

Increasing Capacity for Science and Innovation Policy in Canada

Impact Report on Fedoruk Centre Partnership with the Centre for the Study of Science and Innovation Policy 2016–2022

FEBRUARY 2023

PROJECT FUNDED BY:



JOHNSON SHOYAMA Centre for the Study of Science and Innovation Policy UREGINA SUSASK

SUBMITTED OCTOBER 25, 2022 TO THE SYLVIA FEDORUK CANADIAN CENTRE FOR NUCLEAR INNOVATION INC.

JOHNSON SHOYAMA GRADUATE SCHOOL OF PUBLIC POLICY (JSGS) / CENTRE FOR THE STUDY OF SCIENCE AND INNOVATION POLICY (CSIP) PROGRAM LEADER:

Professor Jeremy Rayner, Energy Program Lead

REPORT PREPARED BY:

Peter W.B. Phillips, Director, CSIP; Bethany Penn, Research and Operations Manager, CSIP; and Alastair McFadden, Director, JSGS

EXECUTIVE SUMMARY **N**

The Johnson Shoyama Graduate School of Public Policy (JSGS) and the Sylvia Fedoruk Canadian Centre for Nuclear Innovation (Fedoruk Centre) are marking the close of a successful six-year, \$2 million partnership to increase the capacity for science and innovation policy in Canada.

The collaboration has expanded policy research capacity in the province, and propelled graduate students and post-doctoral fellows into research and public sector careers. The partnership has also increased public awareness of energy policy issues and options and the role of nuclear science and technology in Canada's energy future.

The agreement achieved three strategic goals for the partners:

1. Capacity building

Support from the Fedoruk Centre was core to the business case for the Centre for Science and Innovation Policy (CSIP) and the development of a broader program of policy research on science and innovation challenges in Canada. The partnership built significant, enduring capacity to undertake research and engage in the policy dialogue about nuclear energy options. Over the duration of the program:

- JSGS recruited three new faculty members to join CSIP in the first three years, each with a unique contribution to the issues of science and innovation policy and specific aspects of public policy (Drs. Hurlbert, Schwartz and Schmeiser). As the partnership matured, JSGS awarded a Tier 1 Canada Research Chair in Climate Change, Energy and Sustainability Policy to Dr. Hurlbert. At its peak, the program engaged nine faculty in research in the area.
- Faculty and researchers raised more than \$3.2 million in incremental funds for nuclear-related research (a 1.5 to 1 matching ratio), as well as several tangentially related grants on climate change and carbon capture and storage.
- JSGS faculty recruited and supervised eight research masters students and eight PhD candidates investigating topics of nuclear innovation policy. Much of that work was infused into graduate courses, case studies and topics for directed student projects.
- Many of the faculty and graduates are now applying their skills and knowledge in the advancement of the energy and nuclear agenda in Saskatchewan, Canada and more widely.

2. Public engagement

Fostering respectful and constructive public dialogue has been both a core interest for our partnership and a major research focus for our team. The team focused on understanding the mismatch of expectations between different stakeholders about nuclear technologies and finding ways to bring together diverse audiences and perspectives for productive and respectful engagement. To aid in this, two public engagement events, titled **Nuclear Insights**, were held, which revealed that acknowledging both critiques and benefits of nuclear research is critical for navigating our energy future.

This insight was then tested and validated with a public survey and a focus group on low dose radiation that engaged more than **70 science experts** attending the 2019 Canadian Science Policy Conference in Ottawa (Hurlbert et al. 2022). In addition, CSIP coproduced **NuclearFACTS** (Forum for Accountability and Communities Talking Science) as a venue for research engagement among leaders of projects funded by the Fedoruk Centre to discuss the potential impacts of their work with each other, the Projects Advisory Committee and a general audience. (cont'd next page) (cont'd) The agreement achieved three strategic goals for the partners:

3. Evidence for decision-making

CSIP researchers have helped to advance our understanding of the barriers and pathways to adoption and use of nuclear technology in the context of a more sustainable energy system.

- To date the research team has published 11 journal articles, 12 non-peer review publications and delivered 39 presentations of their methods and findings. More are in the pipeline.
- Scholarly publication has been an important output, but the partners have also created other opportunities to disseminate work and influence decision making.
 - In 2018, CSIP organized the Canadian Nuclear Society 38th Annual Conference in Saskatoon, sponsored in part by the Fedoruk Centre. The conference included an embedded policy session led by CSIP that explored the potential of and challenges to licensing and deployment of SMRs in Canada and a student conference with research poster presentations.
 - In 2019, CSIP organized an interactive session with focus group discussions at the annual Canadian Science Policy Conference on "Risk, Uncertainty, Unknowns and Nonsense: Engagement with the Public on Radiation, Nuclear and Climate." The results of that event were incorporated into a scholarly article in *Dose-Response: An International Journal.*
- CSIP faculty offer international leadership on nuclear policy: Dr. Margot Hurlbert was a Coordinating Lead Author for the Intergovernmental Panel for Climate Change report on the 2019 Land and Climate Report; in June 2022, Dr. Jeremy Rayner hosted an international workshop at Manchester University entitled Hidden in Plain Sight? Science Policy and the future of Small Modular Reactors; and throughout the program Drs. Hurlbert and Rayner were active in the Canadian Nuclear Society's Generation IV and Small Reactor Division, working on the "Accelerating Licensing of Advanced Nuclear through International Coordination – Exploring Potential Pathways" project and the Canada-US NEST project on SMRs.

Looking forward, we are building on the foundation of this partnership to propel continued work:

- The partnership established a community of researchers that continues to explore the pathways to developing SMRs in Saskatchewan and CSIP continues to advance the dialogue between scientists, social scientists, and the public in this important policy area.
- JSGS is actively exploring a range of growth possibilities, including looking at the potential to develop an industry- or governmentsupported research chair in energy policy options, with a focus on SMRs.

SUMMARY OF ACHIEVEMENTS 2016-2022 ⊾

Saskatchewan aspires to be recognized as a global leader in nuclear research, development, and training. Investments in state-of-the-art facilities and expertise allow for the exploration of the frontiers of nuclear research and technology.

Like other areas of scientific research, work is needed to convert this emerging nuclear science into innovation and impact. Communities, businesses, and governments need to make choices about where, when and how to activate scientific understanding. Such choices rest at the intersection of scientific research and government innovation policy. Whether it is public vaccinations, the use of biotechnology in food, or deployment of nuclear power, research on science and innovation policy has revealed practices that can build trust in our regulatory system and a path to enable innovation that is based on science.

In 2016, the Sylvia Fedoruk Canadian Centre for Nuclear Innovation Inc. took steps to develop the capacity for science and innovation policy in Saskatchewan and Canada. The organization observed that, while nuclear science and technology are advancing rapidly, there is limited ability for citizens and policymakers to explore the science and evaluate options to make use of it. They noted that specific opportunities for nuclear innovation, such as expanded use of nuclear energy, will be advanced in the context of a broad range of alternatives, constraints and considerations – factors that are the domain of nuclear policy rather than nuclear science. The insight led the Fedoruk Centre to invest in a three-year, \$2 million strategic partnership with the Johnson Shoyama Graduate School of Public Policy that eventually extended into a six-year relationship.

Through the initial partnership, the organizations agreed to develop policy research capacity and undertake activities to increase public awareness of nuclear science and technology challenges and the choices facing Canadians. This led to an agreement to join in the development and support of the Centre for the Study of Science and Innovation Policy, an affiliated research centre of the JSGS.

Early work in this partnership delivered new models for respectful and effective public engagement on nuclear science and technology, and the associated challenges and choices. Research has also been supported and evidence delivered on the social and economic impacts of nuclear science and technology. The investment mobilized a full program of research that is described in this report. It included scholarship, policy outreach, public engagement and knowledge mobilization, including publications and presentations of findings. In 2019, the partnership was extended for an additional three years and evolved to include a cluster of multi-year research projects (Appendix A).

As partners, the Fedoruk Centre and JSGS advanced their mutual interest in building new capacity for Saskatchewan to lead research in the public policy dimensions of nuclear science and technology.





PARTNERSHIP GOALS, ACTIVITIES AND ACCOMPLISHMENTS

The partnership between the Fedoruk Centre and JSGS allowed flexibility to respond to policy research opportunities as they emerged. The flexible, adaptive character of the partnership was both innovative and impactful.

It enabled research and collaboration that would not have been possible in strict, project-based funding. The framework allowed CSIP and the Fedoruk Centre to adapt research activities to the evolving science, the specializations of faculty and students and the changing context for nuclear innovation and nuclear policy.

