

# A SUSTAINABLE PATH

## BUILDING KNOWLEDGE AND COMMUNITY



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# A SUSTAINABLE PATH

## BUILDING KNOWLEDGE AND COMMUNITY

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## MESSAGE FROM THE PROGRAM CHAIR

It is my great pleasure to provide the final report of the NSERC-CREATE Sustainable Engineering in Remote Areas (SERA) Program in my role as SERA Program Committee Chair.

By following the work of this program over several years, I have witnessed the remarkable accomplishments that have been achieved. When this project was designed nine years ago, I was the Department Head of the Civil Engineering Department at Queen's University and provided initial support when the training for the SERA program was incorporated in to one of our graduate courses, CIVL 896. I am very pleased to have assisted this program, which started from a solid foundation with inspiring goals at that time, and that later proved to be unique and of great value in Canada.

When I became the Associate Vice-Principal Research at Queen's University in 2018, I was invited to be the SERA Program Committee Chair, which allowed me to continue to be a part of this project and to contribute to its development. In reading the report, you will understand the magnitude of the SERA program and how it has positively influenced the lives and careers of many students across four universities, and the researchers, industry partners, and Indigenous communities who partnered with them. This wonderful collaboration has allowed SERA to achieve its main purpose: to enhance the education of graduate students by incorporating Indigenous cultural perspectives, sustainability, and the necessary business skills into their traditional engineering research.

I am certain that this program has not only contributed to the

education of graduate students by bringing Indigenous knowledge to engineering and by expanding students' professional skills; it has also touched many lives on a personal level by giving Indigenous students opportunities to engage in research, and non-Indigenous students to connect with Indigenous cultures in significant ways. The memorable learning opportunities created by this program will certainly enhance the professional qualifications of the trainees and, perhaps more importantly, encourage personal growth and reflection on their roles in greater society.

On behalf of the Office of the Vice-Principal (Research), I would like to extend my deepest gratitude to all of the researchers, collaborators, students, and members of the Indigenous communities for making this a remarkable and “one of a kind” project in Canada and for concentrating your efforts in creating a better society for all of us. Congratulations to all of you and my best wishes for the continuation of the ideas developed in this program for the future.

Sincerely,



Dr. Kent Novakowski  
Associate Vice-Principal Research  
Chair, SERA Program Committee

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## MESSAGE FROM THE PROGRAM LEADER

I am very pleased and honoured to present this final report of the NSERC-CREATE Sustainable Engineering in Remote Areas (SERA) program. When I reflect back to ten years ago when we wrote the proposal for the funding for this program, I am thrilled to see how far we have come in that time.

The ideas for the program were to advance sustainable research in both renewable energy and housing, but to do so by capitalizing on work that was initiating at the time at Queen's around Aboriginal Access to Engineering, now known as Indigenous Futures in Engineering. Collaboration with the University of Manitoba with their ground-breaking Engineering Access Program (ENGAP), work with Indigenous communities, and sensing and infrastructure expertise with the Structural Innovation and Monitoring Technologies Resource Centre (SIMTReC), provided a strong foundation. Adding the University of Ottawa and the Royal Military College to the mix built upon existing collaborations and strengthened the expertise of the team.

Initial collaborations with the Assembly of First Nations (AFN) and companies Hatch and Neegan Burnside provided excellent connections to both Indigenous communities and organizations, and we built upon those initial partnerships to expand to over 30 companies and Indigenous communities including Roseau River Anishinabe First Nation, Sagkeeng First Nation, M'Chigeeng First Nation, Akwesasne, Mohawks of the Bay of Quinte, Wiikwemkoong, and Sachigo Lake First Nation.

Overall, the objective of the program was to advance reconciliation, but before that term had become commonplace in Canadian society. The Truth and Reconciliation Commission's report and Calls to Action in 2015 were perfectly aligned with many of the objectives of the SERA program. By that time, we had already introduced an innovative graduate course that incorporated Indigenous issues, sustainability, and business skills into a complete package. Students were exposed to topics such as the effects of residential schools, Indigenous traditional knowledge, and best practices for working with Indigenous communities. As mentioned in quotes in the report, several students remarked on how the program had transformed their understanding of Indigenous peoples in Canada. Furthermore, the program supported the research of 19 Indigenous students (17 undergraduate and 2 graduate) representing 32% of the total trainees in the program.

In closing, I am very proud of what was accomplished as a SERA team with the support of the NSERC-CREATE program, industry sponsors, and Indigenous partner communities. My personal reflection is that I have also gained tremendously in both personal and professional growth through the program, particularly with regard to incorporating Indigenous ways of knowing into the classroom. I will be forever grateful and honoured for having the opportunity presented by the SERA program, and I know that this program has been a catalyst for many initiatives to continue the ideas, activities, research, and collaboration that were intrinsic components of the SERA program.



Rahswahérha Mark F. Green, PhD, PEng  
SERA Program Leader

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## INTRODUCTION

In 2013, an innovative, interdisciplinary program was launched between Queen's University, the Royal Military College, the University of Ottawa, and the University of Manitoba with funding from the NSERC-CREATE program. This program, housed in the Faculty of Engineering, provided graduate students with opportunities to explore concepts of Indigeneity, sustainability, and business through course work, industry placements, and experiential learning.

This program allowed learners to gain hands-on skills through industry partnerships, and more importantly, to work collaboratively with Indigenous communities to identify sustainable solutions for their unique infrastructure and social challenges. At annual four-day workshops, students from across the four universities were able to come together to share their research, engage with academic and industry speakers, and have an opportunity to take part in a sweat lodge ceremony. Many students indicated that the activities and experiences of the workshops were a highlight of the program. For students, the experiential learning aspects of the program were identified as invaluable experiences, which have changed the way that they will engage with Indigenous communities throughout their future careers.

Funding for Sustainable Engineering in Remote Areas (SERA) was provided for six years and expired in 2019. This report shares our lessons learned from program from the perspectives of learners, collaborators, and industry partners, as well as thoughts on how some of the innovative features of this program can be sustained as we move forward.

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learning

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## HISTORY OF THE PROGRAM

In 2012, collaborators at Queen's University, the Royal Canadian Military College, the University of Ottawa, and the University of Manitoba, together with industry and Indigenous partners, envisioned an interdisciplinary program that would weave together Indigenous knowledge and history with sustainable principles and practices including an introduction to business. The overall goal of the program was to enhance the education of graduate students by intertwining technical research with cultural sensitivity, ethics, sustainability concepts, and business skills in a collaborative approach connecting researchers in engineering, science, policy studies, and business to members of industry and Indigenous communities.

