tackling the complex challenges of climate change.”
WATERLOO’S ROADMAP TO CARBON NEUTRALITY

UNIVERSITY TARGET: CARBON NEUTRAL BY 2050

Shift: NEUTRAL

1. NET NEUTRAL GROWTH
2. ALIGNING SYSTEMS
   - Campus Priority
   - Financial Support
   - Measurement & Transparency
   - Campus Capacity
3. IMPROVING ENERGY EFFICIENCY
4. LOW CARBON FLEET
5. CENTRAL SYSTEMS RENEWAL
6. ADVANCED HEAT RECOVERY
7. LOW CARBON ENERGY
8. CARBON OFFSETS
9. INDIRECT EMISSIONS REDUCTIONS


Waterloo Supports Climate Change Research and Innovation in Three Critical Areas

**Physical Science**
This research informs our understanding of how the climate system works, how it is expected to change and the implications of these changes for natural systems (e.g. polar ice, forests and coasts) and natural hazards (e.g. floods, wildfires and ice storms).

**Mitigation**
Waterloo researchers are exploring ways we can reduce greenhouse gas emissions and atmospheric CO₂ to achieve national and global goals. These researchers are focused on climate policies, new technologies and the societal transition to a decarbonized economy.

**Adaptation**
As climate change accelerates, Waterloo researchers are assessing the ways we can build resilient communities and economies that will be better able to withstand the impacts of a changing climate.
Established in 2008, the Interdisciplinary Centre on Climate Change (IC³) is a catalyst for climate change research, training and knowledge mobilization, contributing to advancements in climate change solutions worldwide. With over 90 faculty members from over 26 academic departments and several external organizations, IC³ empowers business, government and civil society to respond effectively to climate change and accelerate the transition to a low-carbon and climate-resilient society.

CATALYZING WORLD-LEADING CLIMATE CHANGE RESEARCH AND INNOVATION

FACILITATING EXPERIENTIAL TRAINING FOR THE CLIMATE LEADERS OF TOMORROW

BUILDING LOCAL AND GLOBAL CAPACITY AND COLLABORATIONS
THE INTERDISCIPLINARY CENTRE ON CLIMATE CHANGE (IC3) / 2020

NATIONAL LEADERSHIP

Waterloo supports centres and programs that are accelerating climate action and research across the country.

The Canadian Cryospheric Information Network (CCIN) and Polar Data Catalogue (PDC)
CCIN provides a platform for the exchange of cryospheric information to the research community, public, northern communities and decision makers. PDC, a repository of Arctic and Antarctic research metadata and data records, is the official National Antarctic Data Centre (NADC) for Canada.

Canadian Institute for Climate Choices
The University of Waterloo made a significant contribution to the founding of the Canadian Institute for Climate Choices. Bringing together more than 50 experts from a range of disciplines, this institute focuses on Canada’s climate policy choices to support transformative climate solutions.

Environment and Climate Change Canada (ECCC)
ECCC has been co-located in the Faculty of Environment since 1997, bringing scientists together with an expanding Waterloo network and initiating policy-relevant research across multiple faculties.

Sustainable Development Solutions Network Canada (SDSN)
Part of a global network, SDSN Canada’s mission is to catalyze and convene Canada’s universities, colleges and knowledge institutions to foster practical solutions, integrated approaches and joint learning opportunities towards the achievement of the Sustainable Development Goals (SDGs).

Global Water Futures
This Pan-Canadian research initiative funded by the Canada First Research Excellence Fund, in partnership with University of Saskatchewan, Wilfrid Laurier University and McMaster University, aims to find solutions that protect water quality and quantity across Canada and the cold regions of the world in the face of increasing climate change risks.
Cultivating climate leaders in a climate crisis

Many small islands are facing the hard realities of climate change. Harnessing this urgency for action and using it to spark innovation is what drives Simron Singh’s vision for small islands. His research focuses on the social metabolism (or resource use) of vulnerable small island states and island jurisdictions in the context of sustainability and climate change. Singh collaborates with governments and academic institutions in several Caribbean nations to seek sustainable solutions unique to small islands. His life’s work highlights the urgency of climate action for small islands while showcasing the power of these communities to become leaders in climate action.

