Universities Canada. Universités Canada.

University research: strengthening communities and powering the future economy

Increasingly, Canadians are experiencing the devastating impacts of climate change. Wildfires, heat waves, storms, flooding and erosion have touched communities from coast to coast. Canada now faces the dual challenge of investing in climate adaptations to ensure the resiliency of its communities, infrastructure and economy while simultaneously developing the talent and technology needed to participate and thrive in an increasingly low-carbon global economy.

It can't meet these goals on its own. Canada must work with its universities to conduct critical research, prepare its workforce and partner with communities and businesses across the country to address real-time challenges and propel our economy forward.

Canada's Universities **Action for net zero**

Photo: Teo Romera/Flikr

Strengthening communities and resiliency

The costs associated with climate-related disasters are rising. Since 2010 they have amounted to approximately 5 to 6 percent of Canada's annual GDP growth, which is up from about 1 percent in previous decades.[1] In 2023 alone insured damage for severe weather events in Canada totalled over $3.1 billion,[2] making investments in climate adaptation and resiliency increasingly urgent.

Studies have found that for every

$1

spent on these types of adaptation measures today...

$13-$15

will be returned in years ahead in direct and indirect benefits.[3]

With thousands of existing community partnerships and critical research expertise, universities are natural partners for communities looking to shore up their resiliency to climate disasters.

Over 70 percent of Canada's universities[4] are working with local communities, municipal governments, industries and/or Indigenous communities on local climate issues. They are conducting modelling and research to help communities better understand their susceptibility to the changing climate and extreme climate events, and to develop evidence-based strategies to help mitigate risks. This includes the development of flood plain maps and flood protection strategies, climate-informed urban planning, emergency preparedness strategies, wildfire prevention and management and addressing urban heat islands. When disaster strikes, universities provide on the ground support, with over a dozen universities having served as emergency shelters over the last decade, housing people displaced by climate related emergencies.

[1] Canadian Climate Institute, "*Tip of the Iceberg: Navigating the Known and Unknown Costs of Climate Change*", December 2020, https://climatechoices.ca/wp-content/uploads/2020/12/Tip-of-the-Iceberg-_-CoCC_-Institute_-Full.pdf

[2] Insurance Bureau of Canada, "*Severe Weather in 2023 Caused Over $3.1 Billion in Insured Damage*", January 2024, https://www.ibc.ca/news-insights/news/severe-weather-in-2023-caused-over-3-1-billion-in-insured-damage

[3] Canadian Climate Institute, "*Damage Control*", September 2022, https://climateinstitute.ca/reports/damage-control/

[4] Universities Canada, "*Study of members on climate impact*", October 2024

Thompson Rivers University - wildfires

Communities are also looking to universities to help them strengthen and sustainably expand built infrastructure such as roads, buildings and bridges. University researchers across the country are developing new technologies and innovations such as low carbon cement, flood resistant foundations, wind and storm-resistant roofs and windows, asphalt that can better withstand extreme temperatures and freeze-thaw cycles and sustainable public transportation systems that can meet current and future needs. They are also working with communities to improve and adopt the use of green infrastructure such as treatment wetlands, bioswales, urban forests and woodlots to manage flooding and droughts and to reduce heat islands and coastal erosion. These green solutions help communities restore nature, increase biodiversity, reduce air and water pollution as well as improve health and wellbeing.

But this critical work is only a fraction of what is needed. As communities become increasingly vulnerable to climate-related disasters, Canada faces the challenge of maintaining and safeguarding over 1.13 million kilometres of road networks, and addressing $264.7 billion in core public infrastructure in poor or very poor condition,[5] Canada must invest now in university research and their capacity to partner with communities across the country to help tackle our growing adaptation needs. There are many successful partnerships and approaches that can be built on and expanded.

Thompson Rivers University – wildfire research and training

TRU's Wildfire Initiative conducts groundbreaking studies on wildfire behaviour, prevention and management. It partners with the BC Wildfire Services to provide specialized training to equip firefighters to combat wildfires more effectively and raise public awareness about the wildfire risks and safety measures. TRU integrates Indigenous knowledge and cultural burning practices to enhance ecosystem health, combining modern science with traditional knowledge to develop sustainable wildfire management strategies.

Carleton University – sustainable road transportation

Carleton's Advanced Road & Transportation Engineering Lab enhances road pavement performance and sustainability, designs climate-resilient pavement systems and improves pavement management systems. Their research includes enhancing asphalt using local recycled waste and regenerative materials, as well as the development of smart pavements with features such as self-healing, phase-changing, energy-harvesting and sensing-properties. These innovations aim to minimize life cycle costs, accommodate the new generation of connected and autonomous vehicles and monitor pavement structural health condition and functional properties remotely.

