MCGILL SUSTAINABILITY SYSTEMS INITIATIVE

Annual Report

May 2022 - April 2023

McGill Sustainability Systems Initiative | Initiative Systémique de McGill sur la Durabilité

McGill

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About

The McGill Sustainability Systems Initiative (MSSI) provides funding and opportunities for McGill researchers from all disciplines to interact and co-design projects that tackle sustainability-related challenges.

MSSI EXECUTIVE COMMITTEE

Anja Geitmann
Dean, Faculty of Agricultural and Environmental Sciences

R. **Bruce Lennox**
Dean, Faculty of Science

Jim Nicell
Dean, Faculty of Engineering

A Message from Our Executive Committee

It gives me great pleasure to introduce the May 2022-April 2023 Annual Report for the McGill Sustainability Systems Initiative. This year marks the end of the initiative's fifth year, and I am honored to share the remarkable achievements that have emerged from our collective dedication to advancing sustainability.

Over the past year, the McGill Sustainability Systems Initiative has been a driving force behind interdisciplinary collaboration, fostering innovative projects, groundbreaking research, and meaningful partnerships. Our faculty, researchers, and students have demonstrated an unwavering commitment to addressing sustainability challenges by transcending traditional academic boundaries.

While celebrating our successes, I want to acknowledge Dr. Heather McShane, the Director of the McGill Sustainability Systems Initiative. She has been a key force in guiding us through this initial phase and left for other opportunities in her native U.K. We express our thanks for her dedicated leadership and wish her continued success in her future endeavors. In this context, I am delighted to report that Mr. Evan Henry, a McGill BSc. and MSc., graduate was appointed to the position of Director in November 2023.

As we navigate this transition, I am excited to share our enthusiasm for the development of the next phase of the initiative. Despite the change in leadership, our commitment to advancing sustainability remains unwavering. We see this as an opportunity to build upon the foundation laid in the first 5 years to further enhance the impact and reach of the McGill Sustainability Systems Initiative over the next 5 years and beyond.

I extend my sincere gratitude to everyone who has played a role in making the McGill Sustainability Systems Initiative a success. Each member of our community has contributed to this vital journey toward a more sustainable and equitable future. I invite you all to join us in embracing the opportunities and challenges that lie ahead as we embark on the next chapter of our commitment to sustainability.

Thank you for your continued dedication and support.