Accelerating sustainability transitions

Businesses have the potential to be leaders in greening the economy. Sarah Burch is exploring the role of small and medium-sized enterprises (SMEs) to create transformative change and advance sustainability. Burch and her team developed “TRANSFORM: Accelerating sustainability entrepreneurship experiments in local spaces,” a project comprised of a global network of research and practice hubs in eight countries, including 11 universities and 14 non-academic partners. This innovative project supports SMEs to transition to or adopt fundamentally sustainable business models. Burch and her team recognize the significant impact that SMEs can have in accelerating sustainability transitions and supporting communities as they make progress towards sustainable futures.
**A new era of climate law**

Climate change law has evolved considerably over the past several decades. The United Nations Framework Convention on Climate Change (UNFCCC), Kyoto Protocol and Paris Accord have all contributed to a new framework for global environmental governance. According to Marie-Claire Cordonier Segger, this has sparked a new dialogue creating a tangible pathway toward sustainability transitions. Cordonier Segger is the executive secretary for the Climate Law and Governance Initiative and Senior Legal Advisor to the Presidency of the UN Framework Convention on Climate Change. Cordonier Segger examines the sustainable development dimensions of the Paris Agreement on climate change. This work highlights the importance of reaching the Paris Agreement, including the adoption of new legal research, awareness and capacity-building for “transformation of the world’s economies, societies and ecosystems towards sustainability.”

**Canada in a climate disrupted world**

Top researchers from the University of Waterloo and the Balsillie School of International Affairs, including Daniel Scott and Simon Dalby, are studying the transnational climate impacts on Canada’s economic and strategic interests. These potential impacts span across multiple critical economic sectors, foreign policy issues and public service areas including: trade and investment, infrastructure, food security, shipping and transportation, arctic sovereignty, health and well-being, human mobility, international development assistance and security (e.g. conflicts, disasters, displacement and migration, environmental security).

**Global University Consortium on SDG 13**

Waterloo is 1 of 10 universities across the globe involved in the Consortium on SDG 13 (Climate Action) led by the University of the West Indies.
INNOVATION

At Waterloo, our researchers go beyond departmental disciplines to find interdisciplinary solutions for climate change.

AI to fight climate change

Artificial intelligence (AI) is playing an increasing role in research and innovation. Chris Fletcher and his team are studying how AI can be used to improve computer models that are used to make predictions of future weather and climate. Fletcher says that such models, known as Earth System Models (ESMs), represent our only viable tool for making projections about how Earth’s climate will respond to human-induced increases to greenhouse gas concentrations. Fletcher’s work uses AI to improve the computational efficiency and scientific accuracy of ESMs, which occupy some of the world’s largest supercomputers. Fletcher and his team are breaking down academic silos and finding ways to use the latest AI technology to tackle complexities in climate change research.

Plants inspire ground-breaking tech-based climate solutions

While efforts to reduce emissions are critical for climate change mitigation, some scientists are taking a different approach and exploring unique processes that can convert excess atmospheric CO₂ into useful alternatives. Yimin Wu, scientist and engineering professor, and his team have created an “artificial leaf” to fight climate change. This new technology, inspired by plants and the process of photosynthesis, converts CO₂ into methanol and oxygen. Wu and his colleagues recognize the urgency in fighting climate change and are optimistic about the potential of their discovery to help reduce CO₂ emissions while at the same time creating an alternative fuel.
Intelligent computer vision for arctic sea ice mapping

Advances in computer software and technology are creating new opportunities for research on the impacts of climate change. With advanced intelligent computer vision models and algorithms, David A. Clausi, Linlin Xu and their team, are generating high-resolution sea ice maps of the arctic using remote sensing images from world-class Canadian satellites, such as RADARSAT-2 and the RADARSAT Constellation Mission (RCM). These models and algorithms have been implemented into MAGIC (Map-Guided Ice Classification), a software system used for sea ice monitoring that reads and classifies images provided by the Canadian Ice Service (CIS). Clausi and Xu’s work is helping researchers measure and understand the changes occurring to sea ice, in addition to supporting marine navigation in a warming world.

Breaking down silos for climate solutions

Mathematical biologist, Chris Bauch, thrives in working across scholarly fields and has created a research program centred on applying mathematics to real-world problems in infectious diseases, ecology, social science and sustainability. In a recent study, Bauch and his colleagues, Tom Bury and Madhur Anand, explored the interactions between climate models and social learning. This research highlights how social norms and the ways in which people learn about emission reduction strategies can ultimately influence climate outcomes. Bauch’s interdisciplinary approach to research demonstrates how climate change can be tackled from almost any angle.
Waterloo researchers are finding ways to reduce emissions and advance sustainable energy solutions to mitigate climate change.