The agreement specifically set three broad goals:

- **1. Building Capacity**
- 2. Public Engagement
- **3. Evidence for Decision-Making**

The first three years of work focused on policy capacity building. This included securing and supporting research leaders, recruiting policy fellows for additional capacity, recruiting students and reaching beyond the partnership to create pathways and relationships for research. These efforts generated a strong base for targeted projects in the three years that followed.

Two projects were linked to the deployment of small nuclear reactors as part of the energy supply in Saskatchewan. A third was linked to a national policy for major research facilities, which could include a small nuclear reactor for neutron generation and materials science.

Over the life of the agreement, CSIP scholars have become increasingly recognized as leading scholars and advisors on the role of nuclear energy in global energy markets.

1. Building Capacity

2. Public Engagement

3. Building Evidence for Decision-Making

The strategic investment from the Fedoruk Centre led to the development of CSIP as a joint research centre affiliated with JSGS at the University of Regina and University of Saskatchewan. The provisional offer of support from the Fedoruk Centre was core to the business case for CSIP and, once approved in 2016, CSIP moved quickly to build strategic capacity in the area of nuclear research, development and training. CSIP engaged with the Fedoruk Centre and others to build a platform and capacity for collaborative policy research. Some of this involved recruiting faculty and preparing students for research on energy policy and the nuclear industry.

JSGS recruited three faculty members to join CSIP in the first three years, each with a capacity to engage in the broad issues of science and innovation policy, and specific aspects of the decision space. Two Fedoruk Fellows joined JSGS's teaching and research faculty – Dr. Margot Hurlbert at the University of Regina and Dr. Elizabeth Schwartz at the University of Saskatchewan. Dr. Peggy Schmeiser became the Associate Director of CSIP with teaching and research focused on dimensions of dialogue and decision-making. Dr. Jeremy Rayner, Energy Research Lead at CSIP, who was already working with the team, took on the leadership role for the Fedoruk Centre partnership. At the end of the Fedoruk Fellowships, Dr. Hurlbert was awarded a Tier 1 Canada Research Chair in Climate Change, Energy and Sustainability Policy and Dr. Schwartz moved to Memorial University to take up a tenure-track appointment where she continues research on the intersection of climate policy and local governance.

The team of CSIP scholars integrated social sciences with natural sciences to establish CSIP as a platform for information and public engagement. Efforts have brought profile, new voices and collaborators in nuclear science and innovation policy. The collaborative focus of the partnership created local, national and international networks. Researchers and practitioners have advanced interdisciplinary research on policy and public engagement. Along with researchers and students at the Universities of Saskatchewan and Regina, CSIP has developed partnerships with:

- CANDU Owners Group (COG)
- Canadian Nuclear Laboratories (CNL)
- Nuclear Energy Agency through the Nuclear Education, Skills and Technology Framework (NEA-NEST)
- Dalton Nuclear Institute, University of Manchester
- Canadian Nuclear Society
- McMaster University (NEST SMR Project)
- PROMISE (Promoting Youth Involvement and Social Engagement) Research Network



At the root of our work has been an effort to nurture partnerships between science, social science and society. Dr. Schmeiser took the lead on much of that work, exploring models of engagement at a range of major research facilities (e.g. Canadian Light Source, TRIUMF and SNOLAB). Her work revealed best practices in institutional design and management, and explored the often-ignored role of community in mobilizing people from different disciplines to work toward a common purpose. This involved substantive qualitative analysis of how individuals and small groups in large, science-based spaces engage, communicate, collaborate and co-create. This work triggered a national dialogue with decision-makers from across the big science community about models to strengthen collaboration, community engagement and impact.

The partnership between CSIP and the Fedoruk Centre propelled a host of collaborations that leveraged other research funding and capacity. At its peak, nine faculty members (Drs. Atkinson, Boucher, Coates, Hurlbert, McNutt, Phillips, Rayner, Schmeiser and Schwartz) used some of their own time and research funds, matched with other university funds, to recruit research students and advance work aligned with the partnership (Appendix B). Over the life of the agreement, JSGS faculty supervised eight master's students and eight PhD candidates investigating topics of nuclear innovation policy. They also infused aspects of the research into graduate courses, case studies and topics for directed student projects (Appendix C).

Faculty and researchers from JSGS and CSIP broadly leveraged more than \$3.2 million of incremental funds on nuclear related research (a 1.5 to 1 matching ratio), as well as a number of tangentially related grants on climate change and carbon capture and storage. Examples include securing financial and in-kind contributions from the CANDU Owners' Group (COG) and Canadian Nuclear Laboratories (CNL), the Nuclear Energy Association Nuclear Education Skills and Technology (NEA-NEST) Fellowship Program, the Canada Research Chairs Program, Social Sciences and Humanities Research Council (SSHRC), SaskPower and our host universities (Appendix D). Three related CSIP research projects were partner-sponsored while other work leveraged the funding provided by the Fedoruk Centre to bring in additional research funds.

One ongoing research venture deserves acknowledgement in this partnership report. With Fedoruk Centre funds, the Universities of Regina and Saskatchewan became participating organizations in the Canada-US Nuclear Education Skills and Technology (NEST). The NEST SMR program, a Nuclear Energy Agency (NEA) program involving the EU, USA and Canada, is dedicated to the training and development of people for the anticipated deployment of SMRs. The project aims to create expertise in social aspects of nuclear science and technology. CSIP was actively involved in summer events for students in 2020, 2021 and 2022, including with the SMR Press Pitch exercise held in conjunction with 2022 Generation 4 and Small Reactors International Conference (G4SR-4) in Toronto in September 2022 (http://smrpress.com/overview). JSGS students participated in teams of mostly engineering students, demonstrating the value of multidisciplinary teamwork. As a result of previous capacity building support from the Fedoruk Centre, CSIP was able to introduce NEST to social science researchers from SCK-CEN, the Belgian nuclear research centre.

While the Fedoruk Centre-CSIP partnership has concluded, the established capacity and momentum continues. Faculty, research students and alumni remain engaged in advancing social science research related to the application and adoption of nuclear technologies. Many of the students supported by the partnership continue their research and graduates are beginning to take on jobs in policy areas where they are translating their experience to inform decisions about our energy future.

PARTNERSHIP GOALS, ACTIVITIES AND ACCOMPLISHMENTS **N**



Social science research on engagement and public understanding of nuclear technologies is advancing rapidly. Ensuring that emerging researchers and future public servants are trained in the latest methods has been an important goal for CSIP and the Fedoruk Centre.

Tyler Koebel, JSGS Master of Public Policy graduate, is one of these emerging leaders. Tyler wrote his thesis on "Public Risk Perceptions toward Socially Contentious Technology: How Cultural Values and Basic Knowledge Affect Nuclear Energy Risk Assessments," which was summarized and published in Policy Options.

He started his professional career as a policy analyst with the Governments of British Columbia and Northwest Territories and now serves as Senior Policy Advisor, Nuclear Energy Division, Natural Resources Canada, in Saskatoon.

The partnership increased expertise, research and training capacity by supporting thirteen graduate students and seven faculty. The partnership also enabled graduate students to attend workshops and conferences to present their work and created venues to broadcast their research, including NuclearFACTS, CSIP Innovation Forums and CSIP's Making Waves blog.

1. Building Capacity

2. Public Engagement

3. Building Evidence for Decision-Making

Fostering respectful and constructive public dialogue has been both a core interest for partners and a major research focus for our team. The partnership enabled the JSGS, through CSIP, to bring together a network of researchers, including faculty at the Universities of Saskatchewan and Regina, to create a niche area of specialization in the interdisciplinary research on public policy and public engagement related to nuclear science and technology. CSIP has also assisted the Fedoruk Centre to host respectful conversations with the public, researchers, students and policymakers.

The research agenda that the Fedoruk Centre and CSIP has advanced is informed by work in political science and sociology. It has called into question the long standing "deficit model" of the public understanding of science. The research has made clear that it is unhelpful to assume that the public is ill-informed about the risks and benefits of nuclear technologies or that they are waiting passively to be educated by experts. Public engagement aimed at educating the public by addressing presumed deficits often flounders. Although individuals may not be technologically sophisticated, they can often be well-informed, especially with relevant local knowledge.

Understanding how different publics construct risks and benefits, and how trust is established between community members and experts (especially when they disagree on fundamental interpretations of risk) are critical to designing effective public engagement and mobilizing science.

Much of the work supported by the Fedoruk Centre has focused on understanding the mismatch of expectations between different stakeholders about nuclear technologies and finding ways to bring together diverse audiences and perspectives for productive and respectful engagement.

To aid in this, two public engagement events, titled *Nuclear Insights*, were held. The events invited dialogue on the

benefits of nuclear research and nuclear technology for the people of Saskatchewan. Nuclear Insights synthesised some of the best available social science research and allowed researchers to contribute to fruitful conversations by explaining their work in plain language and engaging in open discussion with citizens.