Sincerely,

R. Bruce Lennox, on behalf of the MSSI Executive Committee
Dean, Faculty of Science

The MSSI in Numbers

$9.6M

to support sustainability research at McGill

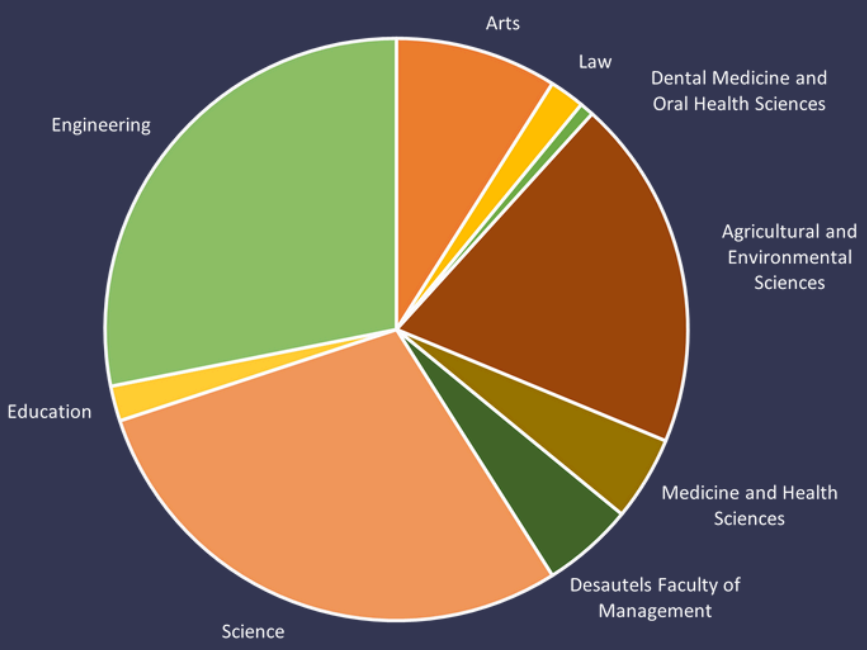
206

academic publications

248

students and postdocs supported

MSSI Members



256

faculty members from across

9

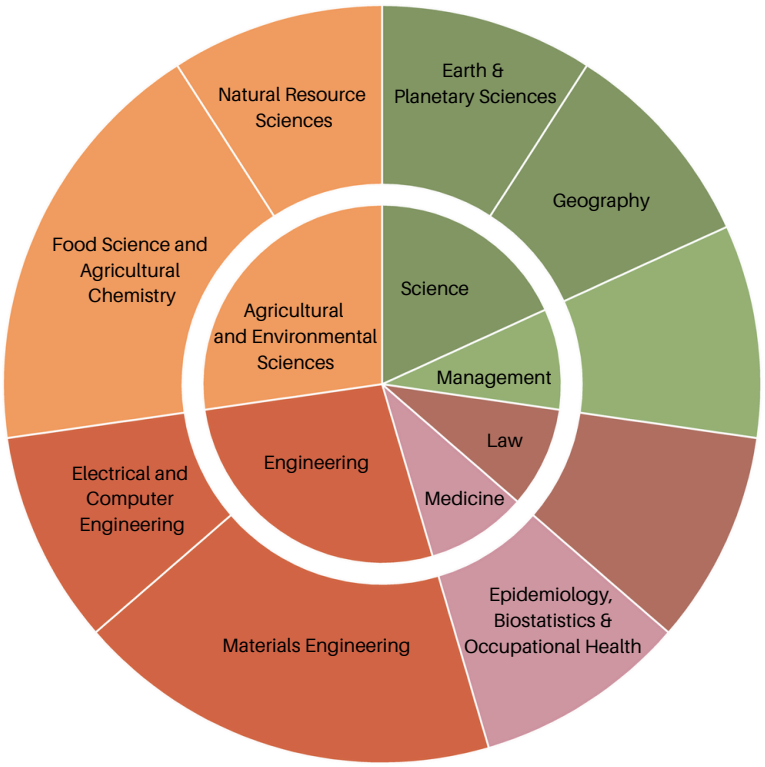
McGill faculties

11

projects from

6

faculties funded through the 2023 MSSI funding competitions



External funding awarded to support the continuation of MSSI sustainability research

$250,000

Infrastructure Canada

$300,000

Fondation J. Armand Bombardier

$1.35 million

NSERC Alliance and PRIMA Québec

MSSI Funding Programs

The MSSI provides funding to support bold and innovative research projects that address sustainability challenges and build McGill's capacity for collaborative research.

Funding competitions are launched annually and are open to all faculty researchers at McGill.

$200,000 in funds dispersed this year

Ideas Fund

Solutions for a more sustainable future require outside-the-box thinking and novel approaches that may be seen as too bold for traditional funding sources. This fund provides recipients with the resources needed to explore ideas that have the potential to make a significant impact on a sustainability-related challenge.

NEW PROJECTS

Global survey of Bisphenol S and alternative color developers in thermal papers in food packaging

Thermal labels used in food packaging may be a significant dietary source of previously unknown contaminants. Of particular interest are color developers such as Bisphenol S (BPS), often used in thermal labels, which have been demonstrated to migrate from packaging into food itself.

This project will undertake a global survey of color developers used in thermal labels and identify less hazardous chemicals using human cell-based assays. *Lead researcher: Stéphane Bayen (Food Science and Agricultural Chemistry)*

Maximally efficient photocatalysis through Janus nanoparticle-based band engineering

Photocatalytic reactions are accelerated chemical reactions driven by sunlight. This project aims to engineer how such reactions are optimally coordinated with nanomaterials to dramatically improve their efficiency.

Combining advanced theoretical design and state-of-the-art experimental synthesis methods, this technology would mimic and turbocharge natural photosynthetic and enzymatic processes. It could contribute to new ways to sustainably produce hydrogen from renewable water resources, synthetically scrub carbon dioxide, and drive the remediation of water resources in emerging economies. *Lead researcher: Kirk Bevan (Materials Engineering)*

Reducing electronic waste with fruit juice-based flexible, stretchable, and biodegradable batteries

Batteries are a significant contributor to total electronic waste (e-waste) generated by Internet of Things (IoT) devices such as smartphones. This project aims to design and fabricate biodegradable, flexible, and stretchable batteries to power such devices. These low-cost batteries will be based on electrolytes fabricated from fruit juice and paper-based biodegradable electrodes.

Ultimately, they will reduce the environmental impact of e-waste from the disposal of IoT devices. *Lead researcher: Sharmistha Bhadra (Electrical and Computer Engineering)*

Sustainable pollinator biodiversity conservation in the Quebec cranberry industry

Quebec is one of the largest cranberry-producing regions in the world. This project will assess how cranberry production affects pollinator biodiversity in and around farms by surveying the insect biodiversity of cranberry farms and their surrounding natural habitats.

The project's aim is to empower the Quebec cranberry industry to promote a sustainable balance between agricultural production, economic growth, and biodiversity conservation. *Lead researcher: Jessica Gillung (Natural Resource Sciences)*

Active packaging enabled by molecular imprinting-based smart coating to extend food shelf life

Food that is produced but not consumed is an important contributor to global carbon emissions. This project aims to develop a novel smart packaging material, based on molecular imprinting technology, that could potentially extend the shelf life of food products.

This packaging could reduce food waste caused by spoilage bacteria, which are microorganisms that cause food to deteriorate. *Lead researcher: Xiaonan Lu (Food Science and Agricultural Chemistry)*

PROJECT RESULTS

A sample of previously funded projects that have wrapped up this past year

The effect of microplastics on cloud droplet formation

This project studied the lifecycle and impact of microplastics on atmospheric processes such as cloud formation. While most microplastics had no effect on water uptake, microplastics that had been aged by ultraviolet light did take up a significant amount of water.