With funding provided by the NSERC-CREATE program, these collaborators recognized that they could fulfill a unique need in the higher education landscape. Providing engineering services in northern and remote areas posed, and continues to pose, significant challenges and opportunities for Canada's future. The media coverage of the need for infrastructure and housing in communities such as Attawapiskat when the grant was written, underscored some of the challenges faced by engineering firms when working in the north. Unfortunately, many of those problems still exist today. To meet these development needs, engineering companies require professionals who understand the physical challenges of working in remote areas, as well as the societal and cultural impact of working with Indigenous communities. Until the creation of the NSERC-CREATE Sustainable Engineering in Remote Areas (SERA) pro-

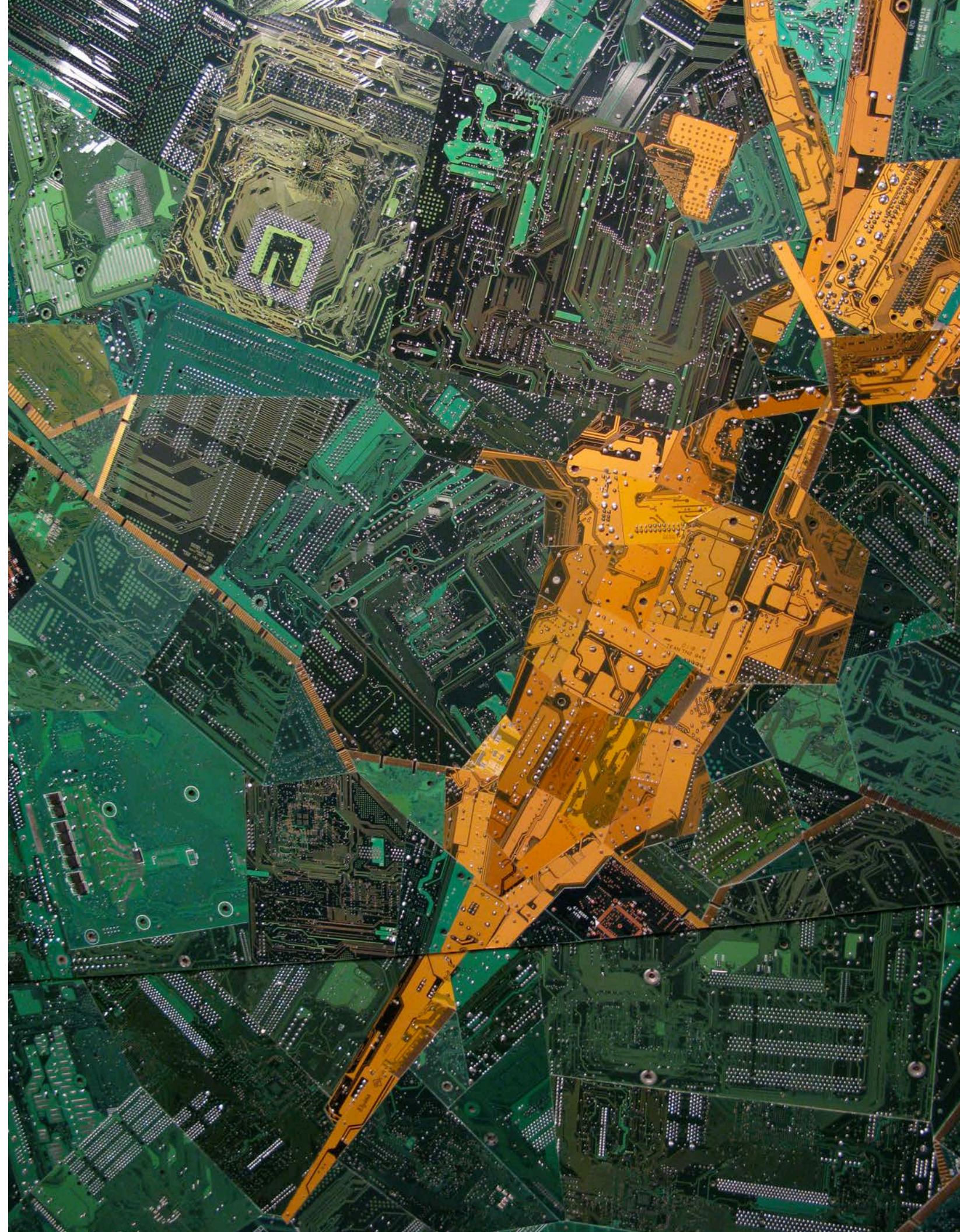
gram, no graduate-level program in Canada had existed to meet that need.

Over the past six years, 7 postdoctoral trainees, 37 graduate students and 16 undergraduate students have participated in the SERA program. Three of the graduate students and all of the undergraduate students were Indigenous. All participants had opportunities to gather annually at a four-day workshop to share ideas and learn from industry and research experts and cultural leaders, and they have had opportunities to participate in cultural events such as a sweat lodge ceremony.

Through participation in CIVL 896 at Queen's (CIVIL 7350 at Manitoba), a foundational interdisciplinary engineering course delivered synchronously to all participating partner institutions, students had opportunities to learn from SERA researchers and guest lecturers. Topics included sustainability, such as sustainable building materials and sustainable forms of energy, business studies (including how to work through a business case), and Indigenous history and concerns, such as the importance of the duty to consult. Assignments for the course were also structured to allow students to pursue and reflect on their own interests related to these topics by asking them to attend an additional two lectures on sustainability and two lectures on Indigenous issues and to submit written reflections on what they learned from those experiences.

Overall, the SERA program's greatest accomplishment was the contribution to reconciliation with Indigenous peoples. This was achieved by educating 19 trainees (32 %) of the total SERA trainees in engineering research, developing and delivering Indigenous curricular content to graduate students at all four universities, and developing partnerships with Indigenous communities (Roseau River Anishinabe First Nation, Sagkeeng First Nation, M'Chigeeng First Nation, Akwesasne, Mohawks of the Bay of Quinte, Wiikwemkoong, and Sachigo Lake First Nation).

Wally Dion  
*Man Changing into Thunderbird (Gut Brain)*, detail, 2010  
72 ½ h x 66 w inches  
circuit boards, plywood, nails.



niigaaan Anishinaabemowin

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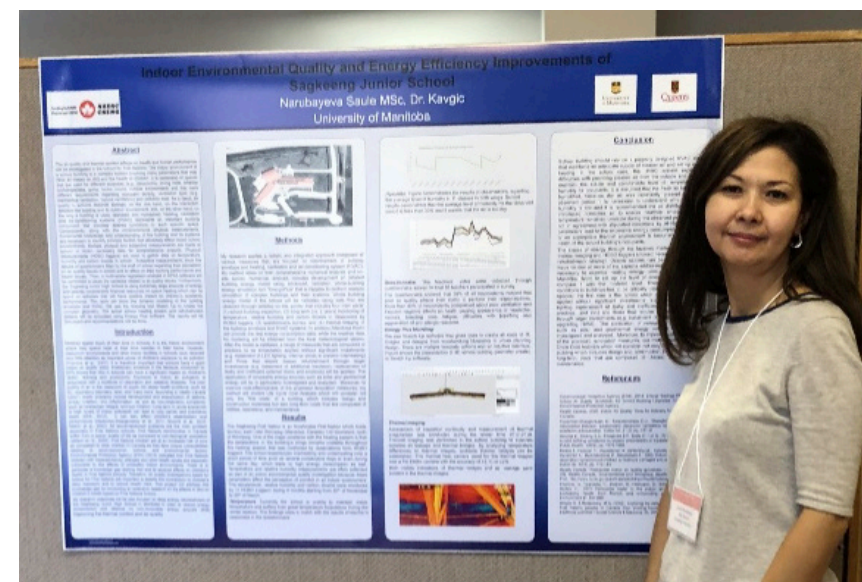
future

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## BUILDING CONNECTIONS

Through the annual workshop and the CIVL 896 course, students from the University of Ottawa, Queen's University, the University of Manitoba, and the Royal Military College came together in person or online to learn together and to have opportunities to share findings from their own research projects with their national colleagues. Bringing students together from multiple institutions created networking and collaboration opportunities amongst the next generation of engineers and interdisciplinary colleagues.

