

McGill
Sustainability
Systems
Initiative

Initiative
Systémique de
McGill sur la
Durabilité

ANNUAL REPORT

MAY 1, 2018 - APRIL 30, 2019



McGill

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2018 - 2019 OVERVIEW & EXECUTIVE SUMMARY

Over the last year, the McGill Sustainability Systems Initiative has stewarded the formation and growth of the University's sustainability research community, and enabled the connection of researchers, both at our various events and via our major research programs. The initial three MSSI Research Themes are now well established, forming new communities by virtue of their integrated and multi-disciplinary nature. From the presentations at the Materials theme 'Cells to Society' symposium to the launch of the Landscapes Scholars group and the development of the Urban Environment theme's 'Sustainability Dashboard', the MSSI themes support innovative sustainability research that would not be accessible through existing funding programs.

2018 - 2019 saw the launch of the fourth of the MSSI Research Themes, Sustainability Transitions. This cross-cutting theme, led by researchers from the Faculties of Law, Management and Science, focuses on areas important to small- to medium-enterprises (SMEs) in moving to more sustainable practices: sustainability decision-making processes, motivations for change, and obstacles and opportunities for a sustainable transition. It also investigates and develops appropriate and accessible metrics such as goals, indicators, and standards that could stimulate transitions to sustainability and permit the measurement of progress. The year's activities also included the launch of the MSSI Collaboration Dashboard, an application accessed through the MSSI website that provides a real-time snapshot of MSSI members' collaborations, publications, and associated publicity. The dashboard also maps members' research to the 17 United Nations Sustainable Development Goals (SDGs).

Looking forward to the coming year, we anticipate the launch of the fifth MSSI Research Theme as well as final reports on the research programs funded by the first round of Innovation and Ideas Fund awards.



MSSI OVERVIEW



Governance

Executive Committee

Anja Geitmann, Dean, Faculty of Agriculture and Environmental Sciences

Bruce Lennox, Dean, Faculty of Science

Jim Nicell, Dean, Faculty of Engineering

Heather McShane, MSSI Program Director and Catalyst-in-Chief (*ex-officio*)

Advisory Committee

Nigel Roulet (Chair), Department of Geography

Elena Bennett, Department of Natural Resource Sciences

Benoit Boulet, Department of Electrical and Computer Engineering

Sylvie de Blois, Director, McGill School of Environment (*ex officio*)

Jaye Ellis, Faculty of Law

Dror Etzion, Desautels Faculty of Management

Subhasis Ghoshal, Director, Trottier Institute for Sustainability in Engineering and Design (*ex officio*)

Andrew Gonzalez, Department of Biology

Peter Grutter, Department of Physics

Minodora Iordan, Office of the Vice-Principal, Research and Innovation

Mark Lefsrud, Department of Bioresource Engineering

Bruce Lennox, Dean, Faculty of Science (*ex officio*)

C.J. Li, Department of Chemistry

Heather McShane, MSSI Program Director and Catalyst-in-Chief (*ex officio*)

François Miller, Director, McGill Office of Sustainability (*ex officio*)

Tim Moore, Department of Geography

Doina Precup, School of Computer Science

MSSI Hub staff

Heather McShane, Program Director and Catalyst-in-Chief

Larissa Jarvis, Research Assistant (part-time)

Marie Simard, Administrative Assistant (part-time)