The findings of this research imply these plastics can affect water uptake and loss in aerosol particles. Another implication of these findings are that these plastics could be transported long distances in the atmosphere through being incorporated into water cycles. *Lead researcher: Thomas Preston (Atmospheric and Oceanic Sciences; Chemistry)*

A unified approach towards understanding defect tolerant materials for solar energy harvesting

Perovskites are regarded as promising material for use in next -generation solar energy technologies. While there has been much research into their performance, there is still little understanding of the mechanism that enables their high efficiency, in particular what is happening at the very beginning (as in first trillionth of a second) of the process.

This team of researchers has combined their expertise in ultrafast spectroscopy to complete a trio of experiments on perovskite nanocrystals, revealing much of the remarkable physical properties that gives rise to their promise in energy applications. The development of this technique has also positioned the team to further explore and understand these promising materials. *Lead researcher: Patanjali Kambhampati (Chemistry)*

Solving aerosol enigma in the blink of an eye

Airborne particles and their interaction with clouds are a major uncertainty in climate change and pose public health threats. Small particles, less than 100 nanometers in size, cause millions of premature deaths annually.

This project allows us to detect aerosols in a millisecond and explore their fate in the environment, providing solutions to some air pollution challenges by creating 4-dimensional data needed for health and climate change modelling. *Lead researcher: Parisa Ariya (Atmospheric & Oceanic Sciences; Chemistry)*

Design of innovative clean technologies for sustainable use of marine biomass

This project developed sustainable and innovative post-harvesting processes using abundantly available but underutilized red seaweed biomass.

The process recovers multi value-added products such as bioactives, biomaterials, and biofuels with minimal chemical use, low energy cost and minimal waste. *Lead researcher: Benjamin Simpson (Food Science and Agricultural Chemistry)*

Mechanochemical synthesis of disordered-rocksalt anodes for ultrafast-charging Li-ion batteries

This project has led to the development of fast-charging Li-ion battery (LIB) anode compounds produced via a single-step mechanochemical method based on sustainably sourced materials.

The newly developed approach provides an alternative pathway towards cost-effective and sustainable synthesis of stably high-performing LIB anodes for rapid electric vehicle recharging. *Lead researcher: Jinhyuk Lee (Mining and Materials Engineering)*

Innovation Fund

The Innovation Fund was created to serve as a catalyst, accelerating the development of ideas or technology toward widespread societal adoption. This is achieved by providing seed funding for sustainability-related research with the potential to inform policy or move an innovation toward commercialization.

$100,000 in funds dispersed this year

NEW PROJECTS

Development of mesoporous polymer-in-ceramic ion conducting membranes for solid-state Li batteries

Current-state Lithium-ion batteries (LIBs) powering electric vehicles (EVs) are characterized by relatively low energy density, meaning limited driving range, employment of flammable chemicals, representing safety hazards, as well as non-sustainable sourcing of critical components. All-solid-state lithium batteries have been identified by the EV industry as truly transformative sustainable alternatives.

This project develops a polymer-in-ceramic structure that is intended to provide stable solid electrolytes with optimized interfacial integration to lithium metal anode and composite cathode for high performance and sustainable next-generation EV batteries. *Lead researcher: George Demopoulos (Materials Engineering)*

New tools for sustainable groundwater management

There are major sustainability challenges in ensuring clean water supply for small Northern communities that rely on groundwater.

The first step to ensuring sustainable water resources is identifying a well's capture zone (WCZ), the region from which a well extracts drinking water. By delineating the WCZ, groundwater can be protected for sustainable recovery. Most small Northern communities either haven't identified the WCZ or hire expensive consultants.

This project will build a new webtool that quickly estimates the WCZ for communities and households, using a recently published new set of analytical solutions. An initial version of the webtool is programmed, but it requires investment to be fully operational for potential users. *Lead researcher: Jeffrey McKenzie (Earth & Planetary Sciences)*

PROJECT RESULTS

A sample of previously funded projects that have wrapped up this past year

Prototype reactor for the Power-to-Gas process

This project designed and built a prototype reactor for the production of renewable natural gas (RNG) from carbon dioxide and biogas in collaboration with Montreal based company Xebec Adsorption Inc. This process enables combined carbon dioxide capture and utilization with energy storage in the form of RNG. The prototype reactor was successfully built and operated for several hundred hours, showcasing the proof of concept. *Lead researcher: Jan Kopyscinski (Chemical Engineering)*

Developing a near real-time sensor network for urban air pollution: prototype evaluation

This project collected data to train new deep learning models capable of predicting local temporal variations in air pollution and noise based on images and audio data. Using the data collected during the project, researchers developed a new version of image/audio sensor that they hope to market for commercial application in conjunction with the developed deep learning algorithms. *Lead researcher: Scott Weichenthal (Epidemiology, Biostatistics & Occupational Health)*

SSH-Ideas Fund

This award provides seed funding to explore bold ideas drawn specifically from humanities, arts, and social sciences research with the potential to illuminate or solve sustainability-related challenges.

