Research and International Review

Carleton University

Research and International

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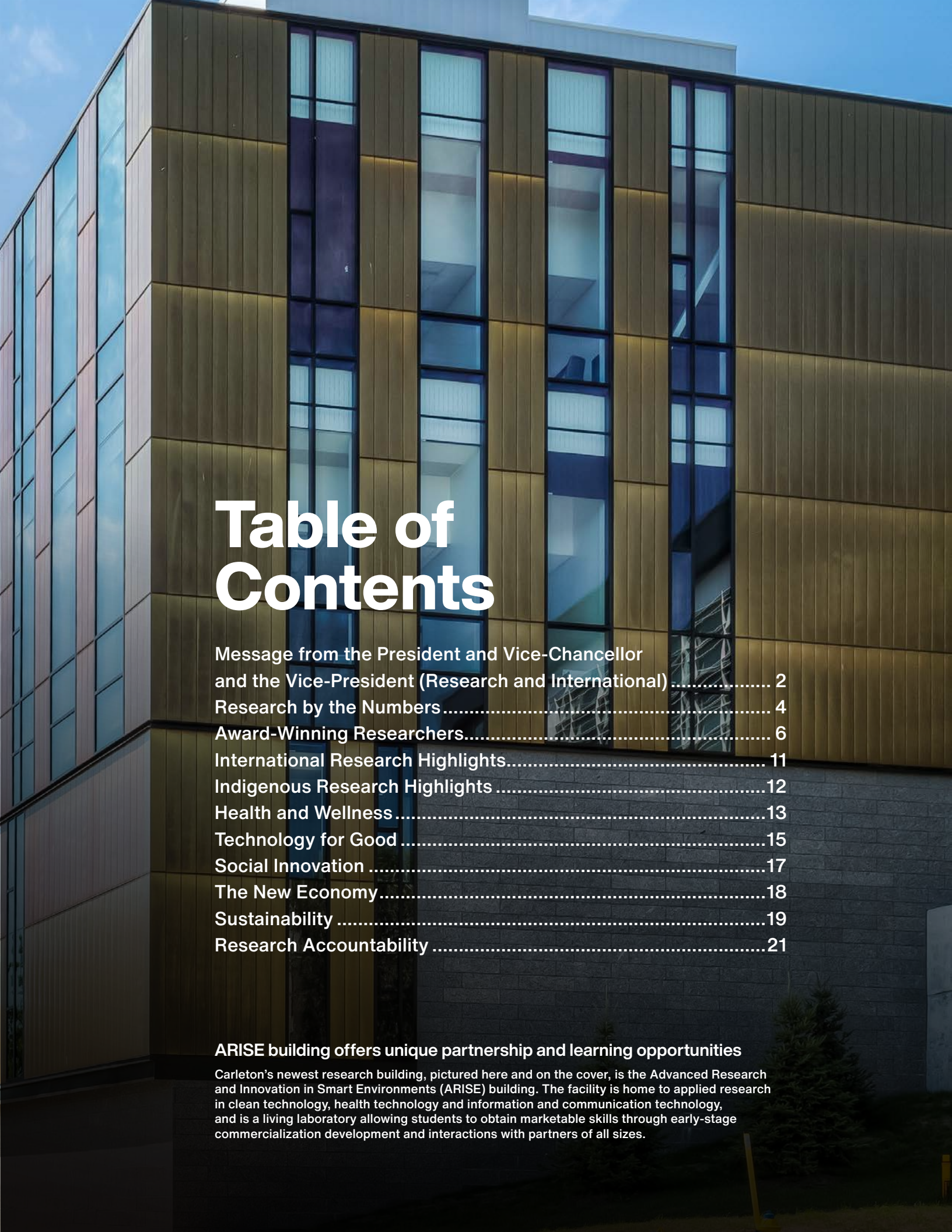

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ARISE building offers unique partnership and learning opportunities

Carleton's newest research building, pictured here and on the cover, is the Advanced Research and Innovation in Smart Environments (ARISE) building. The facility is home to applied research in clean technology, health technology and information and communication technology, and is a living laboratory allowing students to obtain marketable skills through early-stage commercialization development and interactions with partners of all sizes.