[5] Statistics Canada, "*Canada's Core Public Infrastructure Survey: Replacement values, 2020*", March 2023, https://www150.statcan.gc.ca/n1/daily-quotidien/230320/dq230320a-eng.htm

University of Prince Edward Island – mapping coastal erosion

UPEI partners with the provincial and federal government on climate risks and adaptation programs. It's new interactive mapping tool, Climate Hazard & Risk Information System, allows users to explore which areas are at risk of inland flooding due to intense rainfall, areas at risk of coastal flooding, water depth predictions and coastal change and erosion data from the past 50 years. It will help First Nations, municipalities and homeowners as they make decisions about development and plan the design and location of built infrastructure.

University of Winnipeg - municipal climate change adaptation strategies

The Prairie Climate Centre (PCC) at the University of Winnipeg worked with the City of Selkirk to develop the City of Selkirk's climate change adaptation strategy. The strategy was designed to integrate seamlessly into the City of Selkirk's long-term business planning process to help ensure its successful implementation. In 2019, the City of Selkirk was awarded the Canadian Network of Asset Managers' (CNAM) Tereo Asset Management Award for their climate change adaptation strategy. Because 80 percent of Canadians live in cities, the PCC's Climate Atlas initiative has developed a series of reports summarizing projected climate changes for Canada's major cities including an overview of some important local impacts, as well as ideas and technologies that can be used today to help these cities increase their climate resiliency.

University of Calgary - improving stormwater management

The Town of Okotoks worked with researchers at the University of Calgary to develop a green bioretention facility to manage stormwater. Due to its innovative design, the bioretention beds can either absorb or filter storm water into its underground aquifer within 48 hours of a storm. This has improved local drought and flood resistance, water quality and biodiversity. University researchers are helping to improve and replicate the bioretention beds' success by studying which plants and soils have the best infiltration rates and which can digest methane and other contaminants.

University of Saskatchewan - water security

The University of Saskatchewan's Global Institute for Water Security (GIWS) conducts critical research and trains highly qualified personnel to ensure water security, sustainably protect freshwater to meet local and global food production needs, mitigate and manage water-related disaster risks, understand and adapt to the impacts of climate change on cold regions and co-create with Indigenous communities to protect healthy waters, people and ecosystems. Projects include working with the Saskatchewan Water Security Agency to install state-of-the-art equipment and develop models to provide early warning of issues that could affect drinking water treatment in Regina and Moose Jaw and developing the world's most sophisticated hydrological and water management models in the Saskatchewan River Basin to forecast future water supply and flooding.

University of British Columbia

University of Manitoba – understanding permafrost thaw

Researchers at the University of Manitoba are studying how permafrost thawing affects northern communities, infrastructure and ecosystems. They collaborate with local Indigenous groups to incorporate traditional ecological knowledge into their research. This partnership helps develop sustainable strategies to manage the impacts of permafrost thawing in Arctic and Subarctic regions.

Université Laval – climate change and arctic ecosystems

Université Laval conducts extensive research on the impacts of climate change on Arctic ecosystems and the communities that depend on them. The ArcticNet network based at the Université Laval, partners with Inuit communities to monitor changes in sea ice, wildlife and vegetation. This collaboration aids in the development of adaptation strategies that support the resilience of Arctic ecosystems and livelihoods.

@ArcticNet/Doug Barber

@ArcticNet/Keith Lévesque

Increasing productivity and global competitiveness

Canada's low-carbon exports have more than doubled in value since 2013, reaching $38.7 billion in 2023. This is nearly twice the growth rate of all other exports combined,[6] and demonstrates the potential opportunities of an increasingly low-carbon economy. With productivity down 2.2 percent in 2023, the third consecutive year of decline,[7] Canada must make strategic investments in key areas such as low carbon industries to improve its global competitiveness. To be successful, these investments must be accompanied by supports for university research, the commercialization of these discoveries and the training of highly skilled Canadians This will provide workers with both the technology and knowledge necessary to leverage it to increase automation, innovation and efficiency in sectors that are critical to our economy.

Already, Canada's universities are training and educating over 1.4 million students per year and providing hundreds of green experiential and work integrated learning opportunities to build a highly skilled, diverse and adaptable workforce.

40+ universities

in Canada are using their campuses as living labs:

- **piloting and testing new climate technologies and innovations,**
- **providing students with hands-on learning opportunities and**
- **derisking technology adoption for industries and communities across the country.**

In addition, universities are working to support researchers and entrepreneurial students in the commercialization of their innovations and discoveries. Universities are increasing their real-world impact through lab to market programs, campus business accelerators and incubators, and the development of partnerships with industry and local businesses. These industry-research partnerships are critical to ensuring growth in key sectors of Canada's economy. They allow businesses to attract highly qualified talent and adopt new technologies and innovations to increase productivity, reduce their carbon footprint, and ensure long-term sustainability.