$40,000 in funds dispersed this year

NEW PROJECTS

Measuring heat islands in Accra, Ghana, to inform climate resilience strategies

Higher temperatures, longer heat waves, and heat islands pose challenges to urban ecosystems and population health, and are exacerbated by climate change and urbanization. Cities in the Global South are starting to implement policies and practices to mitigate urban heat and strengthen heat resilience and adaptation, especially among vulnerable residents. However, most lack the fine-scale intra-urban environmental data needed to inform evidence-based decisions.

This team will measure indoor and outdoor temperatures in more than 150 locations throughout Accra, the capital and largest city in Ghana. They will also combine these temperature measurements with satellite images and census data to develop a model for estimating indoor temperature for residential locations throughout the city. The study's findings will contribute to a citywide monitoring system that will identify neighbourhoods and people at the highest risk of heat stressors and enable more cost-effective decision-making on heat resilience and adaption in Accra. *Lead researcher: Jill Baumgartner (Epidemiology, Biostatistics & Occupational Health)*

Investigating the role of post-decision messages in promoting sustainable investment choices

Retail investors – individuals who invest their own money – are scattered and often inexperienced, but they have the potential to pressure public equity firms into adopting more sustainable practices. Most research on sustainable investment marketing has focused on pre-decision evaluation tools available to investors as they make choices about their assets. However, little has been done to explore the role of post-decision nudges to shift individuals toward sustainable investments.

This project will investigate the effects of text message reminders that encourage retail investors to make more sustainable investment choices. Specifically, this research will test the theory that nudging investors through mobile trading apps after a successful and profitable sustainable equity acquisition can promote more sustainable investing through positive reinforcement. *Lead researcher: Laurette Dubé (Management)*

Understanding the effects of conservation efforts on ethnic minority farmers in Vietnam

Faced with growing threats to biodiversity, the desire to create "green sanctuaries" has become an increasingly powerful rhetoric in many countries. However, this vision of intact and uninhabited natural spaces is fraught with human consequences.

This project focuses on the creation of the Bat Xat Nature Reserve in northern Vietnam, which is being developed in an area where ethnic minority farmers cultivate black cardamon under the forest canopy to gain income for their semi-subsistence livelihoods. Such activities will be banned in the reserve.

Researchers will investigate the impacts of this ban and other restrictions on surrounding ethnic minority communities, and how these farmers are responding. *Lead researcher: Sarah Turner (Geography)*

Assessing the accessibility of urban sustainability initiatives in Montreal

Cities are currently faced with the large-scale challenges of rapidly decarbonizing their economies and infrastructure, increasing their accessibility to persons with disabilities, and meeting the complex needs of an ageing population. However, little is known about the intersection of these efforts.

To address this gap, researchers will complete a case study of the accessibility of urban sustainability initiatives in Montreal. Their analysis will focus on capturing the lived experience of disabled and elderly people interacting with the concrete outcomes of four pivotal climate mitigation policies in Montreal related to transportation, housing, green spaces, and phasing out carbon-intensive products.
The project's findings will help identify opportunities to increase the accessibility of the transition to a low-carbon economy in urban environments, as well as improve the ways in which the needs and perspectives of disabled and elderly persons are considered in efforts to reduce carbon emissions in Montreal and beyond. *Lead researcher: Sébastien Jodoin (Law)*

PROJECT RESULTS

A sample of previously funded projects that have wrapped up this past year

'I don't trust supermarket food': Urban agriculture in Asia

This project revealed the temporary and insecure status of urban agriculture in Hanoi, Vietnam as well as highlighted the contradictions within Vietnam's "green city" discourse. Drawing on specific urban governance options, it also showed how urban residents still undertake urban agriculture, negotiating or compromising with state officials, if necessary, to meet their needs for fresh and safe produce. *Lead researcher: Sarah Turner (Geography)*

Quantifying and characterizing energy poverty: a community-based survey

In Spring 2022, a community-based survey was conducted in the Town of Bridgewater, Nova Scotia to document energy poverty – the first in-depth characterization of this issue at a community-level in Canada. Over 500 people participated. Results show that almost 40% of survey participants face energy poverty. Results have been used by the Town of Bridgewater to inform the delivery of Energize Bridgewater, a local program designed to tackle energy poverty. *Lead researcher: Mylene Riva (Geography)*

SELECTED PUBLICATIONS FROM OUR FUNDING PROGRAMS

Hall, R., Pal, D., & Ariya, P. A. (2022). Novel dynamic technique, Nano-DIHM, for rapid detection of oil, heavy metals, and biological spills in aquatic systems. Analytical Chemistry, 94(32), 11390–11400. doi.org/10.1021/acs.analchem.2c02396

Horsch, C. C. A., Antunes, P. M., & Kallenbach, C. M. (2023). Arbuscular mycorrhizal fungal communities with contrasting life-history traits influence host nutrient acquisition. Mycorrhiza, 33(1), 1–14. doi.org/10.1007/s00572-022-01098-x

Madramootoo, C. A., Jain, A., Oliva, C., Wang, Y., & Abbasi, N. A. (2023). Growth and yield of tomato on soil amended with waste paper based hydrogels. Scientia Horticulturae, 310, 111752. doi.org/10.1016/j.scienta.2022.111752

Williams, J. P., Ars, S., Vogel, F., Regehr, A., & Kang, M. (2022). Differentiating and mitigating methane emissions from fugitive leaks from natural gas distribution, historic landfills, and manholes in Montréal, Canada. Environmental Science and Technology, 56(23), 16686–16694. doi.org/10.1021/acs.est.2c06254

MSSI Research Themes

The MSSI Research Themes address complex sustainability challenges through three years of funding at $400,000 per year.