Figure 1: Saule Narubayeva, M.Sc, Graduate student at the University of Manitoba showing her poster during the 2018 SERA workshop.  
(Photo provided by Saule Narubayeva)





*The program content is good and combines practical experience with theoretical experience. The workshops and webinars provide insight into other student research as well as current industry practices.*

*The SERA program was a great opportunity for me to gain knowledge and insight on how sustainability can be actualised in local communities. Although the program specifically states sustainable engineering, it was diversified to a large extent to capture the needs of non-engineering students like myself. I was exposed to several experts within the sustainability field who generously shared their experiences and knowledge with us. The hands-on activities incorporated within the program right from the first few days of the SERA conference and throughout the program were beneficial in enhancing my positive experience with the program. While not a business student, I found it very beneficial to be exposed to various fundamental aspects of business which is relevant for building my career outside the classroom.*

## WITH INDUSTRY

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SERA trainees also had experiential learning opportunities through internships with industry partners. Companies such as Hatch, DNV GL, Building Alternatives, Remasco, Neegan Burnside, and many others have allowed trainees to gain firsthand knowledge and experience by embedding trainees within their projects through internships. Internships were typically four to eight months in length and trainees spent most of their time on site with the companies working on SERA-related projects. Some of the experiences of the trainees are expressed in the following quotes:

*I was hired right after graduation for a very challenging position and have been very involved in helping with tackling the renewable industry challenges on a daily basis. I am happy to report that we have been very successful and our small team of three is regarded as one of the leading teams globally to provide risk assessment services for solar energy projects to lenders and investors.... I was introduced*

*to renewable energies through the SERA program and that is the only reason why 6 years later I am still working in this sector as a professional engineer. More importantly, the SERA program was the main reason I was selected for this position 4 years ago among 300 other applicants while I was a fresh graduate and other applicants had years of experience to offer. In brief, the SERA program was amazing and did wonders for me. I will always be grateful and more than happy to support it with anything I can.*

*SERA program helped me immensely in both funding as well as in providing an intensive understanding of cultural sensitivity, ethics, sustainability concepts through the SERA course and the annual SERA conference. Also, the internship requirement enabled me to get trained under the industry experts and greatly improved my skills in tackling real world engineering problems. I am immensely appreciative of the many opportunities I received through this program.*

*The mandatory internship was very helpful for me as a former student. It helped me to apply my knowledge regarding sustainable energy in industry. My suggestion is that SERA help students find the internship because it is difficult to find a relevant intern position.*

*The SERA program provided a valuable mix of academic, theoretical and practical engineering experience for challenges being faced in remote Indigenous communities. The program encouraged and facilitated direct communication and exposure to industry partners who are working and researching in the field of sustainable engineering in remote areas. The program also included direct experiences and interaction with Indigenous people and communities.*

*This is a very impressive program that has provided me with lots of chances for working and collaborating with people with academic and industrial backgrounds. It helped me gain rich industrial experiences, which directly contributed to my first job in Ciena. I hope this program will continue supporting students and providing them opportunities to expand their academic and industrial connections and put what they've learned into practice.*

## WITH COMMUNITIES

The SERA program developed strong partnerships with several Indigenous communities to encourage sustainable projects within these communities. We formed collaborations with Roseau River Anishinabe First Nation and Sagkeeng First Nation in Manitoba focussed on the development of *Good Building Practice Guidelines* for First Nations Housing in Canada.

The research program was conducted by an interdisciplinary research team from the Universities of Manitoba and Winnipeg and included researchers from Engineering (Drs. D. Polyzois, K. Dick, and M. Alfaro), Education (Dr. E. Polyzois), and Health Sciences (Drs. P. Orr and L. Larcombe). The research was part of a Collaborative Health Research Project (CHRP) funded by the Natural Sciences and Engineering Research Council (NSERC), the Canadian Institutes of Health Research (CHIR), and SERA.

In support of the research project, the Band Council at Roseau River Anishinabe First Nation wrote: “the potential opportunity for our community to participate in a study that will impact generations and possibly forever change housing on-reserve has our community excited. Today, we are in a housing crisis. The greater majority of our homes... have major deficiencies from poor construction and little to no maintenance over the years due to lack of adequate funding.”

The *Good Building Practice Guidelines* have been shared with the Dakota Tipi First Nation and are being considered for possible implementation in the construction of six new prototype ‘small houses’ on both the Roseau River Anishinabe First Nation and the Dakota Tipi First Nation this summer.

Harry Miller from the Dakota Ojibway Tribal Council, with whom we are currently working, indicated that “we have to find an alternate way to build structures on-reserve that use local materials and available man-power, and that resonate with traditional ways of building.”

The *Good Building Practice Guidelines* are available as part of the PhD dissertation of SERA student Patrick Gloux <https://mspace.lib.umanitoba.ca/xmlui/handle/1993/35442>



Figure 2: Sponsored community gathering to obtain feedback regarding the condition of their homes prior to the start of our community-based project.

We also partnered with Focus Forward for Indigenous Youth. Evan Veryard from this group was the keynote speaker for the annual workshop in 2019. Some SERA trainees collaborated with Focus Forward for Indigenous Youth on projects for Indigenous communities such as Akwesasne Community Agriculture and Wiikwemkoong Greenhouse for Change.

*During the brief period I volunteered with Focus Forward, I worked remotely to identify potential sources of funding for renewable energy projects taking place in several Indigenous communities. In addition, I was tasked to identify similar renewable energy initiatives taking place in other Indigenous communities that could serve as reference and help structure the projects Focus Forward was working on. All these tasks were fulfilled during the COVID-19 pandemic, thus there was no opportunity for field visits or opportunities for close interaction with those involved in the project.*

*My internship is design and project management on a variety of civil engineering projects. I've had the opportunity to work on community housing in a fairly remote community which allowed me to use some of the course and research experience.*

*The social aspects of the program focusing on remote communities and indigenous issues really put the engineering we do in perspective (most programs focus only on the technical part of engineering and not the social impacts).*

Figure 3: SERA Post-doctoral trainee Salah Sarhat during the Assembly of First Nations 2017 National Housing and Infrastructure Forum & Tradeshow held in Quebec. (Photo provided by Salah Sarhat)



Wally Dion  
*Thunderbird II*, 2010  
72 h x 55 3/4 w inches  
circuit boards, plywood, nails.



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community

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## BRIDGING DISCIPLINARY AND CULTURAL BOUNDARIES

One of the greatest strengths of our program, and among the most memorable learning opportunities for our students, were the hands-on experiential learning opportunities they received. The first day of the workshop began with trainees participating in the Kairos Blanket exercise facilitated by colleagues at the Four Directions Indigenous Student Centre at Queen's. This experiential learning opportunity provided students with an interactive history of Indigenous Peoples including the major findings from the *Royal Commission on Aboriginal Peoples*, *the Truth and Reconciliation Commission of Canada*, and *the National Inquiry into Missing and Murdered Indigenous Women and Girls*.