Message

FROM THE PRESIDENT AND VICE-CHANCELLOR AND VICE-PRESIDENT (RESEARCH AND INTERNATIONAL)

This year, Carleton celebrated its 80th anniversary, providing an opportunity to reflect on how the university has evolved and changed through the years. Since it was established in 1942, Carleton has grown into a dynamic, global research institution. This year epitomizes this evolution, with tremendous successes, awards and growth in our research enterprise.

Carleton is among Canada's fastest growing research-intensive universities. In 2022, our research enterprise reported $97.4M in sponsored funding — that's an unprecedented 79 per cent gain in the past four years, placing us second in growth among Canada's comprehensive and medical universities.

Our rankings in Re$earch Infosource, an independent research and consulting firm, highlighted our research in no less than seven of their Winner's Circles – a first for Carleton. We placed in the top five among comprehensive universities in Canada in categories including not-for-profit and corporate income growth as well as increases in federal funding from the Natural Sciences and Engineering Research Council (NSERC) and the Social Sciences and Humanities Research Council (SSHRC).

The Maclean's 2023 university rankings were also favourable, highlighting Carleton's excellence in the higher education sector, placing us in the position of Canada's Top 5 Best Comprehensive Universities, first overall in the Social Sciences and Humanities grants category, and fifth for Science grants.

This past year we also celebrated Lenore Fahrig, a Chancellor's Professor in the Department of Biology, who earned Canada's top science and engineering prize — NSERC's Gerhard Herzberg Gold Medal for Science and Engineering — for her outstanding contributions to solving wildlife habitat fragmentation and assist with conservation. We also celebrated Sonia Chiasson from the School of Computer Science who was awarded an inaugural NSERC Arthur B. McDonald Fellowship for her work on universal design for computer security and privacy.

We welcomed six new Canada Research Chairs in areas of strategic societal importance, had three of our researchers inducted into the Royal Society of Canada, three named as globally Highly Cited Researchers, and two named to the Order of Canada. It truly has been a hallmark year.

And our impact continued beyond awards. We forged new, productive, health-related partnerships with the Royal's Institute of Mental Health Research, The Ottawa Hospital, the Bruyère Research Institute and CAE. We continue to be inspired by our collaborations with Indigenous partners and not-for-profit organizations. Our innovative partnership with Ericsson has borne fruit with the opening of our state-of-the-art Ericsson-Carleton Mobile Wireless Lab.

We have so many reasons to feel proud, and we invite you to continue reading about our research successes and innovative research stories. We celebrate our faculty and students who, on a daily basis, challenge what's possible.

Benoit-Antoine Bacon
President and Vice-Chancellor

Rafik Goubran
Vice-President (Research and International)

Research Growth and Impact - By the Numbers

REVENUE GROWTH NUMBERS

$97.4M
sponsored research revenue

79%
increase in sponsored research revenue since 2017

69%
increase in Tri-Agency funding since 2017

37.3%
increase in not-for-profit research income growth in the last year

48.6%
increase in corporate research income growth in the last year

RESEARCH OUTPUT GROWTH

13.2
citations per publication (2017-2021)