The Themes allow researchers with diverse expertise to build meaningful collaborative relationships that will last and bolster McGill's capacity for innovation.

ADAPTING URBAN ENVIRONMENTS

With roughly 70% of the global population expected to live in urban areas by 2050, solutions are needed to address the unique complexities of sustainability issues in cities. Ranging from national policies to on-the-ground realities in neighbourhoods, this Theme generates and mobilizes knowledge to make cities more socially inclusive and less environmentally impactful while improving the well-being of residents.

THEME CO-LEADS

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David Wachsmuth
School of Urban Planning
Faculty of Engineering

A LOOK BACK

SUSTAINABLE CITIES AND COMMUNITIES

Since launching in 2017, the Adapting Urban Environments Theme has been exploring what makes cities sustainable. From the impacts and benefits of cities for residents and the natural environment, to how we can define and measure what sustainability means for cities, and how things like “smart cities” and “big data” can contribute to urban sustainability. Projects have maintained a strong focus on inclusivity and justice, both fundamental dimensions of sustainability.

For the Theme’s leads, it has been an opportunity to expand their networks and develop new, long-lasting collaborations with colleagues from outside of their disciplines. “Curbcut and my collaboration with David [Wachsmuth] never would have happened without MSSI funding,” said Prof. Kevin Manaugh. “The freedom it provided to try something new has been transformational for my career and my research trajectory”.

CURBCUT WINS AN AWARD!

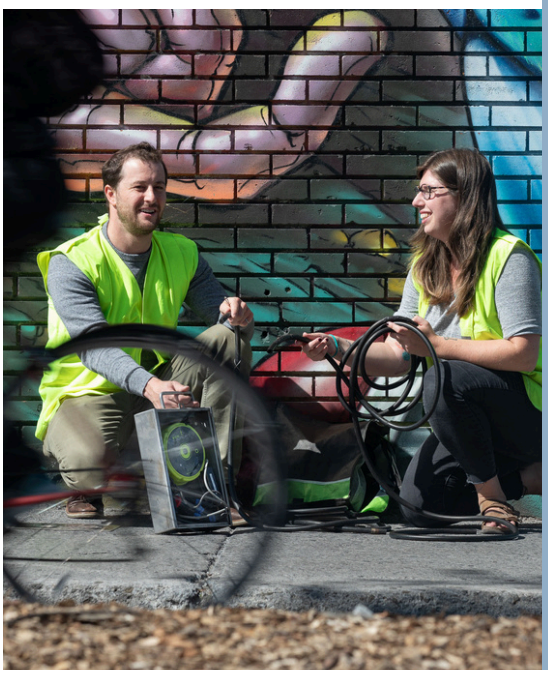
Curbcut (formerly known as “Sus”) is a platform for deep, dynamic, and intuitive exploration of urban sustainability. The Curbcut team was recently awarded the Canadian Open Data Excellence Award by Geomatics Canada.

This project, one of the Urban Theme’s key initiatives, was developed to generate and mobilize the knowledge needed to make Montreal more sustainable. It has since expanded to Toronto, and the team has been updating and further expanding the tool through support from Centraide and the Government of BC. You can explore the tool here: www.curbcut.ca

The Theme's core projects have investigated urban politics and governance, assessed the impacts of urban growth on biodiversity and ecosystems, and developed tools to explore and understand sustainability across scales (see the pop-out box on Curbcut, the Theme's urban sustainability dashboard, on page 16).

These projects have supported over 20 students and early career researchers from across four McGill Faculties, providing training opportunities for the next-generation of sustainability researchers and practitioners. They have also brought in over $1.5 million in additional funding through external grants, contracts, and foundational support through the Fondation J. Armand Bombardier.

The Theme has also supported urban sustainability research beyond its core projects. Seventeen McGill faculty members from six faculties have collaborated on various projects (see examples to the right).