Shabir Abdul Samadh, website workstudy student

Sophie Wang, database & website workstudy student

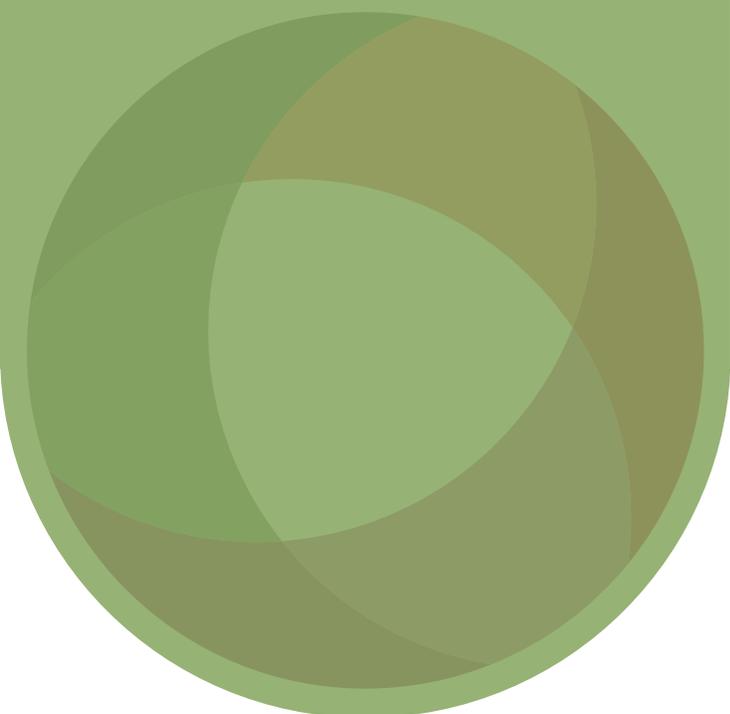
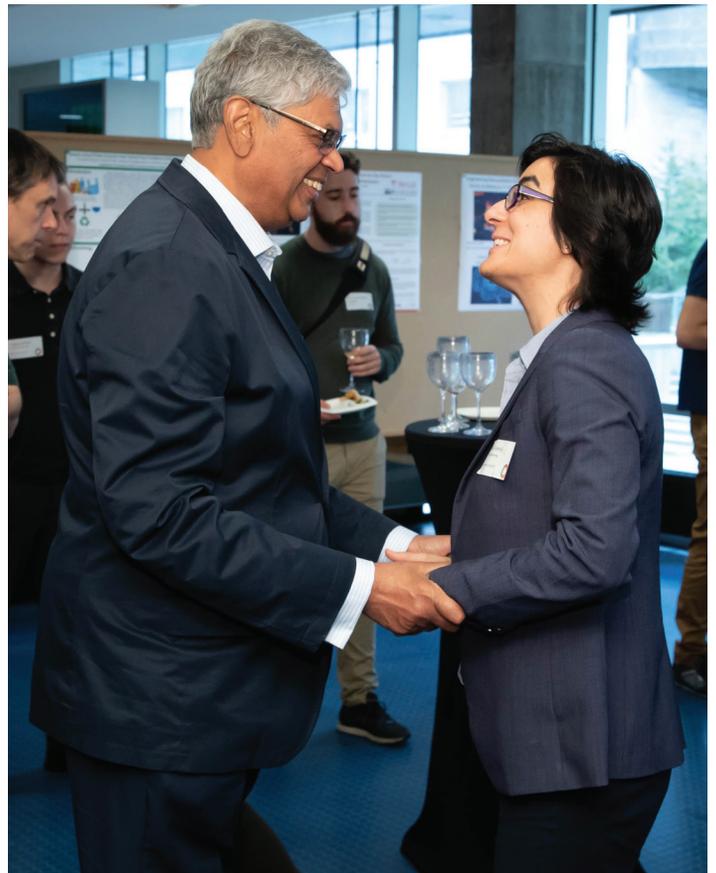
MEMBERSHIP

139

MSSI members
(McGill faculty across 33 departments in 9 faculties)

126

MSSI affiliate members
(students, graduates, post-doctoral fellows, other)



PROGRAMS



Innovation Fund

The MSSSI Innovation Fund provides McGill faculty members with up to \$75,000 to accelerate development of innovations that have potential for commercialization and processes that will lead to policy development in the field of sustainability. Projects must align with the MSSSI vision and demonstrate both feasibility to move from bench toward commercialization or widespread adoption, and the potential to be awarded further funding from commercialization-enabling programs or foundation translational programs at the end of the MSSSI funding period (one year). In 2018 - 2019, 16 applications were received for a total of \$150,000 of available funding.