21.5%
increase in number of Carleton University authors over 5 years

17.1%
increase in scholarly output over 5 years

ABOUT CARLETON

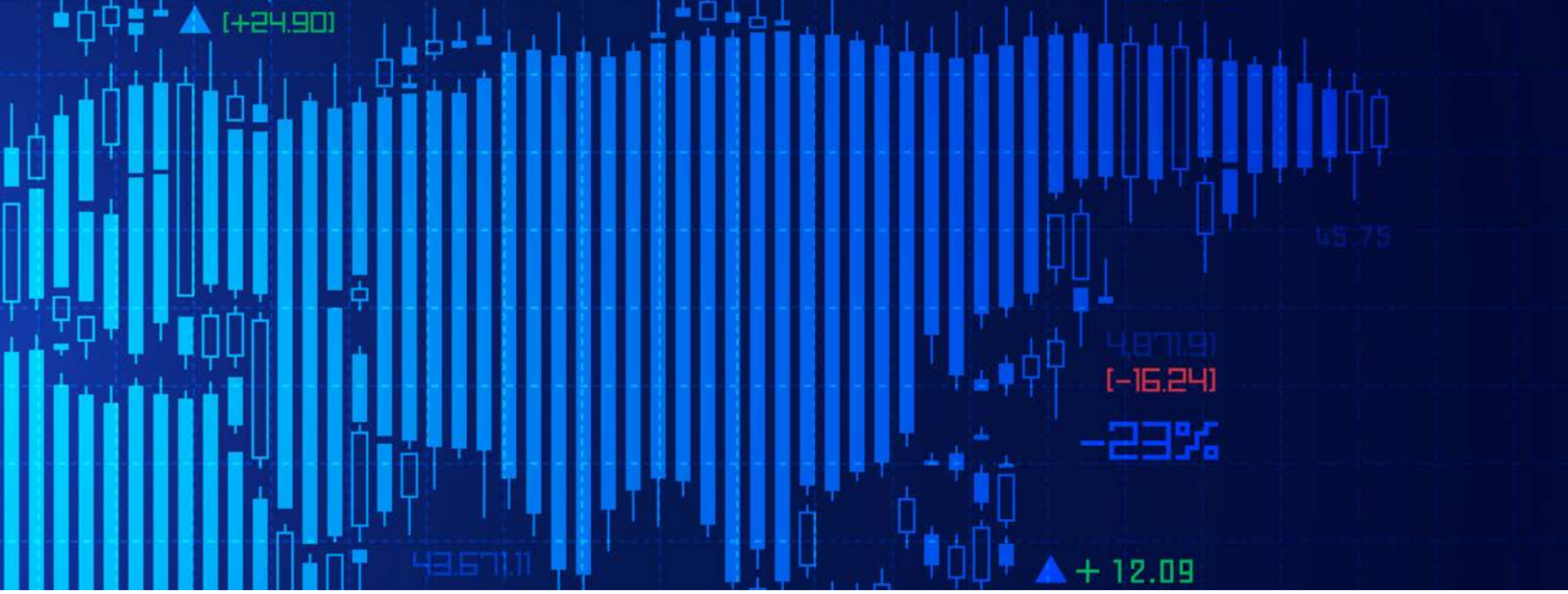
27,026
undergraduate students

4,383
graduate students

1,016
full-time faculty members

177,000+
alumni

893
contract instructors



OUR AWARD-WINNING RESEARCHERS

32
Canada Research Chairs

14
IEEE Fellows

6
Killam Research Fellows

3
Highly Cited Researchers named in 2022 by Web of Science Group

43
Royal Society Fellows and College Members

51
Ontario Early Researcher Award Recipients

27
Order of Canada Recipients

6
SSHRC Partnership Grants

10
Banting Postdoctoral Fellows

CARLETON IS HOME TO:

- NSERC Gerhard Herzberg Canada Gold Medal Recipient
- Canada 150 Chair
- NSERC Arthur B. McDonald Fellow
- One Killam Prize winner
- Two NSERC Strategic Networks

Carleton University was recognized as a top performer in the 2022 Sustainable Campus Index, achieving a top 10 ranking in two impact areas: Water and Wellbeing & Work. The recognition follows Carleton's Gold STARS assessment given by the Association for the Advancement of Sustainability in Higher Education (AASHE), which was achieved in early 2022.