Supporting Urban Sustainability Research at McGill

The Theme has supported a number of urban research projects through the New Opportunities Fund

From a Throwaway Society into a Sustainable Society: a Consumer Perspective. *Emine Sarigollu and Myung-Soo Jo (Management)*

Light, Night and Urban Sustainability, a symposium tackling the question of how the night-time of cities might be made environmentally sustainable, accessible, safe and culturally effervescent. *Will Straw (Art History & Communication Studies)*

Linking Disability Rights and Climate Resilience in Urban Environments. *Sébastien Jodoin and Nandini Ramanujam (Law) and Matthew Hunt (Physiotherapy and Occupational Therapy)*

Methane Emissions from Natural Gas Distribution Pipelines and Infrastructure in Montreal. *Mary Kang (Civil Engineering)*

The Panama Research and Integrated Sustainability Model (PRISM). *Researcher: Brian Leung (Biology)*

Urban Heat Wave Vulnerability Index: extending the Urban Heat Island. *Raja Sengupta (Geography) and Frederic Fabry (Atmospheric and Oceanic Sciences)*

CREATING SUSTAINABLE MATERIALS

To create truly sustainable materials, concerns about functionality, health risks, and pollution must be considered at every stage, from the acquisition of raw materials to their manufacturing and final disposal. Under this Theme, interdisciplinary teams design, develop, and evaluate sustainable materials to meet pressing societal needs

THEME CO-LEADS

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Department of Natural Resource Sciences
School of Human Nutrition
Faculty of Agricultural and Environmental Sciences

George Demopoulos
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Faculty of Engineering

Audrey Moores
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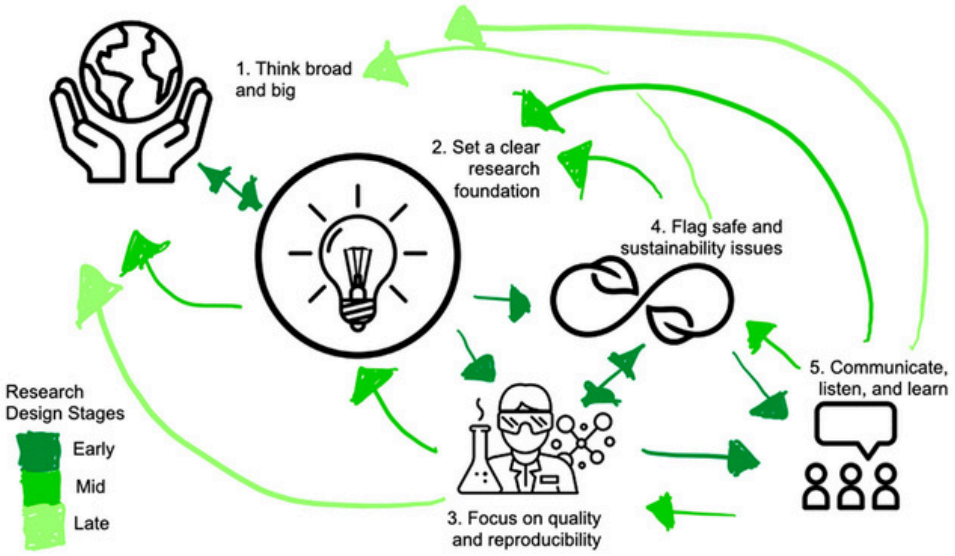
Faculty of Science

PROJECT SPOTLIGHT

SUSTAINABILITY CHECKLIST

MSSI researchers developed a tool to increase safety and sustainability in materials research. The project was led by graduate students and postdoctoral researchers from Chemistry, Natural Resource Sciences, Food Science and Agricultural Chemistry, and Materials Engineering.

The core research of the Materials Theme is on the development, use and evaluation of emerging functional materials, molecules and processes that offer "greener" alternatives to current technologies. This type of research is traditionally done within academic silos: chemists and engineers work on the design and development of novel material, while toxicologists focus on impacts of pre-existing, widely used chemicals. Recognizing the limitations of this approach, the team developed a checklist that other groups can use to improve their research and dissemination efforts.



ACS Sustainable Chem. Eng. 2022, 10, 45, 14658-14664

The tool helps researchers evaluate their process from ideation all the way to communicating outcomes. This encourages them to consider sustainability at different scales, from how their research connects to larger sustainability frameworks to the individual impacts are of their projects. One can read the open-access article and explore the tool at the link below.

Bechu, A., Mittal, K., Xu, K., Yekani, R., Demopoulos, G. P., Moores, A., & Basu, N. (2022). Helping Incorporate Safe and Sustainability into Materials Research: A Checklist Tool Designed for Early Career Researchers. ACS Sustainable Chemistry & Engineering, 10(45), 14658–14664. doi.org/10.1021/acssuschemeng.2c03829

SUSTAINABLE LANDSCAPES

Areas of land have traditionally been divided based on the services they provide, from housing and industrial production to agriculture. This Theme develops new methods and tools to assess the connectivity and sustainability of landscapes, with an alternative and more holistic view of ecosystem services.

THEME CO-LEADS

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Faculty of Engineering

PROJECT SPOTLIGHT

LAND TENURE AND SUSTAINABLE DEVELOPMENT

Sustainable agricultural practices require considerable investments, and smallholder famers may not realize gains for years. Without secure land tenure, they lack incentive to invest in long-term benefits. Instead, many opt to use the land as intensively as possible each year since they have no guarantee for the future. This is just one example of how land tenure security intersects with sustainable development, a relationship explored in-depth in a book co-edited by Prof. Brian Robinson in the Department of Geography and MSSI Landscapes lead.