To meet the pace of economic growth required to compete globally and improve the lives of Canadians, Canada must accelerate and expand its investments in the commercialization of Canadian discoveries, university-industry partnerships and experiential learning opportunities.

[6] Arthur Zhang & Dave Sawyer, "*Canada's low-carbon exports are growing nearly twice as fast as all other exports*", 440 Megatonnes, April 2024, https://440megatonnes.ca/insight/canadas-low-carbon-exports-are-growing/

7 Statistics Canada, "*Hours worked and labour productivity in the provinces and territories (preliminary), 2023*", May 2024 https://www150.statcan.gc.ca/n1/daily-quotidien/240521/dq240521b-eng.htm


University of Calgary

University of Guelph - high-tech and sustainable agriculture research

Researchers at the University of Guelph are working on cybersecurity for smart and secure farms, using high-tech data to build soil health, develop low-emissions dairy cattle breeds and expand agriculture to Canada's northern and remove communities. They are also utilizing artificial intelligence to revolutionize agricultural practices including precision farming, crop monitoring, and pest management to help farmers increase productivity, reduce costs and enhance sustainability.

Polytechnique Montréal and Université du Québec en Abitibi-Témiscamingue - critical minerals research

Polytechnique Montreal and UQAT's Research Institute on Mines and Environment (RIME) is a research institute which partners with industry develop environmentally friendly, innovative and practical solutions for the entire life cycle of a mine. Research projects include management and reclamation of mining waste, modeling and adaptations to climate change, and developing automated management systems. Much of the RIME's research is conducted while training highly qualified personnel who will shape the future of the mining industry in Canada.

Queen's University - sustainable concrete

Reinforced concrete infrastructure accounts for almost 10 percent of global carbon dioxide emissions. As the population of Canada grows, there is a serious need to expand built infrastructure which will require significant amounts of concrete. To help meet Canada's climate goals, researchers at Queen's University, the University of Toronto and Cambridge University are working with industry leaders such as Arup, Aecon, KPMB Architects, and Lafarge to reduce concrete's emissions. In addition to research and testing in the lab at Queen's University, the project also includes the design of a demonstration structure at the Kingston Fire and Rescue Training Centre. The structure will be used by Kingston's Fire services as a classroom and living lab so that local college and university students can come and learn about low-carbon buildings.

University of British Columbia - cleantech hub

The Cleantech Hub at UBC's Okanagan campus is a central innovation space for clean technologies in Western Canada. The Hub focuses on catalyzing academic-industry partnerships to promote clean technologies. These collaborations are essential for bringing Canadian technologies and products to domestic and international markets as well as supporting Canada's transition to a net-zero economy. The Hub is currently focused on projects related to carbon recovery, energy storage, hydrogen technology, and renewable energy. This research supports British Columbia's regional goals and economic prosperity through innovation and green upskilling opportunities.

University of British Columbia

Powering communities and the economy

Canada has committed to reaching net zero emissions by 2050 and to cut emissions by 40-45 percent below 2005 levels by 2030. While it some progress has been made, the Commissioner of the Environment and Sustainable Development to the Parliament of Canada found in 2023 that Canada is not currently on track to meet its 2030 interim targets.

To meet its goals, Canada will not only need to shift current energy production to clean electricity sources, but it must also increase its electricity generation capacity by 2.2 to 3.4 times by 2050 to meet projected needs[8] - while increasing reliability and reducing costs.

To help Canada tackle this challenge, Canada's universities are conducting crucial research to improve and expand clean energy sources such as wind, solar, hydro, wave and nuclear.

Universities are also working to develop and pilot promising technologies such as

small modular reactors, green hydrogen, geothermal energy and carbon capture and utilization.

In addition, they are partnering with industry to reduce the emissions released during the extraction and use of fossil fuels to make our current energy sources more sustainable.

Also, they are helping to train and grow the clean energy workforce which is projected to reach

2.68 million by 2050[9]

Given the unprecedented scale of energy transition and expansion needed to meet our targets, Canada must invest in the solutions and partnerships offered through its universities.