*What started out as a 'fun' exercise with lots of storytelling and walking around in circles, soon ended up as a period of anger and enlightenment. I was made aware of the dark periods in Canada's history which I never knew existed.*

Another interactive activity that has consistently provided trainees with opportunities for engagement was through participation in Robert Lovelace's 'the Game.' During each workshop, Mr. Lovelace, an instructor in the Department of Global Development Studies, facilitated a three-hour role-playing game based on his own experiences as a community negotiator.

*The Game illustrated the common experience for communities to sign over their rights, expecting the agreed upon benefits, and not always receiving this result. It also highlighted the idea that a community's bargaining power in negotiations is limited by the re-*

*sources local to the community, or what the community can offer from a Western perspective. The difficulty of dealing with government processes was very apparent throughout the activity, exhibited through the back-and-forth of negotiations, the seemingly overlapping responsibilities of the federal and provincial governments, and the lack of specificity in the responses from the government representatives. As a participant, it always felt as if the community was not receiving enough value in return for what was being given up.*

*The Game highlighted that Canadian governments are designed to deal with other highly bureaucratic, Westernised systems, like businesses and other European-style democratic governments. This way of structuring interaction and negotiation assumes specific forms of capacity, resources, and human and financial capital that have been systematically removed from Indigenous communities by the very government the Game had us negotiating with. My takeaway from the Game, then, is that any effort to work genuinely with Indigenous communities should begin with establishing what that community needs, and how you or your organisation can help them address those needs.*

As part of annual the 4-day workshop, students were also invited to participate in a sweat lodge ceremony. Trainees shared that the experience taught them more about Indigenous culture and caused them to be more self-reflective in their own lives.

*Taking part in the sweat lodge ceremony gave me insight into Indigenous culture that could only be gained through experience. I have read about various ceremonies and their significance over the years, but actually being involved in the ceremony was a completely different experience. This really impressed upon me the significance of ceremony and traditional space in Indigenous culture, as well as the importance of symbolism and the interconnectedness of all things.*

*This ceremony had a huge impact on the vision I have from myself and what are my values in life. This particular experience immersed me and I now reconsider my relationship with my family, my ancestors and nature in itself. In our current society people don't talk about their personal feelings and experiences with oth-*

*ers, except their partner, and it is mostly unknown (or uncommon) how free talks can release everyday pressure and to see everyday life and experiences as a gift and not a duty.*

*Overall, the sweat lodge ceremony taught me not only to understand the respect and the integrity that first nation communities have with the environment but also to appreciate what I have and share it with others. Moreover, it opened my eyes to acknowledge indigenous knowledge and ceremonies in the community I grew up.*

These experiential learning opportunities provided trainees the chance to reflect on their position as future leaders in their fields and the ways that they may impact Indigenous communities, positively or negatively, through colonial practices or through collaboration.

By allowing trainees to pursue individual interests through authentic experiences and lectures in Indigenous and sustainability issues, the program fostered a sense of curiosity and life-long learning through the flexibility of individualized student experiences.

The SERA program also provided multiple opportunities for the trainees to build their communication skills. Enhancement of presentation skills was one of the main objectives targeted by the SERA program. The annual SERA workshop was the venue where SERA trainees acquired the skills they needed in delivering effective and engaging presentations to a variety of audiences. During these workshops, trainees were required to deliver an individual one-minute presentation summarizing their projects. In addition, trainees presented their research projects through posters to the workshop audience in the poster sessions and during the industry showcases. Many trainees have arranged and secured their industry internship after effective communications to the industry partners attending the industry showcase.

SERA summer biweekly virtual sessions were another opportunity for the trainees to enhance their communication skills by asking questions, sharing feedback, and engaging in critical scientific discussions with the speaker guests and other trainees. Finally, SERA trainees were encouraged and financially supported to participate in First Nations assemblies and conferences where trainees had the opportunity to meet and communicate with First Nations' community members, industry partners, and official decision-makers.

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sustainability

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## SERA DESIGN COMPETITION

The objective of the SERA design competition was to prepare the trainees to apply their engineering knowledge to solve some of the real problems encountered by the First Nation communities. SERA postdoctoral fellow Martin Noel drafted the 2016 design competition. The competition was for designing a sustainable energy solution for the Weenusk First Nation community located in northern Ontario. The community is off-grid and currently relies on diesel generators. In addition, there is no year-round road access, which results in higher costs of transportation. The trainees were asked to form three competing groups. The members of the winning team were Kyle Beaudry, Luke CoDyre, Manoah Gutknecht, Kenneth Mak, and Sarah Seitz.

The 2018 design competition focussed on designing an off-grid sustainable system to provide power to the Kentehke Longhouse in the Tyendinaga community by employing at least one of the renewable energy sources: solar energy, wind energy, or biomass energy. SERA postdoctoral fellow Salah Sarhat drafted the competition in collaboration with Tyendinaga community members. All active trainees were asked to form groups based on criteria that assure members of each group come from different participating institutions (Queen's, Manitoba, Ottawa, RMC) and studying different disciplines (Mechanical Eng., Civil Eng., Science, and Geography). A committee of industry partners, Tyendinaga community members, and SERA postdoctoral fellows Salah Sarhat and Hamzeh Hajiloo judged the presentations and the final reports. The members

of the winning team were Gabriella Vojtila (Queen's), Emma Keeler (Queen's), Saule Narubayeva (Manitoba), Maryam Saaly (Manitoba), and Asif Khan (Manitoba). The winning team studied different renewable energy alternatives to power the Longhouse. The best alternative was chosen based on engineering practices, economic analysis, and power production. The team proposed that the Longhouse be completely operated through solar PV panels (with backup battery) for heating and electricity. This would ensure that the year-round minimum required room temperature feature would be met. Interestingly, besides performing the design, the team constructed a financial plan to help the Tyendinaga community install and operate the suggested proposed system. This financial plan included information about various provincial/federal funds and the requirements of these funds. Figure 4 shows the summary slides of the report from the winning team.

Figure 4: Submission summary for the SERA design competition from the competition winners, 2018. (Photo provided by Salah Sarhat)

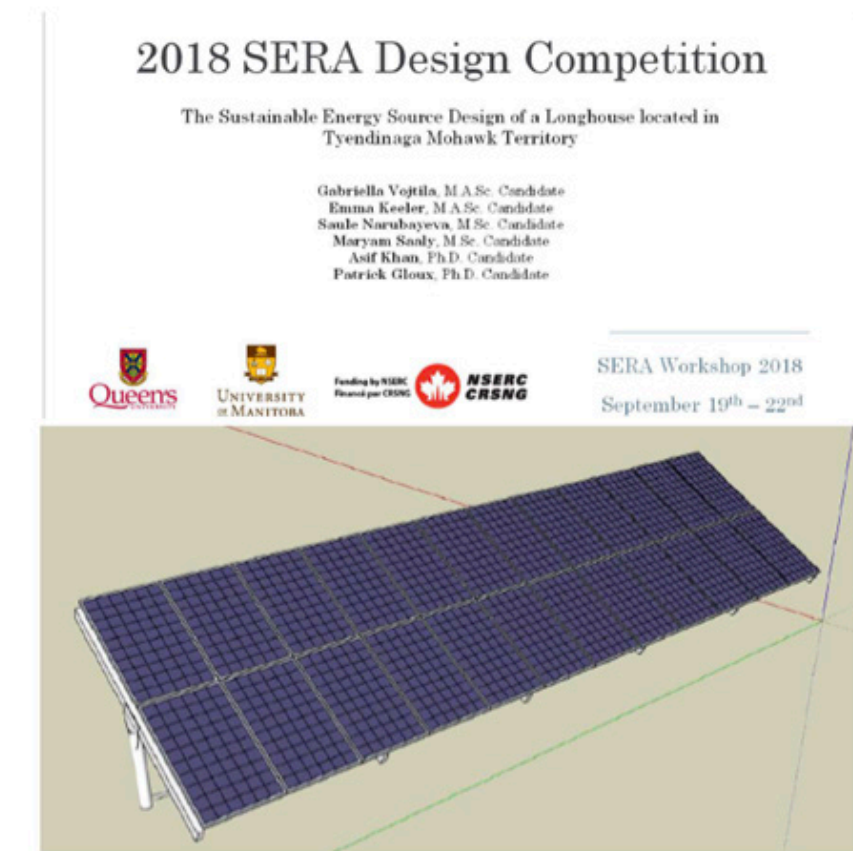


Figure 4: Solar array [4].