Award-Winning Researchers

TWO SCIENCE RESEARCHERS WIN PRESTIGIOUS NATIONAL AWARDS

In October 2022, two highly accomplished Carleton University researchers received prestigious awards from the Natural Sciences and Engineering Research Council of Canada (NSERC).

Lenore Fahrig, Chancellor's Professor in Carleton's Department of Biology known for her trailblazing research on wildlife habitat fragmentation, has won the 2022 Gerhard Herzberg Canada Gold Medal for Science and Engineering from the Natural Sciences and Engineering Research Council of Canada (NSERC). Considered the country's top science and engineering honour, this award is given annually to an individual whose body of work has shown consistent excellence and impact.

Sonia Chiasson from the School of Computer Science is the recipient of an Arthur B. McDonald Fellowship, given by NSERC to early-stage researchers in the natural sciences and engineering to enhance their research capacity so they can become leaders in their field and inspire others. Her cybersecurity research seeks to develop computer security systems that better fit into people's daily lives.

PHYSICS RESEARCHER WINS MAJOR NATIONAL MEDAL

Carleton's **Manuella Vincter**, an experimental particle physics researcher, received the Henry Marshall Tory Medal from the Royal Society of Canada. Vincter is a leader in the international physics community and deputy spokesperson for the ATLAS project, the largest particle detector experiment at the Large Hadron Collider (LHC), a particle accelerator at CERN in Switzerland. Vincter was instrumental in enabling the science underneath the Nobel prize-winning discovery of the Higgs boson, including making sure the LHC detector was able to identify some of the particles the Higgs boson produces.

Erin Tolley, Department of Political Science
CRC in Gender, Race, and Inclusive Politics

Adegboyega Ojo, School of Public Policy and Administration
CRC in Governance and Artificial Intelligence (AI)

Sanjeena Dang, Department of Mathematics and Statistics
CRC in Data Science and Analytics

Jevan Cherniwchan, Department of Economics
CRC in Economics of Sustainability and Globalization

Maria Rogers, Department of Psychology
CRC in Child and Youth Mental Health and Well-Being

John Anderson, Departments of Cognitive Science and Psychology
CRC in Cognition and Wellness

CARLETON RESEARCHERS JOIN THE ROYAL SOCIETY OF CANADA

Three Carleton researchers were elected to the Royal Society of Canada (RSC). Steven J. Cooke, Department of Biology and Director of the Institute of Environmental and Interdisciplinary Science, was named an RSC Fellow, noted for being peer-elected as the best in their field. Jesse Stewart in the Department of Music and Rowan Thomson in the Department of Physics were named as members of the RSC College of New Scholars, Artists and Scientists, which consists of mid-career leaders who provide a multi-generational capacity to address major challenges nationally and globally.

THREE CARLETON RESEARCHERS MAKE HIGHLY CITED RESEARCHERS LIST

In 2022, three Carleton researchers were named as Highly Cited Researchers by Clarivate Analytics, a global leader in providing trusted insights and analytics. Named three years in a row, Steven J. Cooke, Department of Biology and Director of the Institute of Environmental and Interdisciplinary Science is joined by Peter Xiaoping Liu, Systems and Computer Engineering, and Lenore Fahrig, Department of Biology, who was also named in 2020. Those on the list have demonstrated significant influence in their chosen fields through the publication of multiple, highly-cited papers over the last decade.

TWO CARLETON UNIVERSITY RESEARCHERS NAMED TO ORDER OF CANADA

Carleton's **D.R. Fraser Taylor** has been named as an Officer of the Order of Canada. Recognized internationally as a leading figure in the field of cartography, Taylor is the Chancellor's Distinguished Research Professor of International Affairs, Geography and Environmental Studies and the director of the university's Geomatics and Cartographic Research Centre.

Frances Abele, Chancellor's Professor at the School of Public Policy and Administration, was named a Member of the Order of Canada "for her contributions to public policy and administration as one of Canada's pre-eminent scholars of northern policy and Indigenous political development." Abele is a supervisor of Indigenous Policy and Administration and founder of the graduate diploma in Indigenous Policy and Administration. She has worked with Indigenous peoples across Canada and the circumpolar Arctic.