The topic of the first *Nuclear Insights* event, held in 2018 in Saskatoon, was New Research, New Opportunities: A conversation about nuclear research projects in Saskatchewan and their benefits to our province. The second event, held in 2019 in Regina, explored the role radioactivity plays in day-to-day life. At both events, scholars and practitioners undertaking research in social sciences, engineering and physics, health and medicine gave presentations and took questions from members of the public. These events provided significant insight into the design of discussions about the benefits, advantages and implications of nuclear research.

Nuclear Insights recognised that acknowledging both critiques and benefits of nuclear research is critical for navigating our energy future.

This insight was then tested and validated with a public survey and then a focus group on low dose radiation that engaged more than 70 science experts attending the 2019 Canadian Science Policy Conference in Ottawa (Hurlbert et al. 2022).

NuclearFACTS (Forum for Accountability and Communities Talking Science), initiated in 2013 as a venue for research engagement, provided leaders of projects funded by the Fedoruk Centre an opportunity to discuss the potential impacts of their work with each other, the Project Advisory Committee and a general audience. During the Fedoruk Centre-JSGS partnership, CSIP co-produced NuclearFACTS as a manifestation of public engagement and to help communicate the value of nuclear science from various perspectives. a flow in STOR M by RMP and CT Injection: ints of heat flux on the divertor plate

Chiles Xize

PARTNERSHIP GOALS, ACTIVITIES AND ACCOMPLISHMENTS

Understanding Environment, Science and Society

Fedoruk

ude progenities and a species and all data party is an arrival and an arrival and data of all appendix and and a species data and all appendix and a she at an arrival and a species and a she at an arrival and a species and a she at a species bed as any data at a species and a species and a species bed as any

Material

The partnership has enhanced awareness and understanding of nuclear science, technology and innovation issues through public engagement and outreach. Participants in Saskatchewan and beyond have gained a greater understanding about the perceived advantages, opportunities, risks and benefits of nuclear technologies.

(HURLBERT 2022)

EDUCATING

How an issue is framed, and by whom, can strongly affect public perceptions.

Larissa Shasko (MPP 2021; PhD candidate 2021) is supported in part by the Fedoruk Centre partnership. Her research has explored why public opinion on nuclear energy are often characterized as polarized. Shasko's research has determined that the apparent polarization is partly an artificial construct arising from surveys that ask binary questions such as 'do you support or oppose nuclear energy?'

By using more nuanced questions and data from focus groups and other interactive venues, her work found that, while there are strong voices at either end of the spectrum, the bulk of public opinion is aligned somewhere in the middle, categorizing their opinion as somewhat opposed, neutral or, somewhat in favour. Far from being polarized, opinion is quite fragmented.

This insight was used to design and deliver *Nuclear Insights*, two publicfacing events that engaged and tested new models for public dialogue on science. This work is continuing.

1. Building Capacity

2. Public Engagement

3. Building Evidence for Decision-Making

To date, the research team has published 11 journal articles, 12 non-peer review publications and delivered 39 presentations of their methods and findings.

Scholarly publication has been an important output, but the partners have created other opportunities to disseminate work and influence decision making.

In 2018, CSIP organized the Canadian Nuclear Society 38th Annual Conference in Saskatoon, sponsored in part by the Fedoruk Centre. The annual conference provides a forum to share progress and achievements, and to discuss energyrelated issues.

The 2018 conference brought more than 300 global leaders to participate in: plenary sessions with leading scholars and practitioners; technical sessions to present the latest advancements in nuclear science and technology; an embedded policy session led by CSIP that explored the potential of and challenges to licensing and deployment of SMRs in Canada; and a student conference with research poster presentations included with networking opportunities. Guy Lonechild, CEO of First Nations Power Authority, and Vice Chief Don Deranger, Prince Albert Grande Council, presented their views on the opportunity, while Dr. Peter Phillips, CSIP director, presented a plenary talk entitled "Feasible pathways to better nuclear policy", which was subsequently published as 'The three faces of social controversy: framing better nuclear policy dialogue' in simnews Issue 46.

CSIP has hosted a range of events to exchange insights on science policy and nuclear policy. In 2019, CSIP organized an interactive session at the annual Canadian Science Policy Conference, entitled "Risk, Uncertainty, Unknowns and Nonsense: Engagement with the Public on Radiation, Nuclear and Climate". The session involved focus-group discussions which explored the question of how policy stakeholders understand different perceptions of exposure to low dose radiation and how it could be addressed. Information gathered from these focus groups was incorporated into the article "Addressing Risk Perceptions of Low-Dose Radiation Exposure" published in 2022 in *Dose-Response: An International Journal.*

Faculty supported through the original partnership have become directly engaged in the policy process. Dr. Margot Hurlbert has assumed global leadership in her work as Coordinating Lead Author for the Intergovernmental Panel for Climate Change report on the 2019 Land and Climate Report. In June 2022, Dr. Jeremy Rayner hosted an international workshop at Manchester University entitled *Hidden in Plain Sight? Science Policy and the future of Small Modular Reactors*. Drs. Hurlbert and Rayner have also provided expertise through their memberships with the Canadian Nuclear Society's Generation IV and Small Reactor Division, working on the "Accelerating Licensing of Advanced Nuclear through International Coordination – Exploring Potential Pathways" project and the Canada-US NEST project on SMRs.

So far the research team has published:



of their methods and findings.





The partnership is impacting the policy domain:

In June 2022, Dr. Jeremy Rayner (Energy Research Lead and Former Director, CSIP) and Dr. John Root (Executive Director, Fedoruk Centre) spoke to the House of Commons Standing Committee on Science and Research. Dr. Rayner spoke about how small modular reactors (SMRs) present opportunities for a clean energy future in Saskatchewan and Canada.

"The challenge is to maintain our position as leaders and translate that leadership into the development of technology that actually contributes to meeting our clean energy goals."

DR. RAYNER

"Deploying a nuclear power technology in Saskatchewan will not only move us in a good direction... but can also create opportunities for research and innovations in all surrounding fields." The Fedoruk Centre's innovative partnership with CSIP has expanded knowledge and understanding of the policy, governance, social and economic dimensions of nuclear science and technology.

Evidence-based research has guided decision-makers in private and public sectors. Multiple research publications, presentations and collaborations have arisen to date, including 11 peer-reviewed publications, 12 other articles and more than 30 invited presentations and conferences.

DR. ROOT

NEXT STEPS

Looking forward, there are a number of ways we can build on the foundation set by this partnership.

CSIP researchers continue to pursue the common research goals of the original partnership. The COVID-19 pandemic delayed progress of the partnership and transformed some of the research activities. Pandemic disruptions required staging of work so that the later activities could adapt to evolving circumstances and opportunities. While the delays have been frustrating at times, the innovative format of the partnership agreement allowed research activities to adapt to the changing context. In the beginning, for example, there were no specific policy commitments to advance SMRs in Canada, or anywhere in the world.

At the time of this report, four provinces and the federal government have signaled a commitment to explore the feasibility of SMRs in provincial and national power grids and several other countries are actively considering the role of SMRs in their systems.

The US Nuclear Regulatory Commission, in early 2023, issued the final rule certifying NuScale Power's SMR proposed for Oregon, making it the seventh reactor design–and the first SMR–cleared by the regulator for use in the US.

While the partnership agreement has ended, the research insight and new capacity continues. The partnership established a community of researchers and a body of research for translating scientific knowledge and technology into public impact. We developed new insight into the mechanisms for effective public engagement, and the conditions necessary for objective, respectful conversation among scientists, the public and government. The partnership placed Saskatchewan among global leaders in nuclear research, policy development and training. The momentum from the new capacity, knowledge and practices arising from our joint work will deliver real, long-term economic benefits to support a growing nuclear sector in the province.

The Fedoruk Centre and CSIP remain committed to delivering social and economic value to Saskatchewan. We are continuing the dialogue that proactively engages scientists and social scientists with the public in this important policy area and are actively exploring a range of growth possibilities.

In addition to sustaining the policy research focus on SMRs among JSGS faculty and with research students, we are looking at the potential to develop new capacity through an industry or government supported research faculty in energy policy options, with a focus on SMRs.