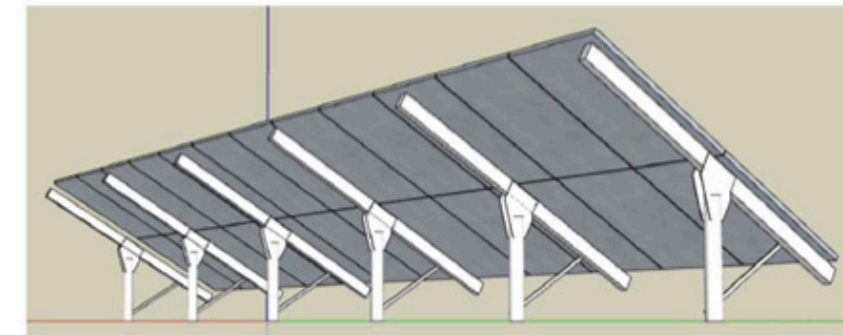


Figure 5: Back structure configuration [4].

Economic Analysis	Project Summary		
	Solar option	Solar+biomass option	Solar option
Purchase value (solar+battery)	15,000.00	15,000.00	15,000.00
Cost of biomass generator		17,100.00	
Cost of wood pellets		2,000.00	
Financing	0.00	0.00	5,000.00
NPV	-369.07	2,641.14	210.77
Payback period	23	6	15
Discount rate (%)	9	9	9

# kiskinwahamāsowin gikinoomaagozi learning

Cree  
Anishinaabemowin

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## CREATING IMPACT

A key component of the SERA CREATE training program was its inclusion of professional development as a deliverable of the CIVL 896 course. Trainees met with the program co-ordinator to discuss their future career goals and to identify areas in which they would like to gain new professional skills or strengthen existing skills that would help them to meet their goals.

The program co-ordinator helped them to identify professional development resources on their campuses and in their communities that were accessible for students. Based on this conversation, trainees developed individualized learning plans and committed to attending at least 10 learning opportunities in their identified skill areas. At the end of the course, trainees submitted a professional development portfolio that included their CVs and any certifications they had achieved.

Gaining professional development skills while in graduate studies provided SERA trainees with an employment advantage over students leaving programs with only technical knowledge. By requiring the professional development portfolio as a course deliverable, trainees left the course with the foundation of a living document that they could continue to update and adapt throughout their careers.

The business skills module provided as part of the CIVL 896 course introduced trainees to basic principles in business, including how to write and analyze case studies. Having these basic business skills allows them to understand multiple project roles and perspectives outside of their own.





Figure 5 (left): SERA program booth with Salah Sarhat (Post-doctoral trainee, Queen's University) and Adnan El Mekdah (PhD trainee, Queen's University) at the Assembly of First Nations 2017 National Housing and Infrastructure Forum & Tradeshow held in Quebec (Photo provided by Salah Sarhat) Figure 6 (right): Dr. Mark Green (SERA program leader) and Salah Sarhat (Post-doctoral trainee) at the Assembly of First Nations 2017 National Housing and Infrastructure Forum & Tradeshow held in Quebec (Photo provided by Salah Sarhat)

*I really enjoyed the Business module. I learned way more than what I expected as an engineer.*

*The SERA program helps students to focus on the connections between theory and practice.*

*I believe the messages and perspectives the SERA program aims to teach its trainees are very important, and I feel that the program has opened my eyes to so many issues and considerations I was not familiar with, particularly in working with Aboriginal communities.*

*I have also met with many industry people which will enable me to pursue better professional life in future.*

*I am very thankful to have been part of the SERA program, it opened my mind on so many levels and made me conscious of deeply rooted issues in Canada (which is important as an international student). I am very thankful to the Prof. Mark Green and the SERA team for organizing the workshop and especially for including more than just a conference-style workshop. The visit in Indigenous communities, the opportunities to go in the sweat*

*lodge, hear their stories and experiences, all of that is priceless to me and I can't thank you all enough for that. I am comfortable saying that the SERA program made me a better person, a more conscious and open-minded person and I wish there were more programs like this in the country.*

*The involvement in the CREATE SERA program allowed me to gain extensive scientific and technical knowledge and expertise about sustainable, high-performance buildings, different energy efficiency strategies, and renewable energy systems that can help solve the problems of energy, sustainability and development in remote areas and First Nations communities. The program provided the gaining of deep knowledge and understanding about renewable energy systems that have great potential in northern communities such as solar energy and biomass through the project. Moreover, I learned more about Indigenous culture and sustainability standards as well as about Canadian history from First Nations communities. I also improved soft skills and advanced my future career through professional development that included both training and an industry internship. The internship allowed me to work with an industry partner in order to gain practical, real-world experience.*

Figure 7: Douglas Tomlinson (Post-doctoral trainee, Queen's University), Hamid Gerami (MAsc trainee, University of Manitoba), Manoah Gutknecht (MAsc trainee, Queen's University) at the Assembly of First Nations 2016 Forum & Tradeshow in BC (Photo provided by Salah Sarhat)



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ohén:ton yohawíhton  
Kanyen'ke:ha  
future

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## CONTINUITY OF THE PROGRAM

The main training continues because it is part of a graduate course (CIVL 896) at Queen's University. Since this course is one of the few graduate courses at Queen's that includes significant Indigenous content, it represents part of Queen's commitment to increase Indigenous content in all programs as expressed in the Queen's Truth and Reconciliation Commission Task Force (TRC) report. The Indigenous module of CIVL 896 may be adapted by other programs (e.g., some undergraduate engineering programs) to incorporate Indigenous content into programs in response to the recommendations of Queen's TRC Task Force. The SERA program has developed the Indigenous content in collaboration with Queen's Four Directions Indigenous Student Centre and this partnership will expand in effectiveness now that Queen's has implemented a new Office of Indigenous Initiatives led by SERA collaborator Janice Hill.

For research, we have also been working with Jim Gallant of Remasco and Sachigo Lake First Nation to support the community's housing and renewable energy needs. The focus of Sachigo's continuing efforts to collaborate with Queen's University lies in their two-pronged strategic goal to sustainably develop both their local natural resources and community infrastructure (including housing) to leverage many existing community economic development opportunities. Sachigo wants to develop its local resources on a sustainably small-scale to preserve their sacred land (aki) and water (nibi) while learning to broaden and deepen its community infrastructure operations, maintenance, and administration capabilities.