CARLETON RECEIVES SIGNIFICANT INVESTMENT FOR HIGH-RISK, HIGH-REWARD RESEARCH

Physics researcher Rowan Thomson and Boris Vukovic from the Department of Industrial Design and the Accessibility Institute (formerly READ Initiative) each received $250,000 from the highly competitive New Frontiers in Research Fund program, which supports research that pushes boundaries. Thomson's team will develop a system for evaluating radiation energy deposited in cells and the associated cascade of biological events. Vukovic's team is implementing artificial intelligence to augment disability-related assessment of functional limitations and recommendations in higher education.

THREE EARLY-CAREER RESEARCHERS RECOGNIZED BY PROVINCE

Three Carleton researchers have each received a $140,000 Early Researcher Award (ERA) from the Province of Ontario for their ongoing research projects in areas including self-monitoring intelligent batteries, Roman artefact research and diabetes pathogenesis. This year's recipients are Hicham Chaoui in the Department of Electronics; Jenny Bruin, who is cross-appointed to the Department of Biology and the Institute of Biochemistry; and Greek and Roman Studies researcher Laura Banducci.

ROYAL CANADIAN GEOGRAPHICAL SOCIETY CELEBRATES CARLETON RESEARCHER

The Royal Canadian Geographical Society (RCGS) is celebrating Christopher Burn as one of 16 individuals who exemplify the Society's mandate to "make Canada better known to Canadians and to the world." A Chancellor's Professor in the Department of Geography and Environmental Studies at Carleton University, Burn is the 2022 recipient of the prestigious RCGS's Martin Bergmann Medal for Excellence in Arctic Leadership.

The ATLAS project at CERN is represented by Carleton's Manuella Vincter as Deputy Spokesperson (see page 7).

James Milner meets with Burundian refugees whose families have been in exile in Tanzania since 1972 to discuss their sense of engagement with the peacebuilding process in Burundi.

International Research Highlights

HELPING AFGHAN SCHOLARS FIND A NEW INTELLECTUAL HOME IN CANADA

Researchers at Carleton and the University of British Columbia joined forces to help scholars and others who are fleeing the crisis in Afghanistan, especially women and ethnic minorities, establish a new intellectual community in Canada. Their project, "Placement, Preservation and Perseverance: Afghan At-Risk Scholars, Activists and Students," received a $1.096 million grant from the International Development Research Centre (IDRC). Carleton is also contributing $164,000 towards the project, reflecting the university's leadership in supporting the Scholars at Risk initiative.

NEW RESEARCH NETWORK WILL SHIFT HOW MIGRATION POLICY IS MADE

A new initiative based in Carleton's Local Engagement Refugee Research Network (LERRN) is seeking to correct the imbalance in research informing forced displacement policy. Supported with $8 million over seven years, the International Development Research Centre's (IDRC) Research Chairs on Forced Displacement Network will establish 12 research chairs at universities in Africa, South and Central America, the Middle East and Southeast Asia. The chairs will form an international network to encourage collaboration and amplify their findings.

Indigenous Research Highlights

ĂRRAMĂT PROJECT LINKS INDIGENOUS WELL-BEING AND BIODIVERSITY

A new project called "Ărramăt: Strengthening Health and Well-Being through Indigenous-Led Conservation and Sustainable Relationships with Biodiversity" has been funded by SSHRC's New Frontiers in Research Fund. The project, co-led by Carleton's **Danika Littlechild** in the Department of Law and Legal Studies involves more than 150 Indigenous organizations, universities and other partners, and aims to simultaneously empower Indigenous peoples to apply their knowledge and engage Indigenous youth in the realm of biodiversity conservation and land governance.