Awards

1. Masad Damha (Chemistry), Tomislav Friščić (Chemistry): *Greener synthetic approaches to biologically active oligonucleotides*
2. Chandra Madramootoo (Bioresource Engineering), Yixiang Wang (Food Science and Agricultural Chemistry): *Building resilience in fragile ecosystems: Innovative cellulose hydrogels for water and fertilizer savings in dryland agriculture*



Ideas Fund (faculty)

The Ideas Fund (faculty) provides up to \$50,000 in seed funding for McGill faculty members to develop sustainability-related ideas. Projects must align with the MSSl vision, have potential to make a significant impact on a sustainability-related challenge and be premature or too bold to be eligible for other funding. The funding period is one year. In 2018 – 2019, 34 applications were received for a total of \$279,000 of available funding.

Awards

1. Jeffrey Cardille (Natural Resource Sciences), Bernhard Lehner (Geography): *GLAD – the Global Lake Analysis Dashboard*
2. Cynthia Kallenbach (Natural Resource Sciences), Peter Douglas (Earth and Planetary Sciences): *Coupling microbial metabolism and biogeochemistry to identify mechanisms that mitigate positive feedback effects of thawing permafrost peatlands to climate change*
3. Bernhard Lehner (Geography), Jim Nicell (Civil Engineering and Applied Mechanics): *Global contaminant fate model and data development to screen for chemicals in rivers and lakes*
4. Walter Reisner & Peter Grutter (Physics): *Fabrication of nanoporous membranes for blue energy harvesting*
5. Jennifer Ronholm (Food Science and Agricultural Chemistry): *Mining the chicken microbiome for anti-infective probiotics to eliminate the need for prophylactic antibiotics*
6. Ali Seiftokaldani (Chemical Engineering): *Combined CO₂ reduction and biomass upgrading system for sustainable production of fuels*

Ideas Fund (student)

Similar to the Ideas Fund for faculty, the student-level Ideas Fund provides funding for bold projects and novel ideas with potential to make a significant impact on a sustainability-related challenge. Funding is capped at \$7,000 and is administered by a faculty supervisor. Twelve applications were received for a total of \$49,000 of available funding.

Awards

1. Matthew Fong (Mining and Materials Engineering): *Seasonal energy storage through means of phase change of water contained in soil*
2. Asif Iqbal (Mining and Materials Engineering): *Designing high performance photocatalytic semiconductor junctions for solar fuel production*
3. Nicholas Lin & Sunny Weng (Chemical Engineering): *Designing fully degradable alternatives to single-use plastics by upcycling food waste*
4. Soyoun Park (Food Science and Agricultural Chemistry): *A new strategy to screen antagonistic bacteria against Staphylococcus aureus for sustainable therapeutics and medical interventions*
5. Paola Sully, Camelia Oliva, Shuting Huang, Yi Zhang (Food Science and Agricultural Chemistry): *“Green” antimicrobial straws - an alternative to synthetic plastic straws*
6. James Williams (Civil Engineering and Applied Mechanics): *A compact, ready-made methane monitoring station powered by leaking oil and gas infrastructure*
7. Tian Zhao (Mining and Materials Engineering): *Transformation of soluble phosphate, a pollutant within manure, to an insoluble, more sustainable calcium phosphate solid with waste concrete*

MSSI ACTIVITIES

Invited speakers

Dr. Jan Marco Mueller, Head of Directorate Office, Science to Policy and Science Diplomacy, International Institute for Applied Systems Analysis (joint with the Science and Policy Exchange, TISPP). May 2018

Professor Andrew Maynard, Director, Risk Innovation Lab at the School for the Future of Innovation in Society, Arizona State University. October 2018

Dr. Katie Gibbs, Executive Director, Evidence for Democracy. November 2018

Professor Kai Chan, Institute for Resources, Environment and Sustainability, University of British Columbia. February 2019

Presentations

Introduction to Sustainability: presentation to the South China Agricultural University Exchange Summer Program, July 2018

An introduction to sustainability and the United Nations Sustainability Development Goals (SDGs). Each year McGill welcomes students from the South China Agricultural University for a Exchange Summer Program at the MacDonald Campus.

Sustainability: presentation to the Go-Lead 2018 student cohort, October 2018

An overview of sustainability and the need to consider the economic, social and environmental impacts of new products/offerings during their development. The Go-Lead program is an extra-curricular program that gives students the opportunity to develop innovation and entrepreneurial skills through hands-on learning.