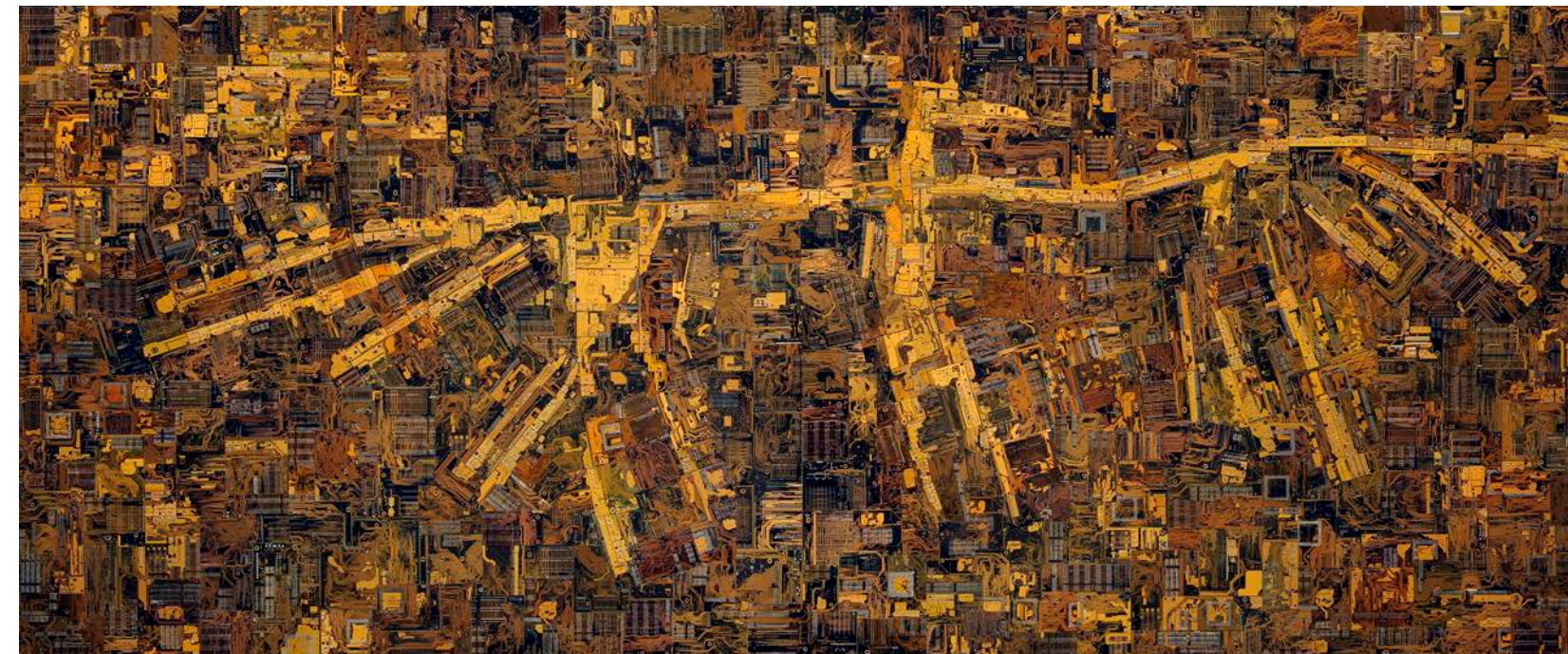
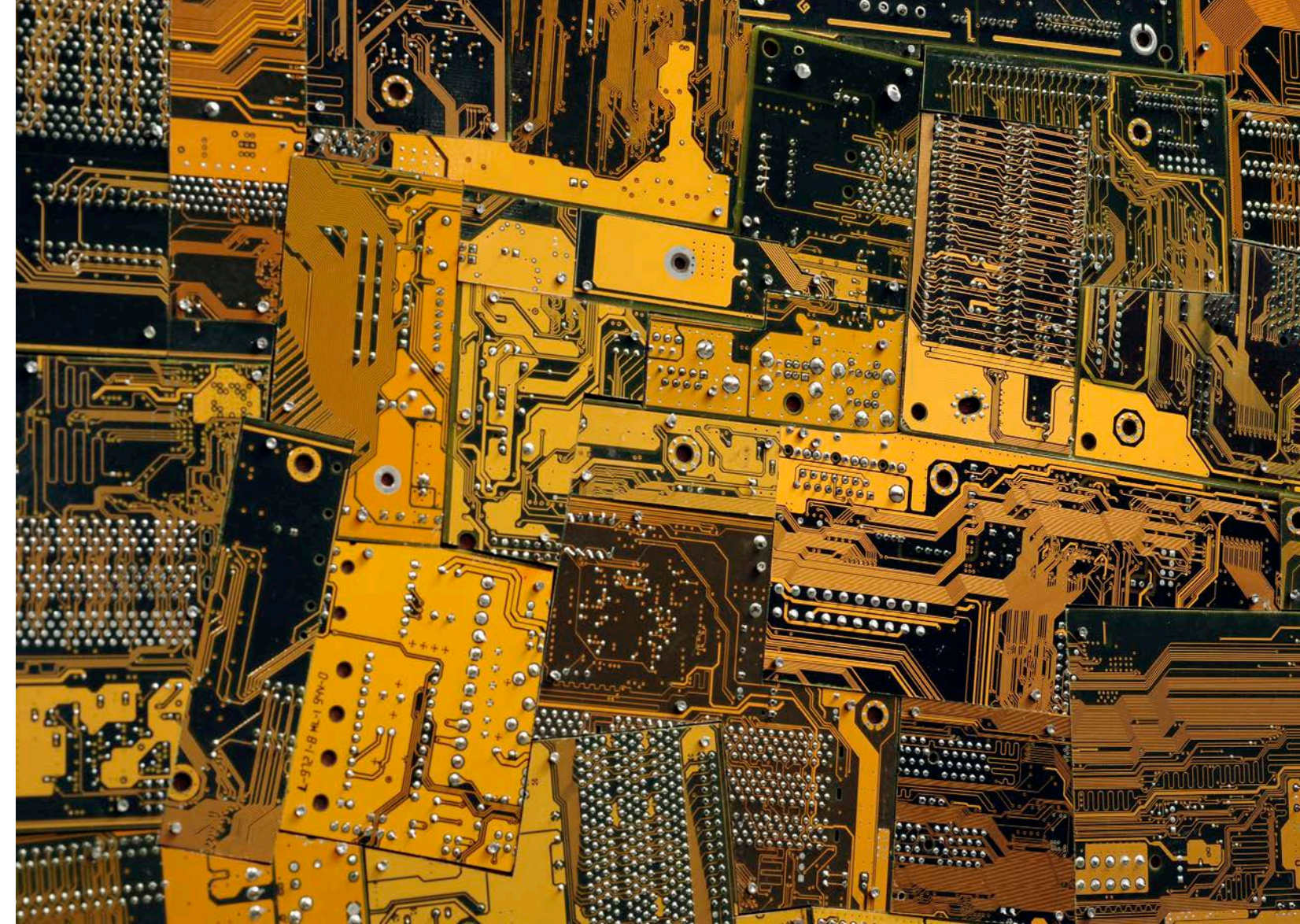


Figures 7, 8, 9: The photos above are three shots from different angles of the same home in Sachigo, taken during a community visit. The home is inhabited and intended to show both a typical home design/vintage/ construction as well as their typical state of disrepair. (Photos provided by Jim Gallant)

The more Sachigo can do itself, the less it will be dependent on costly and wasteful external contractors and government agencies. This is the only way Sachigo believes it will eventually be able to achieve real community autonomy and independence while simultaneously creating more education, apprenticeship, and job opportunities for its own community members.