Land Tenure Security and Sustainable Development (Holland et al., 2022) discusses the implications of secure land tenure — the bundle of rights governing property ownership — on contemporary issues ranging from Indigenous rights and food security to climate adaptation and conflict-driven migration. Land tenure policies may provide a barrier to empowering women, or they could influence a family's decision to emigrate from a drought zone.

"Each chapter offers a big-picture view of the issue at hand, but there are also very grounded examples of how these things play out in real life," Robinson explained. "We wanted to make sure we weren't just publishing our work through traditional academic venues. Our goal was to put together a book that was accessible to practitioners and a broad audience working on development and conservation — something that people on the ground could actually use and relate to."

The book was born out of a working group made up of diverse academics as well as representatives from organizations such as The Nature Conservancy, the World Wildlife Fund, and the Rights and Resources Initiative.

The book is available for free at the link below thanks to funding from the McGill Sustainability Systems Initiative and The Nature Conservancy.

Holland, M. B., Masuda, Y. J. & Robinson, B. E. (Eds.). (2022). Land Tenure Security and Sustainable Development. Read the e-book here.

PROJECT SPOTLIGHT

IMPACTS OF CLIMATE CHANGE IN THE CANADIAN ARCTIC

Infrastructure and transportation systems in Canada's Arctic will have to adapt to a variety of challenges brought on by climate change. A deep understanding of the impacts in the region is critical for informing these adaptation efforts. The Theme's Northern Landscapes group is producing high-quality climate models to help better understand the impacts of a warming climate on the Canadian Arctic and help inform climate adaptation efforts for communities and industries in the North.

A study by Prof. Laxmi Sushama and PhD student Bernardo Teufel, of the Department of Civil Engineering and Applied Mechanics, developed high-resolution climate simulations in Canada's Arctic, the first time such projections were produced at such high resolution over the region.

They identified "hotspots of change" for certain variables over the next 20 years, including more extreme short-duration rainfall intensity, increases to extreme wind gusts, thickening of the layer of soil above permafrost, increased ground temperature, and increased fog.

This research reiterates that urgent action is needed to support adaptation efforts in the region and informs targeted action by highlighting where the hazards are projected to increase the most.

Teufel, B., & Sushama, L. (2022). High-resolution modelling of climatic hazards relevant for Canada's northern transportation sector. Climate Dynamics. doi.org/10.1007/s00382-022-06265-6

SUSTAINABILITY TRANSITIONS

Small and medium-size enterprises (SMEs) employ nearly 90% of Canada's private-sector workforce, making them crucial for putting the country's industries and communities on a path toward sustainability. This Theme explores ways to help SMEs adopt sustainable practices through community building, as well as investigating more effective metrics to stimulate and accurately measure progress.

THEME CO-LEADS

Jaye Ellis
Faculty of Law

Dror Etzion
Desautels Faculty of Management

Catherine Potvin
Department of Biology
Faculty of Science

PUBLICATION SPOTLIGHT

GOVERNING THROUGH CONTROVERSY

Prof. Jaye Ellis, Faculty of Law, is a lead on the MSSI's Sustainability Transitions Theme as well as a co-investigator on the MSSI's Materials Theme, where she is collaborating with researchers investigating the responsible replacement of endocrine-disrupting chemicals.

In an article from the Canadian Journal of Law and Society, Prof. Ellis addresses the role of law and legal experts in bridging the science-policy gap, emphasizing the importance of connecting science and policy through legal frameworks. She draws parallels between scientific and law processes in that they both rely on more than just following established rules and involve complex processes of weighing evidence and exercising judgment.

Prof. Ellis proposes ways to bridge this gap, notably through the development of more sophisticated and nuanced understandings of how scientific knowledge is produced. The publication also highlights the role legal experts can play in facilitating these connections.

Read the open-access article at the link below:

Ellis, Jaye. (2022). Governing through controversy: The challenge of new toxicological methodologies. Canadian Journal of Law and Society, 1-19. doi:10.1017/cls.2022.19

PIVOT

PIVOT is an action research project that uses social media to bring small business owners across Canada together to share their climate action goals, struggles and achievements. The project is one of the core initiatives from the Sustainability Transitions theme. Learn more at www.gopivot.org

CLEANTECH FOR CARBON & ENERGY CYCLES

Cleantech for Carbon and Energy Cycles is comprised of three projects led by researchers from Chemistry, Physics, Mechanical Engineering, and Architecture. Projects explore metals as alternate fuel sources, using wood architecture/built structures for climate mitigation, and artificial photosynthesis technologies to capture carbon dioxide.

THEME CO-LEADS

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Salmaan Craig
Peter Guo-hua Fu School of Architecture
Faculty of Engineering

Hong Guo
Department of Physics
Faculty of Science

C.J. Li
Department of Chemistry
Faculty of Science

PROJECT SPOTLIGHT

ENERGY FROM ARTIFICIAL PHOTOSYNTHESIS

Prof. Hong Guo, Department of Physics, and Prof. C.J. Li, Department of Chemistry, alongside collaborators from McGill and beyond, are exploring artificial photosynthesis to convert carbon dioxide (CO_2) into commercially valuable chemicals and fuels such as hydrogen, syngas (a mixture of carbon monoxide and hydrogen) and methane. The research is inspired by the natural photosynthesis process, which uses solar energy and enzymes to turn CO_2 and water into organic molecules.