The MSSI and Innovation: presentation to the 2019 Sustainability Research Symposium (SRS), January 2019

An overview of the role of the MSSI research themes in developing new models of innovation in the academic setting. The SRS is an annual student-run symposium which in 2019 focused on innovation. It is funded by the MSSI and brings together students, academics and external experts to explore the latest developments in sustainability.



Workshops

Scenario Building Exercise, MacDonald Campus, October 2018

Training session on a method that stimulates ideas for new research by developing a series of potential future scenarios. Attended by 26 faculty, post-doctoral fellows and graduate students.

Cross-disciplinary conversations, October 2018, February 2019

Two invitation-only, cross-disciplinary conversations around cutting-edge topics in sustainability led by MSSI Invited Speakers. Conversations are designed to raise awareness and appreciation of different academic methods and build links between academics in the natural sciences & engineering and those in social sciences & humanities.

Transitions theme development workshop, November 2018

Designed to develop the new research theme on transitioning to sustainability, this open-invitation workshop was attended by 22 faculty and post-doctoral fellows from 14 departments across seven faculties.

Cleantech theme consultation workshop, December 2018

A workshop to investigate the potential for an MSSI research theme based on 'cleantech'. Participants were selected by both open call and targeted invitation. Attended by 21 faculty from seven departments across three faculties.

Other events

Ideas and Innovation Funds Reception, June 2018

A reception to recognise recipients of the 2017-18 Ideas and Innovation Fund awards. The event was designed to bring the 28 awardees together to share and discuss their research with fellow recipients from across McGill. A McGill jazz duo added to the celebratory feel of this event.

Annual MSSI Research Theme Symposium, November 2018

The first Annual MSSI Research Theme Symposium featured a keynote speaker (Katie Gibbs, Evidence for Democracy), updates from the MSSI research themes co-leads and affiliated projects, one-minute research presentations by students and a poster session with 19 submissions from MSSI-associated graduate students and post-doctoral fellows.

Sustainability Soirée (joint with McGill Office of Sustainability, MOOS), January 2019

Co-hosted by the MSSI and MOOS, this student-focused event highlighted research and on-campus activities in sustainability being undertaken at McGill. The event attracted more than 100 attendees and centred on posters presented by recipients of the MSSI student Ideas Fund and MOOS Sustainable Project Fund awards.

Other activities

Go-Lead workshop series, Fall 2018

The MSSI hub assisted throughout the 2018 Go-Lead program, a 10 week extra-curricular program that gives students the opportunity to develop innovation and entrepreneurial skills through hands-on learning. The MSSI role was to ensure that students incorporated sustainability into their start-up projects.

Sustainability Research Symposium (SRS), January 2019

The MSSI is the sole funder for the SRS, a one-day student-run symposium on sustainability. MSSI staff play an advisory role during the symposium's development and production of the post-symposium report. This year's symposium, on the topic of Innovation, attracted more than 100 participants.

MSSI dashboard, February 2019

At the end of February 2019, the MSSI launched the MSSI Sustainability Researcher dashboard. This tool, developed from software generously donated by the Quebec Centre for Biodiversity Science, tracks the number of publications by MSSI members (McGill faculty) per year, and lists the top 30 journals in which they are published. The dashboard also provides data on publication impact, visualises publication collaborations between MSSI members by year, and – a first in Canada – matches MSSI member research to the United Nations Sustainability Development Goals.

Recognitions

Award: Catalyst award for Research and Education, April 2019

The MSSI was awarded the 2019 McGill Office of Sustainability Catalyst award for Research and Education.

MSSI RESEARCH THEMES

Creating Sustainable Materials for the Future

Co-leads appointed July 2017, theme content finalized September 2017.