The projects currently under assessment by the community include small-scale forestry/milling, lumber kiln drying, new home construction, prefabricated exterior wall modules for residential energy retrofits, community greenhouses, clustered district heating system, and light metal manufacturing.

Wally Dion  
*Thunderbird*, 2008  
 47 7/8 h x 116 1/2 w x 3 7/8 d inches  
 circuit boards, plywood, nails.  
 Image courtesy: Don Hall



oodenaawin Anishinaabemowin  
māmawī wīkiwin Cree  
community

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## CONFERENCE PRESENTATIONS

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- Alguhi, H., & Tomlinson, D.G. (2019, June 12-15). *Evaluation of Steel Fibre Reinforced Concrete Beams under Ultimate and Serviceability Limit States*. 6<sup>th</sup> Engineering Mechanics and Materials Specialty Conference, Laval, QC, Canada.
- Al-Jaaidi, A., & Tomlinson, D. G. (2019, June 12-15). *Assessment of Repair Techniques for GFRP Reinforced Bridge Barriers using Vector2*. CSCE General Conference, Laval, QC, Canada.
- Baker, C., Gao, S., Chen, L., & Bao, X. (2017, May 14-19). *Pulse-induced permanent group-velocity matching in a dual-core As<sub>2</sub>Se<sub>3</sub>/PMMA fiber*. Conference on Lasers and Electro-Optics, San Jose, CA, United States.
- CoDyre, L., Mak, K., & Fam, A. (2016, December 14-16). *The Effect of Foam Core Density on Flexural Behaviour of Sandwich Panels with Flax-FRP Skins*. 8<sup>th</sup> International Conference on Fibre-Reinforced Polymer (FRP) Composites in Civil Engineering (CICE 2016), IIFC, Hong Kong, China.
- CoDyre, L., Mak, K., & Fam, A. (2017, July 19-21). *Axial Performance of Natural Flax-Skinned FRP Sandwich Panels with Varying Slenderness Ratios*. 6<sup>th</sup> Asia-Pacific Conference on FRP in Structures (APFIS 2017), IIFC, Singapore.
- El Makdah, A., et al. (2020, November 23-26). *On the scaling of unsteady rotors: Lessons learned from samara seeds*. 18<sup>th</sup> International Symposium on Transport Phenomena and Dynamics of Rotating Machinery (ISROMAC), Virtual meeting.

- Fam, A., & Mak, K. (2016, December 14-16). *Bio-based FRP composites – do they have a place in construction?* 8<sup>th</sup> International Conference on Fibre-Reinforced Polymer (FRP) Composites in Civil Engineering (CICE 2016), IIFC, Hong Kong, China.
- Gao, S., Baker, C., Chen, L., & Bao, X. (2018, May 13-18). *Temperature-sensitivity enhancement in a tapered dual-core As<sub>2</sub>Se<sub>3</sub>-PMMA fiber with an antisymmetric long-period grating*. Conference on Lasers and Electro-Optics, San Jose, CA, United States.
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- Hajiloo, H., Gales, J., Noël, M., & Green, M. (2015, June 28-30). *Material Characteristics of Glass Fibre Reinforced Polymer (GFRP) Bars at High Temperature*. 5<sup>th</sup> International Workshop on Performance, Protection & Strengthening of Structures under Extreme Loading, East Lansing, MI, United States.
- Hayles, M., Sanchez, L., & Noël, M. (2017, October 2-4). *Eco-Friendly Recycled Concrete Aggregate Mix for Structural Applications*. 10<sup>th</sup> ACI/RILEM International Conference on Cementitious Materials and Alternative Binders for Sustainable Concrete, Montreal, QC, Canada.
- Keeler, E., Sarhat, S., Yusuf, M., & Green, M. (2019, June 12-15). *Mechanical Properties of on-site Manufactured Compressed Earth Blocks*. 7<sup>th</sup> International Conference on Engineering Mechanics and Materials, Laval, QC, Canada.
- Leclair, I., & Noël, M. (2020, May 27-30). *Mechanical properties of bamboo after exposure to freeze-thaw cycles*. 8<sup>th</sup> International Materials Specialty Conference, CSCE Annual Conference, Saskatoon, SK, Canada.
- Mak, K., & Fam, A. (2016, August 22-24). *Bio Resins and Bio Fibers for FRP Applications in Structural Engineering Applications*. 7<sup>th</sup> International Conference on Advanced Composite Materials in Bridges and Structures (ACMBS-VII), CSCE, Vancouver, BC, Canada.
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- Mak, K., Fam, A., & MacDougall, C. (2014, May 28-31). *Flax fibre composite sandwich panels for structural applications*. 4<sup>th</sup> International Structural Specialty Conference, CSCE, Halifax, NS, Canada.
- Mak, K., Maracle, O., & MacDougall, C. (2015, August 10-13). *Effect of Cement, Lime and Bioresin Stabilizers on Compressed Earth Block Performance*. 16<sup>th</sup> International Conference on Construction for Sustainability, Green Materials & Technologies (NOCMAT 2015), NOCMAT, Winnipeg, MB, Canada.
- Mak, K., McSwiggan, C., & Fam, A. (2016, December 14-16). *Short and Long Term Performance of CFRP Laminate Produced Using Furfuryl Alcohol Bio Resin for Concrete Retrofitting*. 8<sup>th</sup> International Conference on Fibre-Reinforced Polymer (FRP) Composites in Civil Engineering (CICE 2016), IIFC, Hong Kong, China.
- Mirzazadeh, M. M., Noël, M., & Green, M. (2016, June 1-4). *The Effect of Low Temperature on the Shear-Fatigue Performance of Reinforced Concrete Beams*. Canadian Society for Civil Engineering (CSCE) Annual Conference, London,