There are a number of ways this could develop, ranging from an existing current faculty member taking this on as a sustained research focus to developing and resourcing a new scholar dedicated to working in this field. We are exploring using one or more of the existing pathways to new faculty, including using the JSGS Policy Fellows Program to develop a proposal for a defined, visiting, enhancement or endowed chairs at one of our host universities.¹

https://vpfaculty.usask.ca/documents/chairs-professorships-establishment-guidelines.pdf; https://www.uregina.ca/policy/browse-policy/policy-RCH-010-010.html

1

APPENDIX A PROJECTS SPONSORED BY THE AMENDED PARTNERSHIP AGREEMENT 2019–22

1. Does deliberative engagement improve public understanding of future energy choices?



Principal Investigator:

Dr. Margot Hurlbert

Project Description:

The public engagement literature generally supports the use of engagement designs that allow for dialogue among citizens and between citizens and technical experts. Nonetheless, deliberative engagement designs are expensive, reach relatively few people and there is also some evidence that existing opinions are entrenched rather than modified by dialogue. The project aims to build on the Nuclear Insights program by taking different models of public dialogue on future energy choices across Saskatchewan. The goals are both to contribute to the public engagement literature as well as to provide decision makers with a menu of options for engagement and collaborative policy making. Academic output will be 1-2 peer reviewed publications in each year of the project.

Dr. Margot Hurlbert, Jane Akpan, and Mac Osazawa-Peters worked with SaskPower, and Laura Soparlo to hold virtual two-day citizen juries in Swift Current, Saskatoon, and Estevan. Additional citizen juries were held in Estevan and Regina in 2022. The addition of the citizen juries to the focus groups and business focus groups provides us with a fairly comprehensive and representative, geographically dispersed data set which we will continue to analyze, present and publish. This work is currently being analyzed using other research funds and the Principal Investigator (PI) is drafting journal articles surrounding this.

2. Finding a niche: Northern communities as protected spaces for SMRs.



Principal Investigator: Dr. Jeremy Rayner

Project Description:

Technological innovations have sometimes been described as "hopeful monstrosities": holding out the hope of a better future but not yet entirely fit for purpose in the real world. Influenced by evolutionary economics, some innovation theories have focused on the construction of niche environments where new technologies can develop the adaptations needed to be successful without being exposed to immediate competition from incumbents. This project assesses the potential role of northern and remote communities in Canada as providers of niche environments for SMRs, beginning with the projects in Pinawa and building on previous Fedoruk funded work in Indigenous communities. It aims to build and support the networks connecting government, industry and communities that will be essential to the success of SMRs in the North. Academic outputs, 1-2 peer reviewed articles in each year of funding. This project will build on and continue the collaboration

between JSGS and the Fedoruk Centre around the potential deployment of SMRs in the North and support the Fedoruk Centre goal of managing the risks and benefits of nuclear technology for society and our environment.

This project has supported PhD candidate Mariia lakovleva in her study of how government agencies and SMR vendors are creating narratives about what SMRs are and what they can do, and how communities are responding to these narratives by re-emphasizing their own concerns about their energy needs. A paper on the conceptual framework was published and one on the field work will be presented at G4SR-4. The project finished with a workshop at the Dalton Nuclear Institute, University of Manchester, which brought together students, including Indigenous students, senior researchers, and public servants to explore the issue of a community-based research agenda for SMRs, comparing northern and Indigenous issues in Canada with the place of Wales in the UK. A New Frontiers in Research Letter of Intent was submitted to continue this research and a follow up videoconference of participants to explore other funding opportunities is planned.

3. Advancing convergence and collaborative research through major research facilities (MRF).

Principal Investigator:

Dr. Peggy Schmeiser

Project Description:

Through interviews with researchers and personnel at Canadian MRFs including the former CNBC, CLS, TRIUMF, SNOLAB, VIDO, Ocean Networks Canada and CCGS Amundsen, this project identified and raised awareness about models and obstacles for convergence and collaborative research to address large-scale global challenges through large scale scientific infrastructure and initiatives.

Over 30 hours of interviews with scientists, administrators and board members associated with all seven MRFs were completed, transcribed and inputted into an NVivo data system. During the first year, team members also engaged with officials from the Canadian Foundation for Innovation and a Nobel Laureate. During 2020, the research team also advanced knowledge transfer outcomes:

- A Canadian Science Policy Conference (CSPC) panel organized by the PI including two CEOs of MRFs and a leader in science and innovation policy. November 2020.
- Project presentations as part of Fedoruk Centre initiatives including the NuclearFACTS 2020 Peerto-Peer Forum and meetings with Canadian Nuclear Laboratories (CNL).
- A featured editorial as part of a CSPC online series and CSIP Making Waves website article.
- PI participation in invitation-only Canadian Neutron Initiative Roundtable (December 2020).

Data analysis and article preparation was undertaken in 2021, along with additional sector engagement and knowledge transfer activities:

- PI participation in the TRIUMF 20-Year Vision Topical Group on Emerging Trends in Convergence Research.
- Splash Talk video creation for the American Science of Team Science Annual Conference (June 2021).
- PI participation in invitation-only International Conference on Research infrastructure (June 2021).
- Presentation at NuclearFACTS 2021 Peer-to-Peer Forum.



APPENDIX B FACULTY SUPPORTED OR ENGAGED BY THE PARTNERSHIP

Key faculty (>50% of time on nuclear issues)

Secondary faculty (<50% time on nuclear issues)



Dr. Margot Hurlbert

Professor and Canada Research Chair in Climate Change, Energy and Sustainability Policy, JSGS (lead researcher)

Dr. Michael Atkinson

Professor and Executive Director, JSGS (thesis supervisor and administrative support)





Dr. Jeremy Rayner

Dr. Peggy Schmeiser

researcher)

Professor, JSGS; Research Lead, Energy Policy, CSIP (theme lead and lead researcher)

Adjunct Professor, JSGS; Founding

Associate Director, CSIP (lead

Dr. Elizabeth Schwartz

(lead researcher)

Assistant Professor and Fedoruk

Fellow, JSGS (now at Memorial)

Dr. Martin Boucher

Faculty Lecturer, JSGS (researcher and thesis supervisor)



Professor and Canada Research Chair in Regional Innovation, JSGS; Fellow, Royal Society of Canada

Dr. Kathleen McNutt

Professor and Former Executive Director, JSGS (researcher, supervisor and administrative support)

Dr. Peter Phillips

Distinguished Professor and Director, CSIP (researcher, thesis supervisor and administrative support)









APPENDIX C

JSGS STUDENT RESEARCHERS SUPPORTED BY THE PARTNERSHIP

Current students (2022):

Akpan, Jane, PhD candidate. Interrogating the Science of Small Modular Reactors Cost Estimates, Assumptions and Social Constructs. Supervisor: Dr. Margot Hurlbert.

Garcia-Zepeda, Connie Juliet. MPP candidate. Mapping the Innovation Ecosystems for the Deployment of Small Modular Reactors in Canada and Mexico: An Innovation Policy Approach through Strategic Niche Management and Social Network Analysis. Supervisor: Dr. Jeremy Rayner.



(photo) lakovleva, Mariia, PhD candidate. Connecting Technology with Communities: The Case of Small Modular Reactors. Supervisors: Dr. Jeremy Rayner and Dr. Ken Coates.

Landrie-Parker, Dazawray, PhD candidate. Adoption of SMRs in Canada's North. Supervisor: Dr. Jeremy Rayner.

Mosscrop, Larkin, PhD Candidate. Public Discussions of Nuclear Energy. Supervisor: Dr. Margot Hurlbert.

Sahagun, Francisco, MPP Candidate. Nuclear Energy Perceptions and Technical Aspects of SMRs in Saskatchewan. Supervisor: Dr. Margot Hurlbert.

Shasko, Larissa, PhD candidate. Zombies, Superpowers and Apocalyptic Narratives: Exploring Science Fiction and Social Media as Methods of Youth Engagement on Climate Change, Small Modular Reactors, and Radiation. Supervisor: Dr. Margot Hurlbert and Dr. Jeremy Rayner.

Yanes, Rubens, PhD candidate. Influence of Online Discussions on the Political Agenda-setting Process and Issue Attention in Social Media: the Case of Nuclear Energy in Australia, Argentina, Canada, and Spain. Supervisor: Dr. Jeremy Rayner.

Completed research students (2016-21):

Neetz, Michaela, MPP. 2021. The Influence of Public and Media Attention on Policy: Applying the Issue-Attention Cycle to Radon in Canada. Supervisor: Dr. Jeremy Rayner.

Osazawa-Peters, Mac, PhD. 2020. Risks Governance of

Innovative Power Generation Technologies in Saskatchewan: Pathways to a Sustainable Energy Future. Supervisor: Dr. Margot Hurlbert.

Rees, Haven, MPP. 2020. Land Use Impacts and Policy Incoherence of Small-Scale Utility Renewable Power: SaskPower's Power Generation Partner Program. Supervisor: Dr. Elizabeth Schwartz.

Shasko, Larissa, MPP. 2020. Blurring Divisions in a Fuzzy World: Innovation, Public Engagement and Energy Justice. Supervisor: Dr. Margot Hurlbert.