Co-leads

- Nil Basu, Department of Natural Resource Sciences and School of Dietetics & Human Nutrition, Faculty of Agriculture and Environmental Sciences, Department of Epidemiology & Biostatistics, School of the Environment
- George Demopoulos, Department of Mining and Materials Engineering, Faculty of Engineering
- Audrey Moores, Department of Chemistry, Faculty of Science

Theme Description

A transdisciplinary research program that focuses on the design, development, evaluation, and use of sustainable materials (i.e., functional materials and molecules) to address grand challenges of the 21st century. The unifying area of focus is “energy”. This includes:

- Materials relevant to energy applications
- Design, fabrication, development, evaluation and use of sustainable materials (i.e., paints, plasticizers)
- Development of a “Lab checklist” – assessment of lab practices in terms of sustainability

Current supported research projects

- Sustainable perovskites for photovoltaics
- Quantum dot nanocrystals for LCD screens
- Titanium dioxide in functional materials
- Responsible replacements for endocrine disrupting chemicals (affiliate project)

Supported internal network

The large majority of funds are used to support graduate students and post-doctoral fellows. All Materials theme MSSI-funded graduate students are cross-appointed.

- Research funding support for 15 co-principal researchers and four affiliate researchers from across six faculties
- Research funding support for 10 graduate students and post-doctoral fellows
- Networking and professional development opportunities for 40 additional graduate students and post-doctoral fellows



External network (partnerships, collaborations)

Multi-sectoral involvement in various projects, including six government and industry partners in the titanium dioxide project, and 10 government, industry and NGO partners in the endocrine disruptor project.

Activities

- Monthly meetings for co-principal and affiliate researchers
- Cells to Society Symposium 'Environment and Health': Sustainable Materials. Included two international key speakers and more than 100 participants
- Poster session with 22 posters and 42 attendees
- Annual retreat for 12 co-principal researchers

Representative invited lectures

- Basu, N. *Reconciling Divergent World Views on Mercury Pollution – evolving thoughts on interdisciplinary and translational research*. Keynote presentation, Interplay of Environmental Stressors, Infectious Diseases and Human Health. US National Academies of Sciences, Washington DC. January 2019
- Demopoulos, G. *Development of Sustainable Energy Storage Materials for Li-Ion Batteries*. Keynote presentation, International Conference on Electrochemical Energy Science and Technology, Niagara Falls, ON. August 2018
- Ghoshal, S. *The effects of dissolved natural organic matter on the reactivity of sulfidated metal nanoparticles*. Keynote presentation, 4th International Conference on Environmental Pollution and Health. Nankai University, Tianjin, China. May 2018
- Hales, B. *Does exposure to hazardous chemicals activate distinct toxicity signaling pathways in germ cells and embryos?* Keynote presentation, 18th World Congress of Basic and Clinical Pharmacology, Kyoto, Japan. July 2018
- Moores, A. *Solvent-free Syntheses of Metal and Sulfide Nanoparticles and Plasmonic Catalytic Hydrogenation Reactions*. Keynote presentation, 3rd Green & Sustainable Chemistry, Berlin, Germany. May 2018



Other contributions

- U.S. Provisional patent application: Bhattacharjee, S., Ghoshal, S. *Sulfidated nanoscale zerovalent iron and method of use thereof*. U.S. 62/703,610, July 2018
- Basu, Organizing Committee, 2018 ICCA-LRI (International Council of Chemical Associations) Workshop *Demonstrating Fit-For-Purpose 21C Methods for Risk-Based Decisions*. Ottawa. June 2018

External research funding applied for/obtained through involvement with MSSI

- *Advanced Technological Training network on the risk and remediation of Pollution in URban Environments (PURE-CREATE)*. Program to train the next generation of students to tackle complex environmental problems that plague urban ecosystems. NSERC CREATE Sep 2019 – Aug 2025. \$1.65 M. Basu N. (Co-PI). MSSI collaborators: Bayen S., Tufenkji N.
- *Quebec Ecotoxicology Network (EcoToQ)*. Two-year seed funding to link ecotoxicology researchers across Quebec. FRQNT Strategic Network Grant. Sep 2019 – Aug 2021. \$420,000. MSSI collaborators: Basu N., Bayan S., Head J., Tufenkji N., Yargeau V., Whalen J.
- *Sustainable Electronics and Eco-Design (CREATE-SEED)*, NSERC CREATE LOI 2020-2026. \$1.65 M. MSSI co-applicants: Demopoulos G., Moores A.

Adapting Urban Environments for the Future

Co-leads appointed July 2017, theme content finalized August 2017.