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- Mirzazadeh, M. M., Noël, M., & Green, M. (2017, April 11-13). *Non-Linear Finite Element Analysis of Reinforced Concrete Beams with Temperature Differentials*. AEI 2017 Conference by American Society of Civil Engineers (ASCE), Oklahoma City, OK, United States.
- Mirzazadeh, M. M., Noël, M., & Green, M. (2017, April 6-8). *Fatigue Behavior of Reinforced Concrete Beams with Temperature Differentials at Room and Low Temperature*. Structures Congress 2017 by American Society of Civil Engineers (ASCE), Denver, CO, United States.
- Mirzazadeh, M. M., Noël, M., & Green, M. (2017, April 6-8). *Performance and Accuracy of Fibre Optic Sensors and Digital Image Correlation in Measuring Strain and Crack Widths of Concrete Structures*. Structures Congress 2017 by American Society of Civil Engineers (ASCE), Denver, CO, United States.
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- Mirzazadeh, M., Noël, M., & Green, M. (2017, April 11-13). *Non-Linear Finite Element Analysis of Reinforced Concrete Beams with Temperature Differentials*. Architectural Engineering Institute Conference, American Society for Civil Engineers, Oklahoma City, OK, United States.
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- Noël, M. (2018, July 22-25). *Composites in Construction: A Canadian Experience*. 4<sup>th</sup> Brazilian Conference on Composite Materials, Rio de Janeiro, RJ, Brazil.
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- Noël, M., Sanchez, L., & Fathifazl, G. (2016, August 7-11). *Recent Advances in Sustainable Concrete for Structural Applications*. 4<sup>th</sup> International Conference on Sustainable Construction Materials and Technologies, Las Vegas, NV, United States.
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- Roshan, A., Martin-Perez, B., & Noël, M. (2017, May 31-June 3). *Different Approaches to Model Cover Cracking of RC Structures due to Corrosion*. 6<sup>th</sup> International Conference on Engineering Mechanics and Materials, CSCE Conference, Vancouver, BC, Canada.
- Sanchez, L. F. M., Noël, M., & Santos, V. A. A. (2018, July 9-13). *Techniques to rehabilitate bridge columns affected by alkali-silica reaction (ASR)*. 9<sup>th</sup> International Conference on Bridge Maintenance, Safety and Management, Melbourne, Australia.
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- Sanchez, L., Fournier, B., Jolin, M., Bastien, J., Mitchell, D., & Noël, M. (2016, July 3-7). *The Use of the Damage Rating Index (DRI) For the Condition Assessment of Aging Distressed Concrete*. 15<sup>th</sup> International Conference on Alkali-Aggregate Reaction, Sao Paulo, SP, Brazil.
- Sanchez, L., Noël, M., Fathifazl, G., & Damineli, B. (2016, May 15-18). *Recent Advances on the Use of Sustainable Structural Concrete: A Materials Perspective*. 11<sup>th</sup> International Concrete Sustainability Conference, Washington, DC, United States.
- Sarhat, S., & Green, M. (2016, October 28-30). *Sustainable Engineering in Remote Areas: A Canadian Approach*. 1000 thousand Islands Energy Research Forum, Alexandria Bay, NY, United States.
- Sarhat, S., & Green, M. (2017, June 7-9). *Effect of Elevated Temperatures on the Shear Transfer Strength of Concrete: A Review*. International Fire Safety Symposium, Naples, Italy.
- Shahi, M., & Tomlinson, D. G. (2018, June 13-16). *Behaviour of Fibre Reinforced Polymer Reinforced Concrete Beams with Fibre Mesh Shear Reinforcement*. 6<sup>th</sup> International CSCE Structures Specialty Conference, Fredericton, NB, Canada.

- Terra, M.A., Pereira Junior, R.A., Sanchez, L.F.M., & Noël, M. (2018, July 9-13). *The use of machine learning techniques to assess damage in concrete infrastructure*. 9<sup>th</sup> International Conference on Bridge Maintenance, Safety and Management, Melbourne, Australia.
- Tomlinson, D. G., & Fam, A. (2017, July 19-21). *Response of Flax-FRP Skinned Foam Cored Tubes to Axial Loads*. Asia-Pacific Conference on FRP in Structures, Singapore.
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- Tomlinson, D. G., & Fam, A. (2017, July 19-21). *Effect of FRP Connector Size and Insertion Angle on Shear Transfer in Precast Concrete Insulated Wall Panels*. Asia-Pacific Conference on FRP in Structures, Singapore.
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- Woltman, G., Hanna, M., Tomlinson, D. G., & Fam, A. (2011, July 20-22). *Thermal Insulation Effectiveness of Sandwich Concrete Walls with GFRP Shear Connectors for Sustainable Construction*. Conference on Durability of Composites for Construction, Quebec City, Canada.
- Woltman, G., Tomlinson, D. G., & Fam, A. (2010, September 27-29). *A Comparative Study of Various FRP Shear Connectors for Sandwich Concrete Walls*. 5<sup>th</sup> International Conference on FRP Composites in Civil Engineering, Beijing, China.
- Wootton, N., Sarhat, S., Fam, A., & Green, M. (2018, July 31-August 3). *Static and Cyclic Performance of Laboratory-scale Replicas of a GFRP-Reinforced Concrete Monorail Guideway Beam*. 10<sup>th</sup> International Conference on Short and Medium Span Bridges, Quebec City, QC, Canada.
- Wu, Z., Tomlinson, D. G., & Cruz-Noguez, C. (2019, June 12-15). *Behaviour of 27-year old Prestressed Concrete Bridge Girders*. CSCE General Conference, Laval, QC, Canada.
- Xu, Y., Xiang, D., Ou, Z., Gao, S., & Bao, X. (2015). *Novel bi-pumped Brillouin random fiber laser and its applications*. Schawlow-Townes Symposium: Poster Session, Ottawa, ON, Canada.
- Yousuf, S., Shammeh, S., Asirvatham, D., Dadsetan, S., Sanchez, L., Noël, M., Grazia, M., & Ziapourrazlighi, R. (2017, October 2-4). *The use of low cement structural concrete as a sustainable alternative for civil industry*. 10<sup>th</sup> ACI/RILEM International Conference on Cementitious Materials and Alternative Binders for Sustainable Concrete, Montreal, QC, Canada.
- Yusuf, M., St-Onge, P., Sarhat, S., & Green, M. (2019, June 5-7). *Shear Transfer Strength of Concrete made with Recycled Concrete Aggregate after Exposure to High Temperatures*. 3<sup>rd</sup> International Fire Safety Symposium, Ottawa, ON, Canada.
- Zhang, L., Wang, Y., Xu, Y., Gao, S., Saxena, B., Chen, L., & Bao, X. (2017, May 14-19). *Multi-wavelength Coherent Brillouin Random Fiber Laser with High Optical Signal-to-Noise Ratio*. Conference on Lasers and Electro-Optics, San Jose, CA, United States.
- Zhang, L., Wang, Y., Xu, Y., Gao, S., Zhou, D., Chen, L., & Bao, X. (2018, May 13-18). *Coherent Brillouin Random Fiber Laser for Application in Phase-sensitive Optical Time Domain Reflectometry*. Conference on Lasers and Electro-Optics, San Jose, CA, United States.



Wally Dion, Yellow Quill Reserve SK (Saulteaux) 1976  
*Seated Thunderbird*, 2015. Circuit boards on plywood, nails, acrylic medium and pigment. 104.0 x 122.0 x 5.7 cm.  
Purchase, Art Centre Acquisitions Trust, 2015. Accession number 58-011

Wally Dion finds his inspiration in ancient and historical depictions of Thunderbird, animikiig, which was the most powerful of all the spirit beings in Anishinaabe cosmology. By rendering the Thunderbird from discarded computer circuit boards, the artist contends that Indigenous spirit beings not only inhabit our contemporary world, but also will outlast technology. The artist is attracted to the zigzagging conductive tracks of the circuit board because they resemble bolts of lightning, while copper, the main element used in the electronic components, has a spiritual and historical link with the peoples of the western Great Lakes.

Artist's Statement: These are the Thunderbirds. They have existed in the past and continue their existence today. For thousands of years, people have fashioned mythologies in an attempt to understand the power and significance of the Thunderbird. Viewed collectively as fossils, or as living prophecy, Thunderbirds are pulled from the tar sands of Northern Alberta, hydro-fracked from the bed rock of the Marcellus Shale and resurrected from the uranium mines of Northern Saskatchewan to live again among human beings.



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