[8] Canadian Climate Institute, "*The Big Switch – Electricity in Canada* ", May 2022,https://climateinstitute.ca/reports/big-switch/

[9] Government of Canada, "*Clean Energy Regulations*", September 2024, https://www.canada.ca/en/services/environment/weather/climatechange/climate-plan/clean-electricity-regulation.html

Dalhousie University - battery innovation

Dalhousie University will house a first-in-Canada battery innovation centre to provide a critically needed facility for battery research and energy efficient industrial development. Batteries are a key part of Canada's critical minerals strategy and improvements in their capacity to reliably store and discharge energy from clean sources can help power the shift to net zero. Dalhousie University's new centre will vastly accelerate the speed of experimentation and innovation. The centre will allow for testing to create batteries using range of materials such as lithium, sodium, potassium and other more abundant materials could lead to decreases in battery costs and increases in lifespan, efficiency and sustainability. In addition, the new battery centre will provide businesses and industry open access to use its facilities which will play a key role in training the specialized workforce needed for Canada's growing battery sector.

University of Victoria - renewable energy microgrids

A team of engineers from the University of Victoria are working on a first of its kind renewable energy microgrid incorporating a wave energy device for a remote coastal community on Kootka Island, a National Historic Site and traditional home of the Mowachaht/ Muchalaht First Nation (MMFN). This cutting–edge project is supporting the community in achieving their long-held dream of re-occupying Yuquot after being forcibly relocated decades ago. This project is community-driven as the MMFN is highly motivated to pursue clean energy solutions that improve quality of life, facilitate economic development and support self-determination.

University of Calgary and University of Alberta - next-generation carbon capture technology

Researchers at the University of Calgary developed a CO_2-capturing microporous material called Calgary framework-20 or CALF-20 that attracts and locks in gas molecules. Researchers at the University of Alberta then tested the material and determined that its unique properties make it an excellent candidate for CO_2 capture and that the material could be packed in a column, fastened to the end of a smokestack and withstand water and other contaminants. Once collected, the CO_2 can be compressed and stored in geological formations, pushed back into old wells for enhanced oil recovery or converted back into fuel, such as methanol, to be used in the creation of other products.

CALF-20 has since been scaled up to the multi-kilogram scale by a company based at the University of Calgary and then licensed to an industry partner out of Burnaby, B.C. to commercialize the material. This partner has shown that CALF-20 is suitable in an industrial setting and is now testing it in a cement plant at a capacity of one tonne per day.

University of Toronto - CANSTOREnergy project

This University of Toronto-led project brings together researchers from 11 Canadian universities, along with community, utility and industry partners, to develop technologies that convert carbon-based emissions into useful products, such as fuels and raw materials, and create a net-zero means of seasonal storage for renewable energy that meets specific community needs. The project is co-creating these new technologies with two very different communities, Yukon and Hamilton Ontario, in recognition that there is no one-size-fits-all approach to how carbon conversion technologies may be adapted to existing infrastructure, economic forces and social goals.

Université du Québec à Trois Rivières (UQTR) – hydrogen research

The Université du Québec à Trois-Rivières' Hydrogen Research Institute (HRI) conducts research on hydrogen production, storage, and safety, smart grids and vehicles, and next-generation materials to sustainably transition from current energy systems to low-carbon energy systems. Through its hydrogen research, it is working to address the technical gaps needed for commercially competitive hydrogen energy systems, in performing fluid dynamics simulations of hydrogen releases for safety, as well as the safety and lifetime analysis of new materials and hydrogen energy systems.

Memorial University of Newfoundland – wind turbine research

Researchers at Memorial University are developing a wind turbine system that directly generates heat in a fluid instead of producing electricity in a generator. A wind-powered heating device has great potential to provide clean, thermal energy to people across the province and northern, remote and off-grid regions. To help translate this research into a real-world impact, the researchers are working with the university's Technology Transfer and Commercialization office to evaluate the potential of their research for commercialization and provide support towards creating a business.

Memorial University of Newfoundland

Conclusion

Across the country, universities are active partners in advancing an energy-efficient and climate resilient Canada, working with government, communities and businesses. Through research, innovation, training and engagement, they are improving community resiliency to climate disasters and propelling the economy forward. However, much more is needed to meet the challenges posed by climate change, improve the lives of Canadians and address declining productivity.

Now is the time for Canada to make the critical investments and develop the strategic partnerships with its universities that will enable it to unlock its full potential, overcome the steep challenges ahead, and succeed globally.

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About

Universities Canada is the voice of Canada's universities, representing over 90 public and private not-for-profit institutions at home and abroad. Our member universities are located in communities across Canada, serving over 1.4 million students and employing upwards of 400,000 people. Our universities — through teaching, research and local engagement — transform lives, strengthen communities and find solutions to the most pressing challenges facing our country and the world. For more information on its climate work, please visit: Canada's universities: Action for net zero.

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University of Toronto