Sharpe, Cody, PhD. 2018. Struggles over Urban Sustainability in Saskatoon and Edmonton: The Use of Policy Narratives by Advocacy Coalitions. Supervisor: Dr. Jeremy Rayner.

Baranovskiy, Petr, MPP. 2017. A Search for Sustainable Energy Future for the Northwest Territories: The Role of Policy Integration. Supervisor: Dr. Jeremy Rayner.

Koebel, Tyler, MPP. 2016. Public Risk Perceptions toward Socially Contentious Technology: How Cultural Values and Basic Knowledge affect Nuclear Energy Risk Assessments. Supervisor: Dr. Michael Atkinson.

Thomson, Raymond, MPP. 2016. Twenty-First Century Digital Transformation of Work and Jobs in Northern Saskatchewan. Supervisor: Dr. Ken Coates.

Student assistants:

Ndelle, Yvonne, PhD. 2021. Contested Governance and Lesson Drawing: A Critical Assessment of the Social License Model in Canada's Agri-Food Sector (1998- 2018). Supervisor: Dr. Peter Phillips.

Plante, Melanie, Master of Arts. 2016. The Impacts of Macropolitical Structures on the Influence of Municipalities, Traditional Land Users, and Indigenous Governance Structures in EIA processes. Supervisors: Dr. Greg Poelzer and Dr. Ken Coates.

Santhanakrishnan, Deepak, MPP. 2020. Food Security Goals and Public Distribution System: Potential for Outcome Improvement through the Digitization of India's Distribution Regime. Supervisors: Dr. Elizabeth Schwartz and Dr. Peter Phillips.

APPENDIX D

EXTERNAL RESEARCH GRANTS LEVERAGED BY THE PARTNERSHIP

Research Grant	Principal Investigator	Year	Funder	Amount
Canada Research Chair in Public Policy (Tier 1)	Dr. Margot Hurlbert	2019-26	Social Science and Humanities Research Council of Canada	\$1,400,000
The influence of social learning and attitudes on the perception of risk from low dose radiation & SOTAR leading to an epidemiological study of all causes of death and longevity in Canadians occupationally exposed to ionizing radiation	Dr. Jeremy Rayner and Dr. Margot Hurlbert	2018-21	Canadian Nuclear Laboratories	\$750,000
Risk, Communication, and Learning Concerning Low Dose Radiation'' Exploring clean energy supply chains, communication, social and policy learning	Dr. Margot Hurlbert	2021-24	CANDU Owners Group	\$710,000
Small Nuclear Innovation Policy Partnership	Dr. Jeremy Rayner	2015-17	Social Science and Humanities Research Council of Canada	\$141,590
Public Engagement in Nuclear: Medicine, Mining, Meeting Climate Change Commitments	Dr. Margot Hurlbert	2021-23	Fedoruk Centre	\$137,425.00 (plus \$105,000 matching Mitacs funding)
Public Understanding of and attitudes towards the risks posed by exposure to low doses of ionizing radiation	Dr. Jeremy Rayner	2020	Mitacs Research Training Award	\$6,000
Social Engagement, Governance and Evidence-informed Public Policy Dimensions of Nuclear Energy Development	Dr. Jeremy Rayner	2020-23	Nuclear Education Skills and Technology SMR project	Memorandum of understanding

Total leveraged funding

\$3,250,015

APPENDIXE N PUBLICATIONS, PRESENTATIONS, CONFERENCES

Publications (peer-reviewed):

Hurlbert, Margot. 2022. Place-based power production deliberations in Saskatchewan: Engaging future sustainability. *Clean Technologies and Environmental Policy* 24:1695-1708. https://doi.org/10.1007/s10098-022-02277-2

Hurlbert, Margot, Larissa Shasko and Michaela Neetz. 2022. Addressing Risk Perceptions of Low-Dose Radiation Exposure. *Dose-Response: An International Journal* 20(2). <u>https://doi.org/10.1177/15593258221088428</u>

Larissa Shasko, Michaela Neetz, Margot Hurlbert, Jeremy Rayner & Dazawray Landrie-Parker. 2022. Risk, "Radiophobia," and Social Learning: Applying Lessons from the Literature. *Nuclear Technology* 208(6): 935-946. <u>https://doi.org/10.1080/0</u> 0295450.2021.1996842

lakovleva, M., Rayner, J., Coates, K. 2021. Breaking out of a Niche: Lessons from SMRs from Sustainability Transition Studies. *Nuclear Technology* 207(9): 1351-1365. <u>https://doi.org</u> /10.1080/00295450.2020.1855947

Osazuwa Peters, M., Hurlbert, M., McNutt, K., Rayner, J., Gamtessa, S. 2021. Risk and Socio-technical electricity pathways: A systematic review of 20 years of literature. *Energy Research and Social Sciences* 71. <u>https://doi.org/10.1016/j.erss.2020.101841</u>

Fátima Alves, Walter Leal Filho, Paula Casaleiro, Gustavo J. Nagye, Harry Diaz, Abul Quasem Al-Amin, José Baltazar Salgueirinho Osório de Andrade Guerra, Margot Hurlbert, Harith Farooq, Maris Klavins, Mustafa Saroar, Eliska Krkoska Lorencova, Jain Sureshn, Amadeu Soareso, Fernando Morgado, Paul O'Hare, Franziska Wolf, Ulisses M. Azeiteiro. 2020. Climate Change Policies and Agendas: Facing Implementation Challenges and Guiding Responses. *Environmental Innovation and Societal Transitions* 34: 237-250. https://doi.org/10.1016/j.envsci.2019.12.001

Margot Hurlbert, Mac Osazuwa-Peters, Jeremy Rayner, David Reiner, Petr Baranovskiy. 2020. Diverse Community Energy Futures in Saskatchewan, Canada. *Clean Technologies and Environmental Policy* 22: 1157–1172. <u>https://doi.org/10.1007/</u> <u>s10098-020-01859-2</u> Hurlbert, M., Osazuwa-Peters, M. 2020. Emerging Issues in Energy, Climate Change and Sustainability Management. *Economics and Management* 4(1): 7-13. <u>https://doi.org/10.29015/cerem.873</u>

Viner, D., Ekstrom, M., Hurlbert, M., Warner, N.K., Wreford, A., Zommers, Z. 2020. Understanding the Dynamic Nature of Risk in Climate Change Assessments – A New Starting Point for Discussion. *Atmospheric Science Letters* 21. <u>https://doi.org/10.1002/asl.958</u>

Datta R. & Hurlbert, M. 2019. Energy Management and Its Impacts on Indigenous Communities in Saskatchewan and Alberta: A Scoping Review. *International Journal of Energy Sector Management* 13(4): 1088-1106. <u>https://doi. org/10.1108/IJESM-11-2018-0001</u>

Hurlbert, M., Osazuwa-Peters, M., McNutt, K., Rayner, J. 2019. Transitioning from Coal: Toward a renewable-based socio-technical regime in Saskatchewan. *Environmental Innovation and Societal Transition*. <u>https://doi.org/10.1016/j.</u> <u>eist.2019.11.005</u>

Other publications:

Rayner, Jeremy. 2022. Net zero: What governments have learned about public engagement and nuclear energy. Centre for the Study of Science and Innovation Policy Making Waves Series. March 29. <u>https://www.schoolofpublicpolicy.</u> <u>sk.ca/csip/publications/making-waves/net-zero-what-</u> <u>governments-have-learned-about-public-engagement-and-</u> <u>nuclear-energy.php</u>

Shasko, Larissa. 2021. Insights into the NEST Framework: A chat with Larissa Shasko, Nuclear Energy Agency (OECD). September 6. <u>https://www.oecd-nea.org/jcms/pl_60466/</u> insights-into-the-nest-framework-a-chat-withlarissa-shasko

Hurlbert, Margot. 2020. Climate change and energy in Berdahl, L., Eisler, D., Farney, J., Rasmussen, K. (co-editors). *The Saskatchewan Election: A 2020 Perspective*. Johnson Shoyama Graduate School of Public Policy. ISBN 978-0-7731-0758-8. <u>https://www.schoolofpublicpolicy.sk.ca/documents/</u> research/reports/jsgspp_sk2020-election-recap_final.pdf Hurlbert, Margot. 2020. The Paris Agreement at 5: Time's running out. How to get the world back on track to meet its climate goals. *The Conversation*. <u>https://theconversation.com/</u> the-paris-agreement-at-5-times-running-out-how-to-getthe-world-back-on-track-to-meet-its-climate-goals-151806

lakovleva, Mariia, Larissa Shasko and Michaela Neetz. 2020. The Nuclear Debate: Can we move from polarization to cooperation? Centre for the Study of Science and Innovation Policy Making Waves Series. February 19. <u>https://www.</u> <u>schoolofpublicpolicy.sk.ca/csip/publications/making-waves/</u> <u>the-nuclear-debate-can-we-move-from-polarization-to-</u> <u>cooperation.php</u>