The team's long-term goal is to develop a stable, low-cost, high-efficiency, and transportable CO_2 transformation device powered by sunlight. The short-term objective is to engineer the photocatalysts that will enable solar CO_2 conversion with high performance. We spoke with Dr. Siting Ni, a postdoctoral researcher working on the project, to learn more.

What is a photocatalyst?

Catalysts speed up chemical reactions. Natural photosynthesis uses enzymes as catalysts to drive the reaction, while artificial photosynthesis processes rely on these photocatalysts. "A photocatalyst is a substance that can change the rate of the reaction with the exposure of light," explains Dr. Ni, adding that different types of photocatalysts use different types of light (ultraviolet, visible, or infrared radiation) depending on their composition. .

Photocatalysts are used in many applications, including hydrogen production, wastewater treatment, and solar energy generation, however they also present several challenges to researchers. "The existing photocatalysts used in the conversion of carbon dioxide usually suffer from several limitations," Dr. Ni explained, identifying a number of challenges related to efficiency, energy use, and process complexity.

What is new about the photocatalysts being developed through this work?

This project highlights the value of an interdisciplinary approach to new materials design. "With the joint efforts of chemistry, engineering, and artificial intelligence-guided smart design, we have innovated the process to overcome major challenges faced by other photocatalysts," she explained. The team has engineered a photocatalyst that can perform efficiently and reliably under benign and low-energy conditions.

The Cleantech Theme held an event in September 2022 focused on scaling-up research for commercialization.

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SELECTED PUBLICATIONS FROM MSSI RESEARCH THEMES

Dade, M. C., Downing, A. S., Benessaiah, K., Falardeau, M., Lin, M., Rieb, J. T., & Rocha, J. C. (2022). Inequalities in the adaptive cycle: Reorganizing after disasters in an unequal world. Ecology and Society, 27(4). doi.org/10.5751/ES-13456-270410

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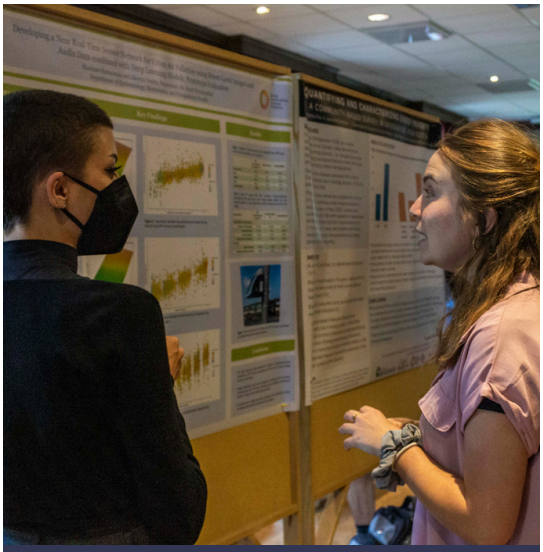
Community Building



The MSSI supports McGill's sustainability researchers by developing events and other opportunities to bring people together.

Our Events

BRIDGING THE GAP BETWEEN BENCH-LEVEL INNOVATION AND READINESS FOR VC INVESTMENT

SEPTEMBER 12th, 2022

This MSSI Cleantech event was held as part of the McGill Sustainable Futures Festival, a week of events that invited students, staff, faculty, and the broader community to come together and envision the future of sustainability on campus and beyond.

This event featured a discussion about scaling up research for commercialization featuring panelists from Anges Québec, Cycle Capital, Sustainable Development Technology Canada, and the McGill Engine Centre for Technological Innovation and Entrepreneurship. Panelists shared their experience and offered advice on how to build relationships with investors, benefit from start-up incubators, and transition from academia to entrepreneurship. The event also included a poster showcase for students and postdocs working on Cleantech research.

You can watch a recording of the discussion here.

SUSTAINABILITY SOIRÉE

SEPTEMBER 14th, 2022

This was the second iteration of the Sustainability Soirée, held in collaboration with the McGill Office of Sustainability (MOOS) This year's event was held as part of the McGill Sustainable Futures Festival.

It was an evening of food, drinks, networking, and exchange to create a more open, connected, and sustainable university. The event featured project teams who have received support from the MOOS Sustainability Projects Fund (SPF), as well as student and faculty researchers funded by the MSSI. Over 100 people attended the event, held at Thomson House.

MSSI COLLECTIVE MEET-UP

OCTOBER 4th, 2022

An initiative that launched online during the early days of the pandemic, the MSSI Collective was able to benefit from the warm fall weather to hold its first in-person meetup. Graduate students and postdocs were able to meet and discuss their sustainability-related research around warm drinks and snacks.

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McGill University is located on land which has long served as a site of meeting and exchange amongst Indigenous peoples, including the Haudenosaunee and Anishinaabeg nations. McGill honours, recognizes and respects these nations as the traditional stewards of the lands and waters on which we meet today.

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