ADDRESSING HEALTH INEQUITIES IN UNDERSERVED COMMUNITIES

Carleton and The Royal's Institute of Mental Health Research have renewed their joint Culture and Gender Mental Health Research Chair held by the Department of Neuroscience's Kim Matheson. In this second five-year term, Matheson will continue to focus on health inequities in underserved communities. Her most recent work is in partnership with First Nations communities and organizations in the Nishnawbe Aski Nation region of Northwestern Ontario.

INDIGENOUS PERSPECTIVES ON URBAN RESTRUCTURING

Rick Colbourne from the Sprott School of Business, received $250,000 from the Exploration stream of the New Frontiers in Research Fund to support his interdisciplinary research on Indigenous-led responses to restructuring in cities and urban centres. Using Two-Eyed Seeing and regulation theory, Colbourne, Sprott's Assistant Dean of Equity and Inclusive Communities, is helping to frame the ways cities are being restructured. The Exploration stream seeks to inspire projects that bring disciplines together beyond traditional approaches.

Health and Wellness

CARLETON AND PARTNERS CONDUCT NEW AGING IN PLACE RESEARCH

Best Buy Health and AGE-WELL have partnered with the Bruyère Research Institute and Carleton in new research that will help older adults continue to live independently. Carleton and Bruyère researchers, with financial and technology contributions from Best Buy Health and AGE-WELL, are investigating in-home, sensor-based smart technologies that monitor various aspects of older adults' safety and well-being. The systems can detect changes in daily functioning and alert remote caregivers to out of the ordinary activity.

PREVENTING AND ADDRESSING FAMILY VIOLENCE

Health Sciences researcher **Francine Darroch** received $946,859 in federal support to adapt, implement and test the inclusion of a trauma and violence-informed physical activity approach into physical activity programs for women and children experiencing violence. Her team seeks to create safe environments for approximately 225 women accessing partner sites in Ottawa, Toronto, and Vancouver, based on understanding the effects of trauma and its links to health and behaviour.

EARLY INTERVENTIONS TO STOP PARKINSON'S DISEASE

Neuroscience researcher **Natalina Salmaso** is a part of an international effort to advance research on Parkinson's disease. Salmaso's contribution to the initiative led by the Michael J. Fox Foundation for Parkinson's Research is focussed on the role played by brain cells called astrocytes, which support the function of neurons and control permeability of the blood-brain barrier. Understanding why these cells die, which occurs before Parkinson's symptoms show, could lead to interventions that stop disease progression.

HEALTH RESEARCH RECEIVES SIGNIFICANT CIHR INVESTMENT

Carleton has received over $3.15M in funding from the Canadian Institutes of Health Research (CIHR), historically its best result in a CIHR Project Grant competition. Neuroscience's Michael Hildebrand, Health Science's Menno Oudhoff, Biology's Jenny Bruin, and Mechanical and Aerospace's Oren Petel have received funding that will further discoveries in important areas of such as diabetes, chronic pain, brain injury, and early-life immune cell function.

Technology for Good

ERICSSON-CARLETON PARTNERSHIP OPENS INNOVATIVE LAB, HOLDS INTERNATIONAL SYMPOSIUM

Government officials and industry representatives gathered on September 28, 2022 to mark the official opening of the Ericsson-Carleton Mobile Wireless Lab in Carleton's ARISE building. The lab was created to expand experiential learning and research in wireless communications. A first of its kind in Canada, the lab hosts a private standalone 5G network that allows researchers to develop, test and optimize state-of-the-art applications.

In addition to this, the partnership held a symposium highlighting 5G wireless communications research that brought together hundreds of researchers from around the globe. The first annual TechTalks Ericsson-Carleton Symposium was held over three days in March 2022 and saw more than 30 presenters covering more than 20 topics such as machine learning, artificial intelligence and adaptive/autonomous systems control.