Rayner, Jeremy. 2020. The Elephant in the SMR. Centre for the Study of Science and Innovation Policy Making Waves Series. April 24. <u>https://www.schoolofpublicpolicy.sk.ca/csip/</u> <u>publications/making-waves/the-elephant-in-the-smr.php</u>

Schmeiser, Peggy, Jennifer Poudrier, Dean Chapman, Anne Ballantyne, Karen Wood and Joelena Leader. 2020. Big Enough Questions. Canadian Science Policy Centre Editorial Series: Response to COVID Pandemic and its Impacts. April 23. https://sciencepolicy.ca/news/big-enough-questions. Reposted to Centre for the Study of Science and Innovation Policy Making Waves Series. April 27. <u>https://www.</u> <u>schoolofpublicpolicy.sk.ca/csip/publications/making-waves/ big-enough-questions.php</u>

Schmeiser, Peggy. 2020. Knowledge in a Blender: Why We're So Mixed Up about Evidence in Public Policy. Centre for the Study of Science and Innovation Policy Making Waves Series. May 27. <u>https://www.schoolofpublicpolicy.sk.ca/csip/ publications/making-waves/knowledge-in-a-blender.php</u>

Schmeiser, Peggy. 2020. Multidisciplinary Collaboration and Evidence in Decision-Making. Centre for the Study of Science and Innovation Policy Making Waves Series. April 3. <u>https://</u> www.schoolofpublicpolicy.sk.ca/csip/publications/makingwaves/multidisciplinary-collaboration-and-evidence-indecision-making.php

Schmeiser, Peggy and Joelena Leader. 2020. The Promise of Convergence Research: The Readiness of Canada's National Research Facilities and Academic Partners to Support Policy Responses to Grand Challenges. Discussion Paper prepared for the Canadian Science Policy conference. November 13. <u>https://na.eventscloud.com/file_uploads/</u> cd4ba019fe480ce0298588fd4da64fa9_CSPCDiscussionPaperfinal.Nov13.pdf_ Schwartz, Elizabeth. 2019. Good Nuclear Policy Should Combine Research, Innovation, and Public Engagement. *The Conversation*. February 20. <u>https://theconversation.com/</u> <u>good-nuclear-policy-should-combine-research-innovation-</u> <u>and-public-engagement-106666</u>

Phillips, Peter WB. 2018. The Three Faces of Social Controversy: Framing Better Nuclear Policy Dialogue. *SimNews* 46: 14-15.

Invited Presentations:

Rayner, Jeremy. 2022. SMRs as opportunities for a clean energy future in Saskatchewan. House of Commons Standing Committee on Science and Research Meeting, Government of Canada, June 9.

Hurlbert, M. 2021. Public Engagement in Nuclear: Medicine, Mining, Meeting Climate Change Commitments. NuclearFACTS Peer-to-Peer Research Forum, Fedoruk Centre, University of Saskatchewan, October 19.

Hurlbert, Margot. 2020. Sustainable Development Goal 13 Climate Change. Lecture for Seventh Annual President's Online Lecture Series on UNESCO Sustainability Goals, University of Saskatchewan, October 28.

Hurlbert, Margot. 2020. Public Engagement and Future Energy Choices. NuclearFACTS Peer-to-Peer Research Forum, Fedoruk Centre, University of Saskatchewan, October 20.

Hurlbert, M. Leavitt, P., Sauchyn, D. 2020. Prairie Water Resilience Research Initiative – Climate change, environment, water and communities. Virtual panel discussion organized by Office of the Vice Present of Research, University of Regina, June 23.

Hurlbert, Margot. 2020. Climate Change, Land and Food: Implications for Saskatchewan. Institute for Public Administration of Canada, Saskatchewan Regional Group, Regina, Saskatchewan, March 12.

Hurlbert, Margot. 2020. Resilient Land and Water Futures. Saskatchewan Association of Watersheds, March 4.

Hurlbert, Margot. 2020. Climate Change: Where are we, and what might the future bring? Scenarios and Pathways. Academics for Climate, University of Regina, February 13. <u>https://youtu.be/8sQ-pBUms6E</u> Rayner, Jeremy. 2020. Finding a Niche: Northern Communities as Protected Spaces for SMRs. NuclearFACTS Peer-to-Peer Research Forum, Fedoruk Centre, University of Saskatchewan, October 20.

Rayner, Jeremy. 2020. Canada-UK Nuclear Energy Dialogue. March 2-4.

Schmeiser, Peggy. 2020. Advancing Convergence and Collaborative Research through MRFs. NuclearFACTS Peerto-Peer Research Forum, Fedoruk Centre, University of Saskatchewan, October 21.

Phillips, Peter. 2018. Feasible pathways to better nuclear policy. Plenary Talk at CNS National Conference, Saskatoon, June 6.

Rayner, Jeremy. 2017. Small Modular Nuclear Reactors: Energy Justice for the 21st Century? Dalton Institute Seminar Series, University of Manchester, March 30, 2017.

Conference Presentations:

Shasko, L. 2022. Imagining a Green Energy Future: Inspiring Youth Inclusion in Energy Transition Policy Decisions. 41st Annual Conference of the Canadian Nuclear Society, June 5-8.

Shasko, L. 2022. Zombies, Superpowers, and Apocalyptic Narratives: Novel Approaches to Advance Youth Engagement on Radiation. Waste Management Symposia, March 6-10.

Shasko, L. 2022. Changing the Future of Nuclear Power Narrative: Moving from Binary Risk/risk Trade-off to a Story of Climate Crisis Aversion. Waste Management Symposia, March 6-10.

Hurlbert, M., Rayner, J., Shasko, L., Landrie-Parker, D., Condor, J. 2021. Public Knowledge and Support for SMRS. 40th Annual Conference of the Canadian Nuclear Society and 45th Annual CNS/CNA Student Conference, Virtual Conference, June 6-9.

Landrie-Parker, D. 2021. Indigenous Perspective in Nuclear Energy. 40th Annual Conference of the Canadian Nuclear Society and 45th Annual CNS/CNA Student Conference, Virtual Conference, June 6-9. Shasko, L. 2021. Age and Support for SMRs as a Low Carbon Energy Option: The Need for Youth-Led Engagement. 40th Annual Conference of the Canadian Nuclear Society and 45th Annual CNS/CNA Student Conference, Virtual Conference, June 6-9.

Shasko, L. and Hurlbert, M. 2021. Innovating the Bridge Building Elements of 'Reluctant Acceptance' - CN275-96. International Conference on Climate Change and the Role of Nuclear Power, International Atomic Energy Agency (IAEA), Vienna, Austria, October 7-11.

Schmeiser, Peggy. 2020. The Promise of Convergence Research: The Readiness of Canada's National Research Facilities and Academic Partners to Support Policy Responses to Grand Challenges. Canadian Science Policy Conference, Virtual conference, November. <u>https://www.youtube.com/</u> <u>watch?v=T3SCHsHSFwE&feature=youtu.be</u>

Shasko, L. and Hurlbert, M. 2020. Realism and a zero-carbon future. Uranium 2020 Conference, Virtual presentation, October 14.

lakovleva, M., Rayner, J. and Coates, K. 2019. Breaking Out of a Niche: Lessons for SMRs from Sustainability Transitions Studies. Workshop on the Nuclear and Social Science Nexus: Challenges and Opportunities for Speaking Across the Disciplinary Divide, OECD-NEA, Paris, December 12-13.

Osazuwa, M., Hurlbert, M., Rayner, J., and Reiner, D. 2019. Deliberating for Energy Democracy, Social Learning, and Reflexivity in Community Energy Futures in Saskatchewan, Canada. 4th International Conference on Public Policy (ICPP4), Montreal, Quebec, Canada, June 26-29.

Rayner, J. 2019. Why Instruments Matter: Governing Energy Transitions in Six Countries. International Sustainability Transitions Conference, Carleton University, Ottawa, Ontario, Canada, June 23-26.

Shasko, L. and Hurlbert, M. 2019. Creative Disruption for Clean Nuclear Energy and GHG Emission Reductions - CN275-97. International Conference on Climate Change and the Role of Nuclear Power, International Atomic Energy Agency (IAEA), Vienna, Austria, October 7-11. Shasko, L. and Hurlbert, M. 2019. Public Perception of Low-Dose Radiation: New Approaches of Study – 19113. Waste Management Conference, Phoenix, Arizona, March 3-7.