**Curbing climate change by capturing carbon**

To achieve Canada’s emission reduction targets, carbon capture and sequestration are important mitigation strategies. Yuri Leonenko is an expert in the development of Carbon Capture and Storage (CCS) technologies to limit CO₂ emissions from Canada’s oil sands. His current research looks at the development of new approaches and technologies that reduce the risks of CO₂ leakage and make CCS more feasible and economic to implement.

**Waterloo institute for Sustainable Energy (WISE)**

WISE believes in clean energy that is accessible and affordable for all. Their mission is to conduct original research and develop innovative solutions and policies to help transform the energy system for long-term sustainability.
**Keep it in the ground**

Targeting the source, researchers like Angela Carter are taking a closer look at oil extraction and its environmental impacts. Carter’s research focuses on environmental policy and politics surrounding oil extraction in Canada’s major oil producing provinces: Alberta, Saskatchewan and Newfoundland & Labrador. Her research highlights the tensions between environmental/community impacts and economic imperatives. Carter’s new research project focuses on supply-side climate policy, examining the political conditions necessary to wind down fossil fuel extraction in developed-world states. With a keen interest in the new “keep it in the ground” movements and legislation, Carter’s research is shedding light on how effective policies can help us decarbonize our energy sources and ensure a just transition for impacted sectors.

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**Sustainability Office**

The University of Waterloo’s Sustainability Office is the central hub for sustainability information, resources and services across campus. The Sustainability Office is working with Plant Operations and many campus partners to implement the *Shift*: Neutral climate and energy action plan to support Waterloo in reaching carbon neutrality by 2050.
Many researchers and programs at Waterloo are taking a closer look at climate risks and how we can advance resiliency in communities throughout the country and around the world.

**Visualizing flood risk to support resilience**

With an interdisciplinary approach to climate change adaptation, Daniel Henstra and his team are identifying strategies to advance flood resiliency in a changing climate. The team is working to assess the flood risk of over 100,000 health facilities and other critical infrastructure across Canada. Their FLOODGOV project will include the creation of state-of-the-art 3D visualizations of future flood risk. By engaging diverse stakeholders, applying interdisciplinary knowledge and providing evidence-based policy advice, Henstra is supporting flood risk governance strategies to effectively manage flood-related impacts across Canada.

**Partners for Action (P4A)**

P4A is an applied research network with founding support provided by the Co-operators Group Ltd. and Farm Mutual Re. Through research, knowledge sharing and by addressing information needs, the network works collaboratively with stakeholders across Canada to advance flood resiliency in the context of a changing climate and extreme weather.
Understanding the changes to extreme weather

As our climate continues to change, we will face more extreme weather events on a local and global scale. Donald Burn is studying the impacts of climate change on extreme weather and hydrological events. Using statistical hydrology to develop approaches for frequency analysis of flooding events, Burn’s team has quantified changes in flooding in Canada and the US. Burn’s research is supporting critical work on characterizing the probabilities of various extreme events and contributing to improved flood warning systems and flood risk management strategies.

Partnership for Canada–Caribbean Climate Change Adaptation (ParCA)

Waterloo was the lead of the multi-national, five-year interdisciplinary ParCA project that integrated climate science and local knowledge to support climate change adaptation in coastal communities in Atlantic Canada and the Caribbean. Together, with university and community partners, ParCA mobilized collective knowledge to assess local climate change adaptation strategies and trained professionals to empower communities to mainstream adaptation into existing policy and planning.

Project Leads from the Faculty of Environment

DONALD H. BURN
Professor
Faculty of Engineering
Civil and Environmental Engineering

DEREK ARMITAGE
Professor
School of Environment, Resources and Sustainability

DANIEL SCOTT
Professor
Geography and Environmental Management

JOHANNA WANDEL
Associate Professor
Geography and Environmental Management
ADAPTING TO CHANGE

The impacts of global climate change are affecting our ecosystems, economies, communities, and our health. Waterloo researchers are finding solutions to adapt to these new realities and reduce risks.

Amphibious homes to keep communities afloat

Protecting communities from the risks of flooding is a heightened concern with the increased frequency of severe weather events. Elizabeth English has seen first-hand the damage that these storms can cause. Her world leading research on amphibious housing gives communities in vulnerable areas a tool to combat the impacts of climate change. English believes that “we need to learn to live with water.” By allowing our homes to float, not only does water move where it needs to “water becomes part of the solution.”