CARLETON AND CAE STRIKE HIGH-TECH HEALTH RESEARCH PARTNERSHIP

Carleton and high-tech company CAE established a three-year research partnership that will advance innovation, talent development and work-integrated learning in simulation and immersive environments, with a focus on advancing health technology, green technology, cybersecurity and computational intelligence technologies for training and operations in the aerospace and health-care sectors.

ROBOTICS LAB TO DESIGN BETTER ORTHOPEDIC IMPLANTS AND SURGICAL TECHNIQUES

The latest health technology partnership between Carleton, the Ottawa Hospital Research Institute and the hospital's Division of Orthopedic Surgery will create a new lab, the Ottawa Orthopaedic Biomechanical Laboratory, with the goal of improving orthopedic implants and surgical repairs. With Carleton investing $140,000 into the $560,000 lab, this partnership will use a new robotic arm to evaluate the materials and techniques used in implants, and to more accurately model their performance.

A demo lunar rover in the moon yard in Mission Control's office in Ottawa: Mission Control Space Services, established by Carleton University graduate and former NASA space shuttle flight controller Ewan Reid aims to streamline space exploration through its cutting-edge software, allowing countries and companies to "unlock the potential of new scientific and commercial opportunities on the Earth, moon, Mars and beyond".

Social Innovation

A SOCIETAL APPROACH TO MUSIC RESEARCH AND CREATION

A new research centre was launched in Carleton's Faculty of Arts and Social Sciences. Music, Sound and Society in Canada (MSSC) will take a critical lens to music and sound in this country. Led by **Ellen Waterman**, the Helmut Kallman Chair for Music in Canada, the centre will explore how music is both shaped by, and helps to shape, Canadian society and will focus on central themes such as decoloniality, anti-racism, accessibility, and environment.

The Launch of the Accessibility Institute

In 2022, Carleton launched the Accessibility Institute (formerly known as the READ Initiative). It is the first of its kind in post-secondary in Canada, and will further strengthen and expand collaborations to advance accessibility across disciplines and sectors, and reaffirms Carleton's ambition to continue leading toward a fully inclusive and accessible Canada.

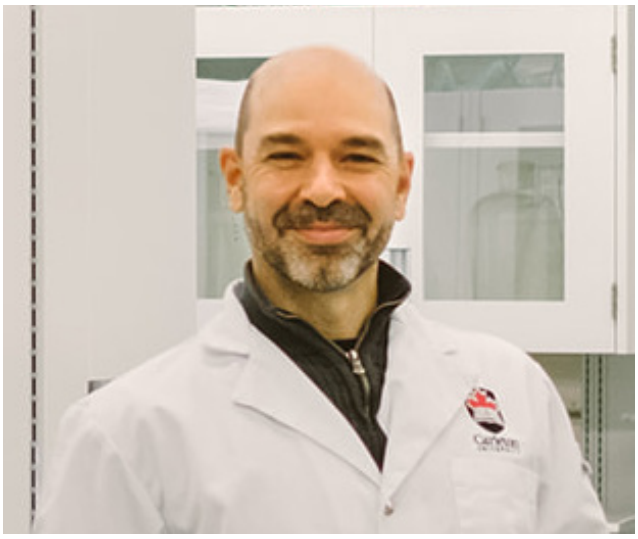
Led by Boris Vukovic, Director of the Institute, it is currently involved in a number of research projects in areas such as accessible housing for autistic adults, employment outcomes for post-secondary students with disabilities, effectiveness of artificial intelligence in assessing disability-related needs, and acoustics barriers in the built environment.

The New Economy

NEW INSIGHTS INTO CANADA'S CHARITABLE SECTOR

Paloma Raggo and team of faculty in the Master of Philanthropy and Non-profit Leadership program at Carleton has launched a major five-year research project within the School of Public Policy and Administration that will change knowledge about the charitable sector in Canada. The Charity Insights Canada Project will collect and share accurate, relevant and timely information about the Canadian charitable sector. The data generated through this work will support the long-term economic viability, impact and resiliency of the sector.