Fletcher, A.J., Akwen, N.S., Diaz, H. Hurlbert, M. 2018. You Relied on God and Your Neighbour to Get Through It: Social Capital and Climate change Adaptation in the Canadian Prairies. Congress of the Social Sciences and Humanities, Environmental Studies Association of Canada, Regina, May 30.

Hurlbert, M. 2018. Developing a diagnostic, strategic, evaluation tool to assess when participation is necessary. Canadian Association of Programs in Public Administration, Congress of the Humanities and Social Sciences, Environmental Studies Association of Canada, Regina, May 28.

Hurlbert, M. 2018. Exploring the Disciplines of Carbon and Climate Change. Environmental Studies Association of Canada, Congress of the Humanities and Social Sciences, Environmental Studies Association of Canada, Regina, May 28.

Hurlbert, M., Akpan, J., Osazuwa-Peters, M., Gomez, B. 2018. CCS Technology: The Governance challenges of Cooperative Approaches to Decarbonization Climate Change Regulation 2.0 – Making the Paris Agreement Work. International Society for Intercommunication of New Ideas (ISINI), WSB University, Wroclaw, Poland, August 30.

Hurlbert, M., Gattinger, M., Bratt, D., Watts, B., Girling, K., Chatigny, E. 2018. Risk Communication and Engagement with the Public in the Nuclear, Climate, and Artificial Intelligence Sectors Panel. Canadian Science and Policy Conference, Ottawa, November 8. Hurlbert, M., McNutt, K., Rayner, J., Osazuwa-Peters, M. 2018. Combining Actor Network Theory and the Multi-Level Perspective of Transitions Management Can we better explain agency of actors or processes that advance niche innovations? International Sustainability Transitions Conference, Manchester, U.K., June 14.

Hurlbert, M., Osazuwa-Peters, M., Shuba, C. 2018. Saskatchewan's Media Vision and Framing of CCS. Carbon Narratives Panel. Congress of the Humanities and Social Sciences, Environmental Studies Association of Canada, Regina, May 28.

Rayner, J. 2018. Integrating the science of low dose radiation exposure: Science, perceptions, learning and communication. Annual Conference of the Canadian Nuclear Society, Saskatoon, June 3-5.

Rayner, J. and Rastogi, A. 2017. Energy justice in Canada's north: Expanding the decision matrix. 1st International Conference on Energy Research and the Social Sciences, Sitges, Spain, April 2-5.

Schmeiser, Peggy. 2017. Addressing Major Global Challenges through Science and Public Policy: Transdisciplinary and Multidimensional Approaches. Canadian Science Policy Conference, Ottawa, November 1-3.

Rayner, J. 2016. A Tale of Two Regulators: Nuclear Regulation and Nuclear Innovation in Canada and the United Kingdom. 24th IPSA World Congress, Poznan, Poland, July 23-28.

Rayner, J. 2016. Informality in the face of institutions: The pathways framework, the governance of energy and the "global nuclear revival". Workshop on Informal Governance at the ECPR Joint Sessions of Workshops, Pisa, April 24-28.

APPENDIX F COMMUNICATIONS, KNOWLEDGE MOBILIZATION AND OUTREACH

CSIP Innovation Forums (2016-22) are biweekly forums hosted by CSIP on topics related to science and innovation policy. The forum is open to students, faculty members, researchers, government and industry employees and interested citizens. Since 2016, the Innovation Forums have evolved from in-person events with local speakers to online events with national and international speakers and gained a much larger audience. During the 2021-22 academic year, CSIP presented 11 forums and had over 600 attendees.

Public Perceptions of Nuclear Technology in Saskatchewan and Ontario. Mar 2022. Larissa Shasko, PhD candidate and Dr. Jose Condor.

Nuclear Development, Communicating Risk and Public Engagement. Sept 2021. Larkin Mosscrop, PhD candidate and Matthew Dalzell.

Are SMRs right for Saskatchewan? Five Questions that still need answers. Apr 2021. Dr. Jeremy Rayner.

Nuclear Risk, Radiation Exposure and People's Perceptions. Mar 2021. Dazawray Landrie-Parker and Larissa Shasko, PhD candidates.

How the Fedoruk Centre is addressing practical and social aspects of nuclear energy. Dec 2020. Dr. John Root.

Radiation, Climate, and Becoming Aware: How open forms of public engagement can address binary limitations in a polarized world. Jan 2020. Larissa Shasko, MPP.

Addressing Wicked Problems in the Face of Uncertainty: Innovating the Wicked Policy Problems of Climate Change. March 2018. Dr. Margot Hurlbert.

CSIP Illuminating Science Speaker Series (2017) brought in high profile national and international speakers to speak on science policy issues.

Building Public Confidence: Communication, Trust and Credibility. 2017. Dr. Kirsty Gogan, Co-Founder and Executive Director of Energy for Humanity. **Making Waves Blog Articles (2019-22)** hosted on the CSIP website, invites faculty, researchers and students to provide unique perspectives on current policy issues.

Net zero: What governments have learned about public engagement and nuclear energy. March 2022. Dr, Jeremy Rayner. <u>https://www.schoolofpublicpolicy.sk.ca/csip/</u> publications/making-waves/net-zero-what-governmentshave-learned-about-public-engagement-and-nuclearenergy.php

The elephant in the SMR. April 2020. Dr. Jeremy Rayner. https://www.schoolofpublicpolicy.sk.ca/csip/publications/ making-waves/the-elephant-in-the-smr.php

The nuclear debate: Can we move from polarization to cooperation? Feb 2020. Mariia lakovleva, Larissa Shasko, Michaela Neetz. <u>https://www.schoolofpublicpolicy.sk.ca/csip/</u> publications/making-waves/the-nuclear-debate-can-wemove-from-polarization-to-cooperation.php

Small modular reactors in Saskatchewan. Dec 2019. Dr. Jeremy Rayner. <u>https://www.schoolofpublicpolicy.sk.ca/</u> <u>csip/publications/making-waves/small-modular-reactors-in-</u> <u>saskatchewan.php</u>

NEST SMR Hackathon (August 17-21, 2020) was hosted by Dr. Jeremy Rayner and supported by the Fedoruk Centre. This virtual event brought together more than 70 nuclear experts, students and government representatives from Canada, the US and the European Union gathered to share their expertise on nuclear energy solutions. Through case studies and presentations, the cross-disciplinary event gave students the opportunity to examine nuclear energy and deployment of SMRs through various lenses – from traditional science and engineering, to considering the social, economic and political impacts. (https://www.eng.mcmaster.ca/news/ mcmaster-hosts-international-nuclear-energy-expertsvirtual-hackathon). NuclearFACTS Peer-to-Peer Research Forum (2018-21) allowed Fedoruk Centre-supported researchers to report on the progress of their research, share highlights and discuss the impacts of their research including its benefits to Saskatchewan.

2021 Presenters:

Kate Dadachova, Targeted radioimmunotherapy as a novel approach for the treatment of multiple sclerosis

Gurpreet Kaur Aulakh, Development of Nuclear Imaging Tools for Pre-clinical Evaluation of Lung Inflammation: Sequential PET-CT Imaging in the Swine and Murine Models

Margot Hurlbert, Public Engagement in Nuclear: Medicine, Mining, Meeting Climate Change Commitments

Graham George, Approaching the Next Generation of Radiopharmaceuticals: Development of Radio-Resistant Chelators with Insights from Synchrotron Light

Humphrey Fonge, Production, processing and evaluation of pharmaceutical-grade 225Ac and 67Cu for cancer theranostics

Peggy Schmeiser, Advancing Convergence and Collaborative Research through Major Research Facilities

Chris Phenix, 18F-ABA: Applications of a Novel Radiotracer for Plant, Animal and Human Health

Eric Price, PET Imaging Pancreatic Cancer with Linker-Enhanced Peptide and Antibody Vectors

Jerzy Szpunar, Microstructural Design of Uranium Based Accident Tolerant Fuel for SMR and CANDU Reactors

Steven Siciliano, Positronic Detection of Iron Reducing, Ammonia Oxidizing Microorganisms

Jeremy Rayner, Finding a Niche: Northern Communities as Protected Spaces for SMRs

Kate Dadachova, Clinical Trial of Radioimmunotherapy of Invasive Fungal Infections in Companion Dogs

Ron Geyer, Development of a Molecular Imaging Probe that Detects Responses to Anti-Cancer Therapies

Jaswant Singh, Nuclear Imaging in Companion Animal Models of Disease

Margot Hurlbert, Does deliberative engagement improve public understanding of future energy choices?

2020 Presenters:

Eric Price, PET Imaging Pancreatic Cancer with Linker-Enhanced Peptide and Antibody Vectors

Jerzy Szpunar, Microstructural Design of Uranium Based Accident Tolerant Fuel for SMR and CANDU Reactors

Margot Hurlbert, Does deliberative engagement improve public understanding of future energy choices?