Intact Centre on Climate Adaptation

The Intact Centre is an applied research centre, established through the leadership and generosity of Intact Financial Corporation, that works with homeowners, communities, governments and businesses to identify and reduce the impacts of extreme weather and climate change.
The impacts of global climate change are affecting our ecosystems, economies, communities, and our health. Waterloo researchers are finding solutions to adapt to these new realities and reduce risks.

A CANADIAN PIONEER IN CLIMATE CHANGE EDUCATION

The University of Waterloo is leading the way in training the first generation of climate change professionals. Waterloo offers two nationally unique graduate programs.

Graduate diploma in Climate Risk Management (CRM)
The Climate Risk Management (CRM) diploma is a fully online program that provides early-to mid-career professionals with a unique learning experience and the opportunity to integrate climate risk management within their field of work.

Master of Climate Change (MCC)
The Master of Climate Change (MCC) program was the first of its kind in North America when it began in 2013. The MCC provides an educational experience for students looking for advanced training and experiential learning specific to climate change. Our graduates are working in a range of professions, across government, NGOs and private sector companies.

MCC Internships: A Work Placement with Impact
Atlas 365 | Dillon Consulting | Environment and Climate Change Canada | Health Canada | Toronto Region Conservation Authority | UNFCCC, Adaptation Programme | Ministry of Natural Resources | Canadian Space Agency

104 ALUMNI from 14 countries
SHAPING FUTURE CLIMATE LEADERS

Beyond the classroom, Waterloo provides students with local and global experiential training and opportunities that prepare them to be leaders in the fight against climate change.

ALUMNI SPOTLIGHT

NICK MERCER, PhD

The four R’s for community research
Bringing research and innovative solutions to remote communities requires a thoughtful understanding of a community and their needs. That is why Nick Mercer, PhD candidate, uses four principles passed down from his Inuit mentors in Nunatukavut to guide his research: respect, reciprocity, rights and relationships. Applying these principles are good practice in any area of research, but particularly important in work involving Indigenous communities. According to Mercer: “Indigenous communities are more than just stakeholders, they’re rights holders.” Mercer is currently working on energy planning research with and for the NunatuKavut Community Council in southern Labrador. Mercer’s experience working with Indigenous communities, as well as the many partnerships he has built within the University of Waterloo community, have helped shape his research in a meaningful way and have left a significant impact on his personal and professional life.

Climate Students
Climate Students, created in the summer of 2014, is a student-led group that facilitates research, education and action on climate change at the University of Waterloo, in the community and on the global stage. Supported by IC3, the group is Waterloo’s focal point for student networking, discussion and climate action.
Intergovernmental Panel on Climate Change (IPCC) and the UN Conference of the Parties (COP)

The University of Waterloo is an official observer to the United Nations Framework Convention on Climate Change (UNFCCC) and participates in the annual Conference of the Parties (COP). Attending COP provides our top student leaders and researchers with immersive exposure to global climate change negotiations and world-leading research networks.

ALUMNI SPOTLIGHT

DOMINIQUE SOURIS

Inspiring youth to take climate action

Climate activist, youth advocate and University of Waterloo Alumna Dominique Souris is co-founder and executive director of Youth Climate Lab (YCL), an organization that supports youth-led policy, project and business ideas that promote action on climate change. During her time as an undergraduate student at the University of Waterloo, Souris’ passion for innovative climate action and international climate policy flourished. As a student, she attended COP19 in Poland, where she volunteered to negotiate on behalf of the Island nation of Seychelles. To this day, Souris continues to be a driven and dedicated climate leader, inspiring youth around the globe to take climate action.
The University of Waterloo is at the centre of a much broader hub of sustainability innovation. Fueled by creativity, entrepreneurship and civic engagement, the Region of Waterloo is harnessing its innovative spirit to find solutions for climate change at home and around the world.
Reep Green Solutions: trail-blazing local action

In 1999, Waterloo faculty members Paul Parker, Ian Rowlands and Daniel Scott along with Elora Environment Centre, founded the Residential Energy Efficiency Project (REEP) to share their climate expertise and drive local climate action.

Twenty years later, this non-profit startup, now called Reep Green Solutions, has delivered 16,000 residential energy evaluations and more than 5,000 low-income lighting upgrades in the Region of Waterloo. The retrofits completed have saved an estimated 27,000 tonnes of greenhouse gas emissions annually. Over the years, more than 100 students from the University of Waterloo have worked with this organization. Reep Green Solutions continues to combine academic research with practical action in the community, to make sustainable living the norm.

Global Climate Strike
Waterloo Region

Waterloo students, staff and faculty are engaged in civic action for climate change, including campus-wide participation in the global climate strikes.