REDUCING AND MAPPING FOOD WASTE



As climate change and supply chain bottlenecks make it more challenging to grow fruits and vegetables, the term "food security" has become commonplace, yet half of all food produced in Canada is thrown away. Chemistry researcher **Tyler Avis** and his team are exploring the use of beneficial microorganisms to outcompete the bacteria, viruses and fungi that damage or destroy plants, a biocontrol method that can protect crops and extend the shelf life of produce.

Each year, millions of tonnes of food are wasted in Canada with food systems playing a major role. This has an impact on greenhouse gas emissions and climate change. **Leanne Keddie**, Assistant Professor of Accounting in the Sprott School of Business is one of the principal investigators in a project that is seeking to foster sustainable food systems by identifying ways that waste can be eliminated at every stage of production and consumption. With localized innovative approaches found Canada-wide, her research is asking why they are not being scaled up.

Sustainability

Housing plays an integral role in Canada's economy, environment, and society, and in an era of climate change, creating sustainable housing has become incredibly important to the integrity and longevity of the built environment and the health and wellness of occupants.

An internationally recognized leader in sustainable housing, Carleton has made it a priority to challenge what's possible for energy efficiency solutions.

SUSTAINABLE BUILDINGS THAT PRIORITIZE OCCUPANT COMFORT

Liam O'Brien in the Department of Civil and Environmental Engineering is researching sustainable building design with a focus on how people use buildings while prioritizing occupant comfort. Given that energy use in residential and commercial buildings accounts for 22 per cent of greenhouse gas emissions in Canada and nearly two-thirds is used for heating, O'Brien closely collaborates with researchers from numerous fields to focus on energy conservation while ensuring a level of well-being.

BETTER ENERGY EFFICIENCY IN HOUSING

Cynthia Cruickshank in the Department of Mechanical and Aerospace Engineering is leading a major project in the new Centre for Advanced Building Envelope Research (CABER). A purpose-built facility in west-end Ottawa, this six-year, $5.1-million project is supported by the Natural Resources Canada (NRCan) Energy Innovation Program and the Ontario Research Fund. Drawing upon advances in insulation materials, prefabricated construction and panelized retrofits, CABER will develop new approaches to constructing building envelopes that are thinner and cheaper, and find new methods for renovating existing buildings with less cost.

TRANSFORMING HOW OIL AND GAS SECTORS MEASURE AND MITIGATE EMISSIONS

To meet Canada's goal of reducing methane emissions by at least 40 per cent by 2025, federal and provincial governments are rolling out regulations to fix methane leaks on oil and gas facility equipment. To detect these leaks, Mechanical and Aerospace Engineering researcher **Matthew Johnson** and his team are testing a new laser-based monitoring tool by deploying wind sensors and creating blinded controlled methane releases to better understand the capabilities of the airborne measurement system.

EFFICIENCY CANADA

Efficiency Canada is the national voice for an energy efficient economy. Housed at Carleton's Sustainable Energy Research Centre, it envisions a future where Canada uses energy efficiency to its fullest potential. In 2022, they released four influential research reports that have seen uptake at the federal level including their 2022 Canadian Energy Efficiency Scorecard and the Municipal Guide to Net Zero Energy-Ready Building Codes. They also launched the DiscoverEE Hub, an online portal that is helping more people join the energy efficiency sector in Canada. Last year, more than 18,000 people visited the site to explore events, training and career opportunities.

Research Accountability

Research Support Fund and Incremental Project Grant

The federal Research Support Fund and Incremental Project Grant programs cover a portion of the costs associated with managing the research funded by CIHR, NSERC and SSHRC, such as salaries for staff who provide administrative support, training costs for workplace health and safety, maintenance of libraries and laboratories and administrative costs associated with obtaining patents for inventions.

These contributions are paramount to the success of strategic investments, such as support for researchers in information technology, post-award support, library resources and intellectual property support.

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