Co-leads

- Andrew Gonzalez, Department of Biology, Faculty of Science
- Kevin Manaugh, Department of Geography, Faculty of Science
- David Wachsmuth, School of Urban Planning, Faculty of Engineering

Theme Description

An integrative program of research on urban sustainability that generates and mobilizes the knowledge required to make cities more socially inclusive and resilient, less environmentally impactful, and better able to meet future sustainability challenges while improving the well-being of residents.

The group is structured around five core multidisciplinary projects that address urban sustainability across different scales, from our individual behaviour to the neighbourhoods we live in and the impacts our urban centres have at the national and global scale.

Current supported research projects

- MYKO - measuring consumer sustainability behaviours
- Sustainable Neighbourhoods - identifying sustainable neighbourhoods in Canada
- Montreal Sustainability Dashboard - bringing data-driven decision making to sustainability problems
- Interlocal sustainability networks - exploring existing urban sustainability network geographies and how they are used
- Panama Research and Integrated Sustainability Model (PRISM) - includes seven projects funded through the PRISM Small Grants competition

Supported internal network

The internal network at McGill consists of faculty researchers, graduate students, post-doctoral fellows and research assistants who work on the various MSSI-funded urban sustainability projects.

- 10 researchers across five faculties
- 13 graduate students, post-doctoral fellows and research assistants

External network (partnerships, collaborations)

Partners include government (Ville de Montreal, Health Canada, Environment and Climate Change Canada), civil society (Rebuild by Design, 100 Resilient Cities, McConnell Foundation, Dark Matter Laboratories, For y observatorio de Panamá, UNESCO, Belmont Foundation) and business (Eco2Urb, ARUP, SUMA Architects).

Activities

- New Opportunities Fund - Three small grants totalling \$22,000 allocated to McGill faculty members for novel research and collaborations on urban sustainability
- Urban Sustainability and Population Health: Turning Data into Insights - research seminar co-hosted with the McGill Geo-Social Determinants of Health (Geo-SDH) research group

Representative invited lectures

- Gonzalez, A. *Mesoecology: the structure and dynamics of ecological networks*. iDiv, Leipzig University, Germany. Nov. 2018
- Gonzalez, A. *Diversity, stability and evolution of networks*. Stanford University, California, USA. Oct. 2018
- Wachsmuth, D. *Metabolisms of Green and Grey: The Politics of Urban Nature in and beyond the City*. Brussels Ecosystems conference, Metrolab, Brussels: Oct 2018 (keynote speaker)
- Wachsmuth, D. *The Role of Civil Society in Building New Alliances and New Knowledge for Sustainable Societies*. Opening of the Centre for Sustainability and Society, University of Copenhagen, Copenhagen. June 2018 (keynote speaker)

External research funding applied for/obtained through involvement with MSSI

- *Alien Scenarios*. Belmont Forum biodiversa collaborative grant. The project uses PRISM to forecast and build scenarios of biological invasions, at a national scale in the context of the Global South. Funded at 1.9M Euros for three years
- *CURBE-CC: A Decision Support Tool for Adapting Green Infrastructure for Climate Change*. NSERC Advancing Climate Change Science in Canada. Amount requested \$413,873
- *Global problems, city solutions: A mixed methods analysis of local climate adaptation plans*. Tri-Agency New Frontiers in Research Fund (NFRF). Amount requested \$200,000

Sustaining Landscapes for the Future

Co-leads appointed July 2017, theme content finalized September 2017.

Co-leads

- Elena Bennett, Department of Natural Resource Sciences, Faculty of Agricultural and Environmental Sciences
- Brian Robinson, Department of Geography, Faculty of Science
- Laxmi Sushama, Department of Civil Engineering and Applied Mechanics, Faculty of Engineering

Theme Description

The Sustainable Landscapes research theme focuses on the connections within and across landscapes, aiming to help inform real-world policy objectives through action-oriented research at McGill. Through co-production of research with relevant stakeholders, this work aims to enhance stakeholders' capacity to understand landscape dynamics and better position research pursuits toward action-oriented outcomes. Theme goals:

- Mobilize interdisciplinary research on landscape sustainability at McGill
- Create a community of researchers around the theme of landscape sustainability science
- Train and engage students in landscape sustainability and knowledge-to-action science
- Engage stakeholders in and around Montreal in landscape sustainability science through a knowledge-to-action approach to better link science, engineering, and decision-making

Current supported research projects

- Impact of agricultural trade on landscape sustainability through ecosystem services (Landscape Scholar Cohort project)
- Developing a framework for analysing landscape sustainability
- The role of property rights in landscape sustainability and the provision of ecosystem services
- Montreal's Foodshed
- Northern Landscapes - climate change and northern communities
- "Pitch & Enrich" funded projects: Groundwater in sub-Saharan Africa; Mennonite land use history in Latin America; Sustainability of urban and agricultural salt marshes

Supported internal network

The internal network consists of faculty researchers from across McGill who collaborate on projects supported by the theme, as well as a tightly integrated group of partially or fully-funded graduate students and post-doctoral fellows:

- Fifteen faculty members directly linked to the theme's research
- Over 45 faculty members who participate in the theme's events
- Four post-doctoral researchers, eight graduate students, and one research assistant in the funded cohort, and over two dozen associated graduate students

External network (partnerships, collaborations)

Statistics Canada, Environment and Climate Change Canada, IBM, Agriculture and Agri-foods Canada, Apex Resource Management Solutions, ALCES, The Natural Capital Project, Future Earth, Resilience Alliance, GEO BON, Programme on Ecosystem Change and Society.

Activities

- Landscapes methodology and framework workshop
- Northern-focused workshop
- Pitch or Enrich event - interdisciplinary research ideas related to landscape sustainability
- Landscape Scholars program
- Regular leadership meetings between co-leads and post-docs/students



Representative invited lectures

- Bennett, E. *Burba Family Lecture*. Northeastern University. April 2019
- Bennett, E. *Seeds of Good Anthropocenes*. TEDxCERN, Geneva, Switzerland. November 2018
- Bennett, E. *Managing working landscapes for multiple ecosystem services as solution to climate change*. US National Academy of Science Sackler Forum, Washington DC. November 2018
- Sushama, L. Canadian Meteorological and Oceanographic Society (CMOS) Tour Speaker (Montreal, Toronto, Rimouski, Quebec City, Fredericton, Halifax, St. John's). 2019

External research funding applied for/obtained through involvement with MSSSI

- *ResNet: A network for monitoring, modelling, and managing Canada's ecosystem services for sustainability and resilience*. NSERC Strategic Network. Total project funding (including partner contributions, total budget): \$9.9M. PI: E. Bennett, MSSSI co-PIs: Robinson, Gonzalez, Humphries, Hickey. Total requested funding: \$5.5M
- *Canadian Arctic Responsive Engineering (CARE)*. A pan-Canadian coordinated effort to study the Arctic, supporting sustainable and resilient civil infrastructure, energy, mining, waste and wastewater, coastal and offshore systems through an integrated approach in collaboration with Arctic communities, resource developers and other network partners. NSERC Strategic Network. Total project funding (including partner contributions, total budget): \$10.2M. PI: L. Sushama, MSSSI co-PIs: Bouffard, Frigon, Ghoshal, Miranda-Moreno, Sasmito. Total requested funding: \$5.5M

Sustainability Transitions

Co-leads appointed December 2018, theme content finalized March 2019.

Co-leads

- Jaye Ellis, Faculty of Law
- Dror Etzion, Desautels Faculty of Management
- Catherine Potvin, Department of Biology, Faculty of Science

Theme Description

Small- and Medium-Size Enterprises (SMEs) employ nearly 90% of private-sector workers in Canada. This suggests that they are well positioned to become hubs of social, cultural and economic change.

The MSSSI Sustainability Transitions theme will build strong and innovative research in close collaboration with SMEs and with agencies and organizations that support them. The theme will be solutions-oriented, hinging on the recognition that sustainability will create economic opportunities.

The theme will focus on two main streams:

- Understanding and sharing stories of SMEs' sustainability decision-making processes, motivations for change, obstacles and opportunities for a sustainable transition
- Studying and promoting the development of metrics such as goals, indicators, and standards that could stimulate transitions to sustainability and permit the measurement of progress





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