Chris Phenix, 18F-ABA: Applications of a Novel Radiotracer for Plant, Animal and Human Health

Jeremy Rayner, Finding a Niche: Northern Communities as Protected Spaces for SMRs

Musharraf Khan for Project Leader Humphrey Fonge, Production, processing and evaluation of pharmaceuticalgrade 225Ac and 67Cu for cancer theranostics

Steven Siciliano, Positronic Detection of Iron Reducing, Ammonia Oxidizing Microorganisms

Kate Dadachova, Clinical Trial of Radioimmunotherapy of Invasive Fungal Infections in Companion Dogs

Ron Geyer, Development of a Molecular Imaging Probe that Detects Responses to Anti-Cancer Therapies

Jaswant Singh, Nuclear Imaging in Companion Animal Models of Disease

Peggy Schmeiser, Advancing Convergence and Collaborative Research through Major Research Facilities

2019 Presenters:

Chris Phenix, Reversible Ligands as PET Radiotracers for Imaging Glucocerebrosidasae

Eric Price, Multi-Centre Development of Solid Targetry for the Cyclotron Production of Gallium-68, Scandium-43 and -44, Zirconium-89 and Technetium -99m

Humphrey Fonge, Production, processing and evaluation of pharmaceutical-grade 225Ac and 67Cu for cancer theranostics Ekaterina Dadachova, Combination of immunotherapy and radioimmunotherapy for treatment of metastatic melanoma

Steve Siciliano, Positronic Detection of Iron Reducing, Ammonia Oxidizing Microorganisms

2018 Presenters:

Chijin Xiao, Control of plasma flow in STOR-M by RMP and CT injections: Studies of diverter heat flux in COMPASS

Gurpreet Aulakh, Domestic animal models for human disease: Developing nuclear technologies for diagnosis and treatment

Kalowatie Deonandan, Establishing social license: Women, respect, and stakeholder engagement in the nuclear sector

Vijay Gaja, 89Zr target development, production and in-vivo validation project

Stephen Kay, SoLID heavy gas Cherenkov detector prototype

Humphrey Fonge, FDOPA PET/CT to monitor the effectiveness of fetal dopaminergic grafts in Parkinson patient

Nuclear Insights (2018-19) brought together experts and the public to discuss, in plain language, the benefits of nuclear research and nuclear technology to the people of Saskatchewan.

Nuclear Insights: The role radioactivity plays in day-to-day life. 2019. Moderated by Larissa Shasko, MPP.

Panelists:

• Esam Hussein, a nuclear engineer, discussing 'Imaging with natural radiation; Radon in homes'.

• Zisis Papandreou, a professor of physics, discussing "Nuclear imaging of plants'.

Kate Dadachova, a professor of pharmacy and Fedoruk

Chair in Radiopharmacy, discussing 'Use of radiation in medical contexts'.

Nuclear Insights: A conversation about nuclear research projects in Saskatchewan and their benefit to our province. 2018. Moderated by Dr. Elizabeth Schwartz, Fedoruk Fellow.

Panelists:

• Margot Hurlbert, a social scientist, discussing 'Policy considerations for new nuclear technologies'.

• Esam Hussein, a nuclear engineer, discussing 'What it takes to build a nuclear reactor'.

• Alex Rajput, a neurologist, discussing, 'Diagnosing and treating Parkinson's disease'.

Women in Science Speaker Series (2019-22) showcased the outstanding contributions of women scientists and research leaders to national dialogue and policy development in Canada.

Dr. Donna Strickland, Nobel Laureate. 2022. Generating Highintensity Ultrashort Optical Pulses.

Dr. Roberta Bondar, Canada's first female astronaut and world's first neurologist in space. 2019. Sustaining the Future of Our Planet and Ourselves. Jointly presented with the University of Saskatchewan Whelen Lecture.

Honourable Kirsty Duncan, Minister of Science and Sport. 2019. Equity, Diversity and Inclusion in Research.

APPENDIX G STUDENT TESTIMONIAL: LARISSA SHASKO



"When I began my journey as a student at Johnson Shoyama in the Master of Public Policy Program in 2017, I knew very little about nuclear-related topics.

Now in the PhD of Public Policy program, and because of the support I've received from the partnership between CSIP and the Fedoruk Centre, my knowledge about the essential role of nuclear energy in solving the climate change crisis has flourished." My Master's thesis, "Blurring Divisions in a Fuzzy World: Innovation, Public Engagement, and Energy Justice," brought citizens and specialists together for deliberative dialogues on the role of small modular reactors (SMRs) as a low carbon energy option. The study sought to address the lack of trust, stakeholder conflict and binary ways of thinking that are creating barriers to the implementation of policy solutions to climate change.

Since 2018, I've been employed as part of a research team on a project called, "Addressing Public Concerns about Their Exposure to Low Doses of Anthropogenic Radiation" where I conducted an extensive literature review, analyzed and helped design surveys, written and presented research findings, and identified priority areas for public engagement. One of the most important research findings from this project is the need for innovative public engagement methods to foster inclusion of youth and women in the process of imagining a future where SMRs are part of the low carbon energy mix. "The opportunities I've had to meet inspiring researchers in the nuclear sector and to work under the supervision of my incredibly knowledgeable supervisors Dr. Margot Hurlbert and Dr. Jeremy Rayner have ignited my passion."

LARISSA SHASKO (PHD STUDENT)

In response, my PhD thesis research looks at how social media and science fiction can help advance youth engagement on radiation, nuclear energy, and climate change. My recent paper at the 2022 Waste Management Symposia called "Zombies, Superpowers, and Apocalyptic Narratives: Novel Approaches to Advance Youth Engagement on Radiation" was a WM2022 Paper of Note Award Winner and a WM2022 Superior Paper Award Winner. I also presented some of my early research in this area as the Keynote Speaker of the Social Sciences and Humanities Nuclear Research Student Forum at the University of Regina in June 2022. My PhD research responds to survey data that indicates the majority of youth from Saskatchewan and Ontario are ambiguous about their support for small modular reactors (SMRs) but are ambivalent toward learning more about nuclear power, radiation, or climate change.

Future deployment of SMRs as a climate change solution depends on inspiring the next generation of STEM and social science researchers to pursue careers in the nuclear energy sector. My research interest in youth engagement was sparked by my experience as a Fellow of the Nuclear Education Skills and Technology (NEST) Framework, an initiative of the Organization for Economic Co-operation and Development (OECD) and the Nuclear Energy Agency (NEA).

In August 2020, I participated in the *Small Modular Reactor* (*SMR*) *Hackathon*. This virtual event featured interactive training sessions to build technical and non-technical knowledge as cross-disciplinary researchers. During the event, we learned about the technical, societal, regulatory and policy elements for deployment scenarios of SMRs, and we worked in teams of three or four students, along with one mentor, to develop a theoretical deployment strategy for a small modular reactor technology. Following this event, I was selected by the NEA to be one of the

first featured NEST Fellows to share my experience about the program at conferences, NEA webinars, and featured interviews on the NEST website. I was also an Invited Speaker at the OECD's Global Nuclear Science and Engineering Commencement, an online event to celebrate and recognize the accomplishments of the graduating class of 2021 within the nuclear science and technology fields.

Through the support of CSIP and the Fedoruk Centre, I've had the opportunity to attend and present at a number of conferences including the Waste Management Symposia in Phoenix, Arizona in both 2019 and 2022, the 2019 International Atomic Energy Agency's Conference on Climate Change and the Role of Nuclear Power in Vienna, Austria, and the 2019 Early Career Researcher Colloquium and Workshop on the Nuclear and Social Science Nexus held by the OECD in Paris, France.

I've also presented at a number of national conferences held both in person and virtually during my time as a student at Johnson Shoyama. Locally, I've presented my research on public perceptions of nuclear technologies in three separate CSIP Research Forums from 2020-2022.

In 2019, I was asked to moderate an interactive event hosted by CSIP and the Fedoruk Centre called *Nuclear Insights: The role radioactivity plays in day to day life.* The opportunities I've had to meet inspiring researchers in the nuclear sector and to work under the supervision of my incredibly knowledgeable supervisors Dr. Margot Hurlbert and Dr. Jeremy Rayner have ignited my passion in pursuing a career in this field.

None of this would have been possible without the support I've received from the partnership between JSGS and the Fedoruk Centre during my time as a graduate student at Johnson Shoyama.

CONTACT INFORMATION

jsgs@usask.ca 🖪 306-966-8509

fedorukcentre.ca schoolofpublicpolicy.sk.ca scienceandinnovationp<u>olicy.ca</u>

PROJECT FUNDED BY:



