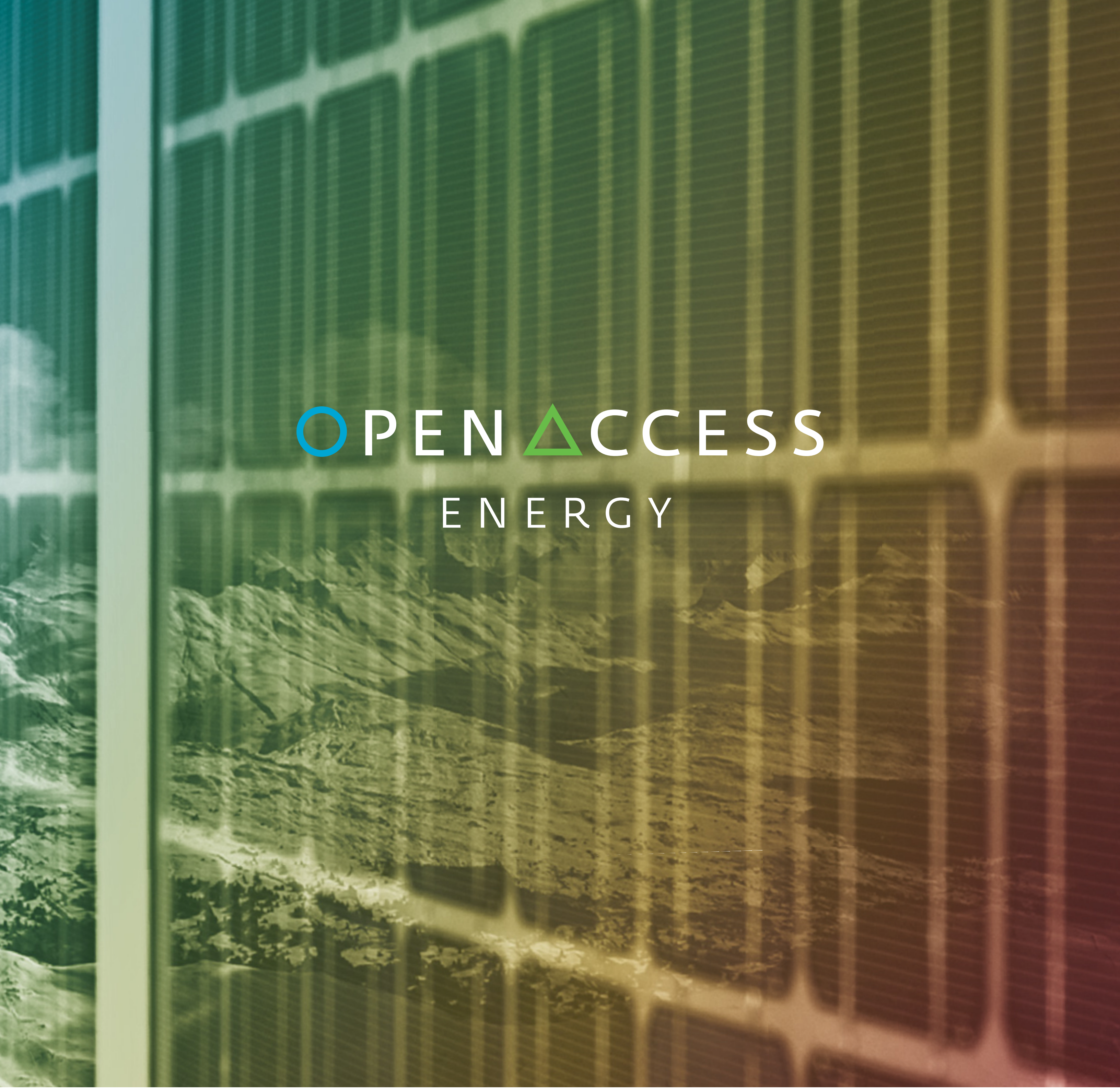

COP22 Brief

Power to change the world

WGSI

Waterloo Global Science Initiative

PERIMETER INSTITUTE FOR THEORETICAL PHYSICS

UNIVERSITY OF WATERLOO

Contents

Founded in 2009, Waterloo Global Science Initiative (WGSI) is a non-profit partnership between Perimeter Institute for Theoretical Physics and the University of Waterloo, a pairing that has previously resulted in the distinguished Perimeter Scholars International program and the University of Waterloo's pioneering Institute for Quantum Computing. The mandate of WGSI is to promote dialogue around complex global issues and to catalyze the long-range thinking necessary to advance ideas, opportunities and strategies for a secure and sustainable future through our Summit Series, Blueprints and Impact Activities.

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Recommendations for global action on energy access

The aim of the Waterloo Global Science Initiative (WGSI) is to foster connections and strategic partnerships between individuals and organizations positioned to deliver effective solutions to pressing global problems where science and technology will play a key role.

In 2015, WGSI chose to focus on the global energy access challenge framed in the UN's Sustainable Development Goal 7.[1] It is a multifaceted problem with a diverse array of possible solutions and persistent challenges. Meeting SDG 7 requires the deployment of novel, affordable and robust energy technologies and implementation models to meet the needs of the over one billion individuals globally who currently have no access to electricity.[2]

By convening OpenAccess Energy – a summit of experts and influencers – to identify knowledge gaps and challenge assumptions, we have narrowed down the problem space and indicated areas where creative global alliances can make a real difference. Our chosen focus is opening access to decentralized low-carbon electricity, an opportunity to bring profound change to the lives of a significant number of people.

As a result of our ongoing research and discussions, we suggest three necessary actions to remedy this situation:

1. Establish an enabling environment

Governments working, where appropriate, with supra-national finance organizations such as the IMF and the World Bank, need to remove barriers to progress. Currently, the off-grid space, which is vital for establishing universal electricity access, is not a priority of most regulatory authorities and is largely left to fend for itself in terms of economics, planning and regulation.[3]

We recommend state actors establish a coherent regulatory environment, including certification and quality standards, that levels the energy "planning field," thus allowing innovative off-grid energy access solutions to reach their full potential. Those seeking to implement energy access also need governments and large financial institutions to make the financial environment more conducive to establishing a truly global energy market. A host of measures, from reducing import tariffs on equipment and standardizing funding application procedures to educating lenders about the risks and benefits of energy access programs will open energy access opportunities.

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2. Create demand for energy access

Scalable sustainable energy infrastructure and supply relies on the economics of demand. However, populations currently deprived of energy access are often unaware of the benefits that new technologies can bring to their communities, and thus, no demand exists.

Governments and NGOs can work together to change this situation with three clear strategies. First, implement community energy education that informs end-users of the value of energy. This public-private endeavour can piggyback on existing resources from sectors such as healthcare and education that are co-reliant on energy access. Previous consumer awareness campaigns of this type have proven extremely effective at driving demand for, and trust in, new technologies such as solar lanterns and solar home systems. Second, create "energy champions." These individuals make the potential benefits clear to their communities, explore the necessary technical issues and encourage suppliers to take up the market opportunity thus created. Third, establish links between remote, isolated and Indigenous communities. This increases their awareness of opportunities, solution-developing capabilities and buying power.

3. Scale and sustain the electricity market

A successful energy access initiative is one that becomes self-sustaining, and follows a model that can be scaled or replicated. This will require an ecosystem of trained technicians and entrepreneurs, researchers developing appropriate technology, and – perhaps above all – a strong multi-directional flow of data on issues such as consumers' energy use, financial status and future demand.

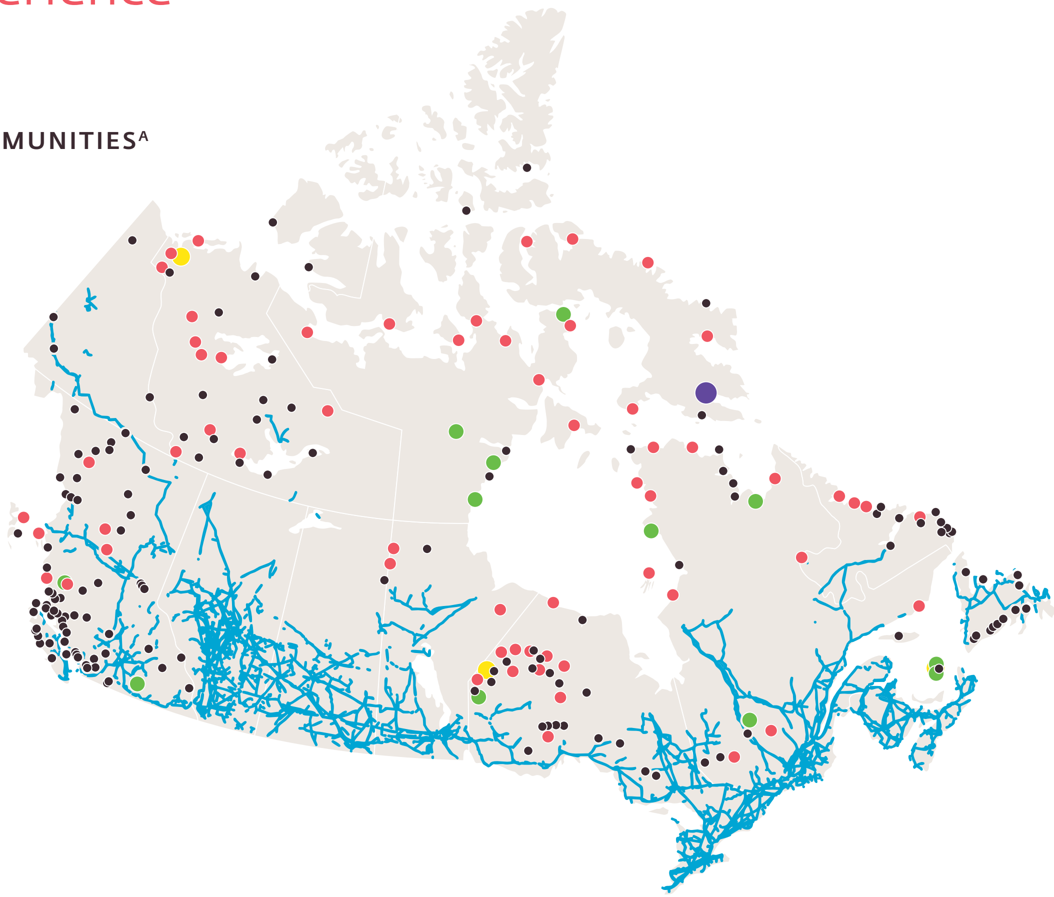
We recommend that governments partner with communities where energy access remains a challenge to provide education and training. We also recommend that governments and NGOs provide assistance to establish businesses that generate and collect energy-related data. Finally, we recommend that academic researchers establish and enforce a new focus on user-centric design in the energy access sphere, ensuring demonstrable and proven value for the end-user. Research programs should work in explicit partnership with individuals from affected communities creating a dynamic exchange of in-field and in-lab expertise.

In the next section, we will explore how these recommendations apply to remote communities in Canada, a vast majority of which are Indigenous communities.

1. UN. (2015). Sustainable development goals. United Nations.
2. IEA. (2014). Scenarios and projections. International Energy Agency.
3. Bazilian, M. et al. (2010). Understanding the scale of investment for universal energy access. Geopolitics of Energy 32, (10 – 11), 19 – 40.

Accessing energy – the ongoing Canadian experience

CANADA'S REMOTE COMMUNITIES[A]



Introduction

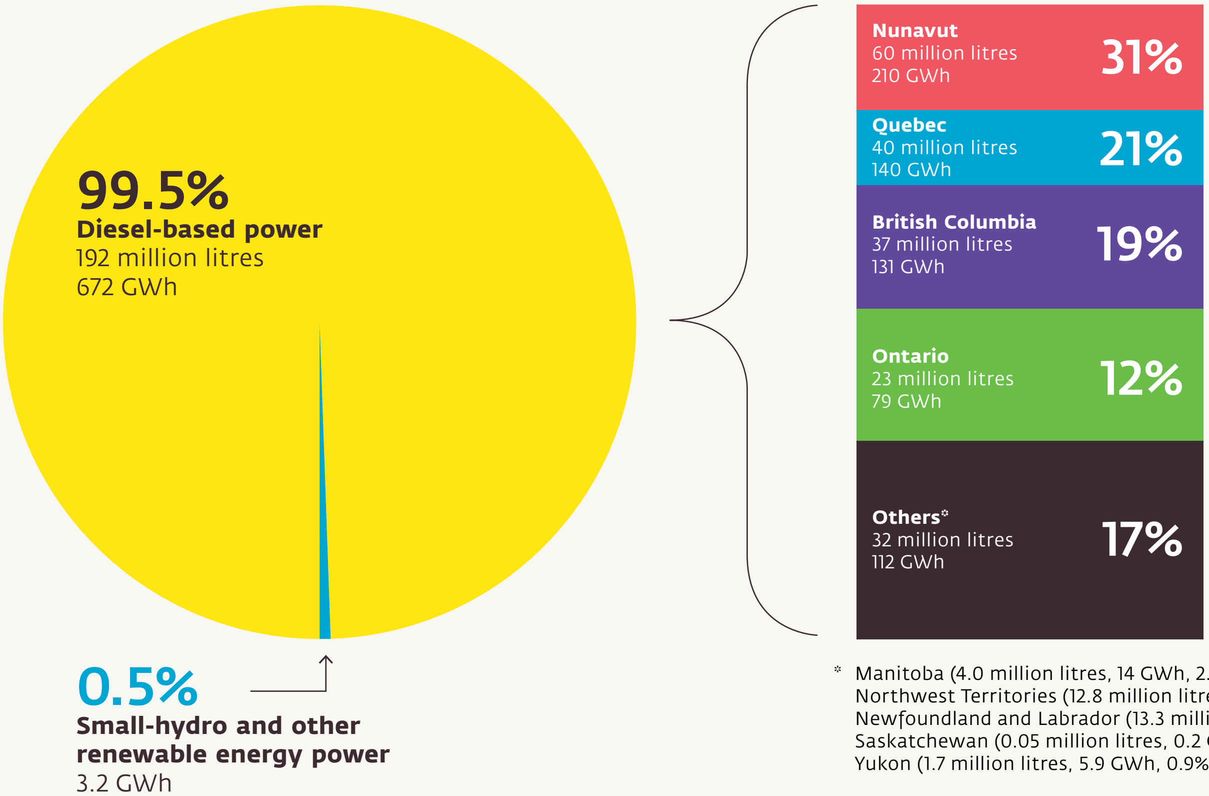
When we consider energy access, Canada is in a unique situation. Despite being a developed country, it has significant pockets of population that do not have reliable access to electricity. Across the country – particularly in the North – there are 279 remote communities that are not connected to the North American electric grid.[4] Many of these communities are home to Indigenous peoples and approximately 240 rely mainly on diesel fuel for electricity that is flown, barged, or trucked in. Not only is this hugely expensive, it also has significant environmental consequences.

We know that education, health, economic opportunity and social inclusion are all radically improved by reliable access to electricity.[5] These communities' ongoing disadvantage constitutes a serious societal problem that federal and provincial governments acknowledge must be addressed. However, only marginal progress has been made to date.

The good news is that a number of these communities in collaboration with government and non-government agencies have undertaken efforts to supplement or replace aging diesel generators with clean, renewable electricity supply – utilizing wind, solar and small hydro power sources to reduce reliance on fossil fuels. Lessons from these projects should be of wider interest to the millions of other marginalized communities across the globe that face persistent barriers to modern electrification.

4. Knowles, J., (2016) Power Shift: Electricity for Canada's remote communities. The Conference Board of Canada.
5. GEA (2012) Global Energy Assessment - Toward a Sustainable Future. Retrieved from: http://www.globalenergyassessment.org

ELECTRIC ENERGY SOURCE & DIESEL CONSUMPTION IN REMOTE COMMUNITIES[B–I]



* Manitoba (4.0 million litres, 14 GWh, 2.1%)
Northwest Territories (12.8 million litres, 44 GWh, 6.7%)
Newfoundland and Labrador (13.3 million litres, 46.5 GWh, 6.9%)
Saskatchewan (0.05 million litres, 0.2 GWh, 0.03%)
Yukon (1.7 million litres, 5.9 GWh, 0.9%)

Canada's energy access problem

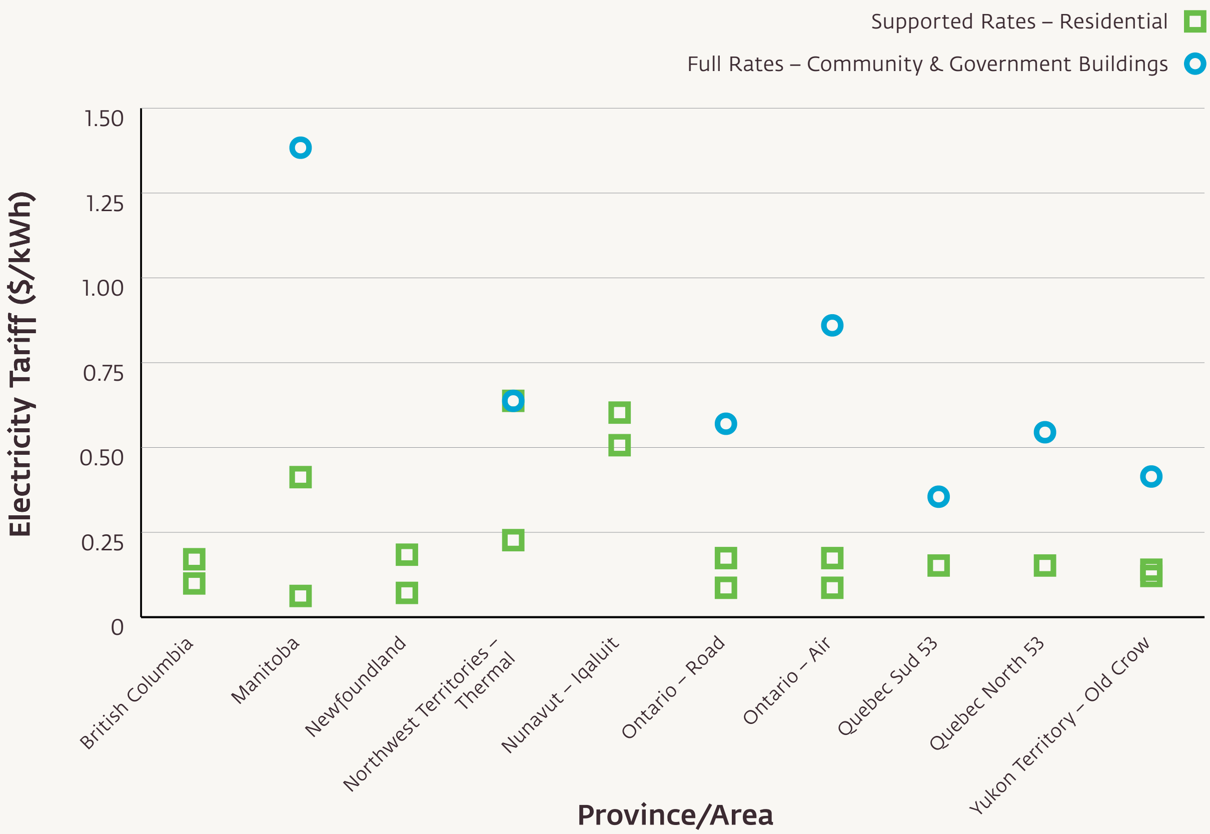
According to World Bank figures, Canada has 100 per cent access to electricity.[6] However ten percent of Canada's Indigenous population is not grid-connected and restrictions on the level of access are encountered in some of the diesel-based communities.

Of particular concern is the reliance on diesel-fueled generators. Importing diesel to remote areas is problematic and expensive.[7]

Climate change is set to make things worse, both by worsening the extremes of the weather, and by making some transport options even more uneconomic. Many communities only have ground transportation access via winter ice roads, warming trends in recent years[8] have seen some communities' road access diminish to the point where they have to fly in their diesel. Air transportation can double the cost of electricity.[9]

6. World Bank, (2016). Canada: Access to Electricity. Retrieved from: http://data.worldbank.org/indicator/EG.ELC.ACCS.ZS?locations=CA
7. Arriaga, M. et al., (2013). Renewable Energy Alternatives for Remote Communities in Northern Ontario, Canada, IEEE Transactions on Sustainable Energy. 4(3):661.
8. Stephenson, S.R., et al. (2011). Divergent long-term trajectories of human access to the Arctic. Nature Climate Chanmge. 1:156 – 160.
9. Government of Canada, (2011). Status of Remote/Off – Grid Communities in Canada. Natural Resources Canada. Retrieved from: https://www.nrcan.gc.ca/sites/www.nrcan.gc.ca/files/canmetenergy/files/pubs/2013-118_en.pdf

ONGOING ISSUES: HIGH COST OF ELECTRICITY IN REMOTE COMMUNITIES[J–Q]



Although this cost is partially covered by the budgets of federal and provincial governments, these communities' economic difficulties mean electricity remains a significant expense in locations where economic development is halted. Additionally, aging diesel storage facilities cause frequent spills which are enormously expensive to clean up. It is not always clear who is responsible for initiating and paying for remediation. According to Indigenous and Northern Affairs Canada, over 250 sites at or near First Nations and Inuit communities are still waiting for petroleum hydrocarbon spills to be cleaned up.[4] The Canadian federal government faces millions of dollars in liability associated with the ongoing need to remediate sites contaminated by hydrocarbon fuels.

Then there is the greenhouse gas problem. These communities are burning fossil fuels, leaving a legacy of carbon emissions. Emissions from off-grid remote communities are almost three times Canada's per capita average for the public electricity and heat sector.[10] Environmental issues are of paramount importance for many of these communities, and there is strong desire to help reduce greenhouse gas emissions.

10. Government of Canada, (2016). National Inventory Report 1990–2014: Greenhouse Gas Sources and Sinks in Canada. Environment and Climate Change Canada.

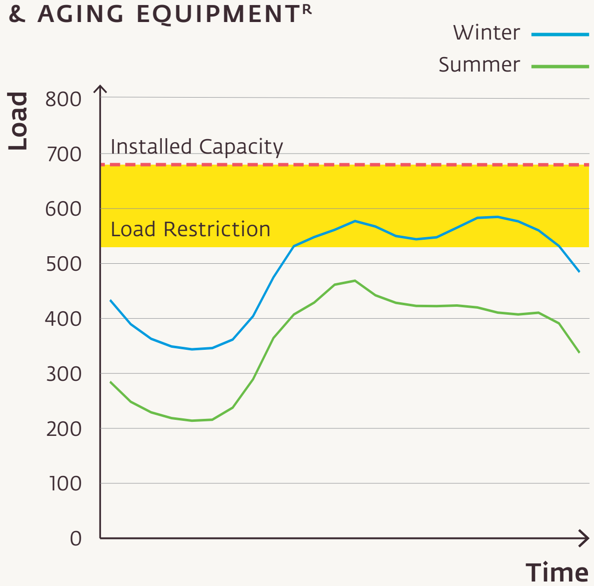
In remote communities,

1,500 litres of diesel fuel

are burned per person per year[10]

Finally, and perhaps most acutely, there are electricity use restrictions that arise from limited generating capacity and aging diesel generators. Nunavut, Ontario, and British Columbia are regions where an estimated 25% to 50% of communities have a "load restriction status," meaning that peak electricity demand is near the maximum operating capacity of the diesel-generator plant.[11] Load restriction status has a number of consequences, including a strangling effect on a community's economic development due to an inability to connect new houses, buildings or water treatment plant upgrades to the electrical system. This chokes economic and community development opportunities and has significant quality of life impacts on already impoverished communities.

OUTAGES, LOAD RESTRICTION & AGING EQUIPMENT[R]



Indigenous peoples constitute the fastest-growing segment of the Canadian population,[12] with people under the age of 25 representing nearly half of the population of Indigenous communities. These young adults are the principal casualties of a severe housing crisis in remote communities that has arisen in part because existing electricity infrastructure cannot power any new homes. Many are forced to live in their parental homes with their own young families. School closures because of power outages swallow a fifth of the education time in communities like Pikangikum First Nation where power surges due to unreliable generators also regularly destroy education infrastructure, such as WiFi routers, internet servers and laptop computers. In the same community lack of electrical power for sewage and drinking water systems has caused illness, including gastrointestinal, skin and urinary tract infections, to occur at a much higher rate than in grid-connected communities.[13]

Solutions

There are solutions. Renewable energy systems that operate in coordination with the current infrastructure can reduce fuel consumption and the associated greenhouse gas emissions. In the future, these systems can alleviate the electricity generation cap that many communities are currently facing. Because these technologies harness natural, freely available energy resources while causing little or no environmental damage, they align with the deep cultural and spiritual values of Indigenous peoples.

Installation costs of renewable energy technologies in remote communities remains a major barrier. The cost of installation can be more than twice as high as an equivalent grid-connected system. Nonetheless, the saving in carbon emissions and the rising cost of diesel transportation means that many projects could be considered worth the investment, and can even result in significant cost savings over time in certain conditions.[14]

11. Henderson, C., (2016). Personal interview with Mariano Arriaga.
12. Government of Canada, (2010) Fact Sheet – Urban Aboriginal population in Canada. Indigenous and Northern Affairs Canada. Retrieved from: https://www.aadnc-aandc.gc.ca/eng/1100100014298/1100100014302
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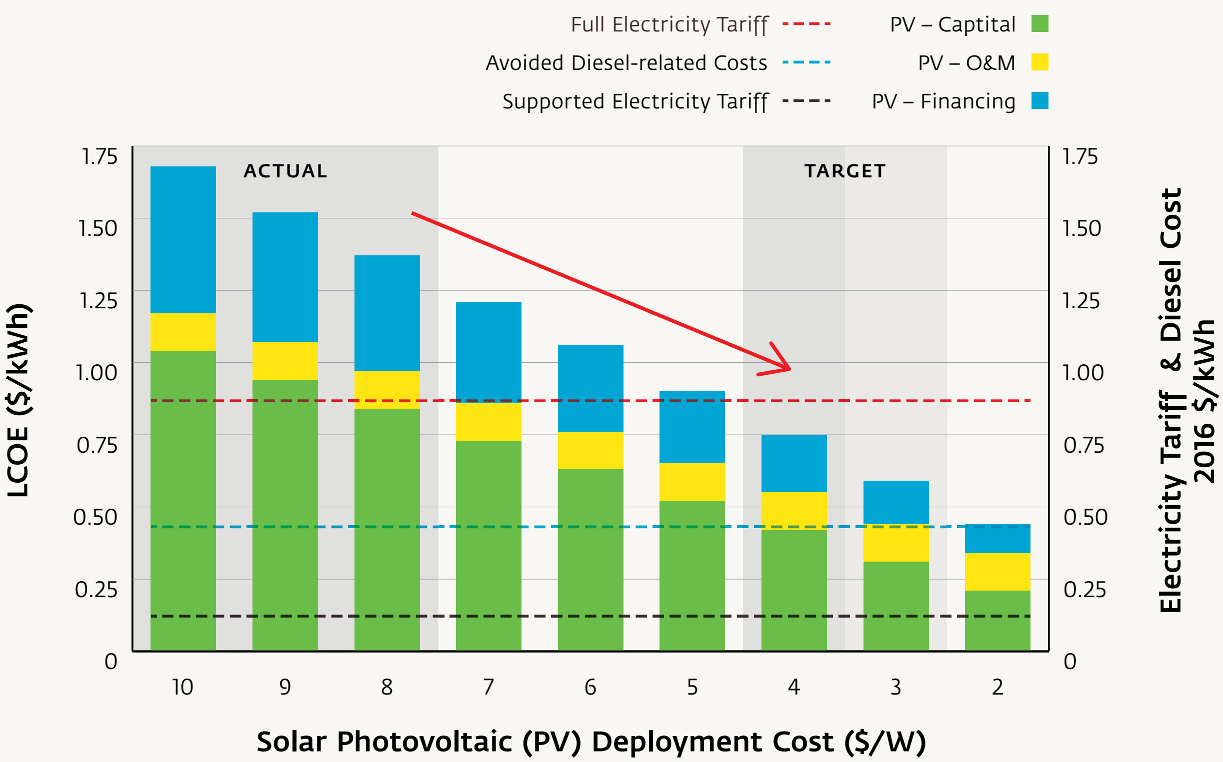
14. Arriaga, M. et al., (2016). Long-Term Renewable Energy Planning Model for Remote Communities, IEEE Transactions on Sustainable Energy. 7(1):221.

HIGH COST OF RENEWABLE ENERGY DEPLOYMENTS IN REMOTE COMMUNITIES[S–T]



A recent assessment by researchers at the Waterloo Institute for Sustainable Energy in partnership with the World Wildlife Fund assessed 13 remote Arctic communities and found significant cost savings over time when renewables are added to their existing electricity supply.[15] Experiences in Alaska and Siberia also point toward the appropriateness and cost effectiveness of these solutions in Northern environments when they are implemented properly. Add to this the fact that the Canadian Federal government has committed to making significant investments in adding renewable generation capacity in order to meet climate targets anyway,[16] as well as the low interest borrowing situation, and the case for investment in renewable generation capacity in these communities – those who would stand most to gain from such investments – becomes crystal clear.

However, in order to turn the page on decades of energy poverty in some remote communities in Canada, many obstacles have to be overcome in the initiation, planning and implementation of renewable energy projects. A key element in the success of renewable energy and fuel saving projects in remote Indigenous communities in Canada to date has been the role played by the communities themselves in lobbying for investment, forming partnerships with external organizations that can help guide the process, and empowering their citizens to be a part of decision-making and education with respect to the project.

15. Canizares, C. (2016). Fueling Change in the Arctic. World Wildlife Federation. Retrieved from: http://awsassets.wwf.ca/downloads/summary_and_prefeasibility_report.pdf
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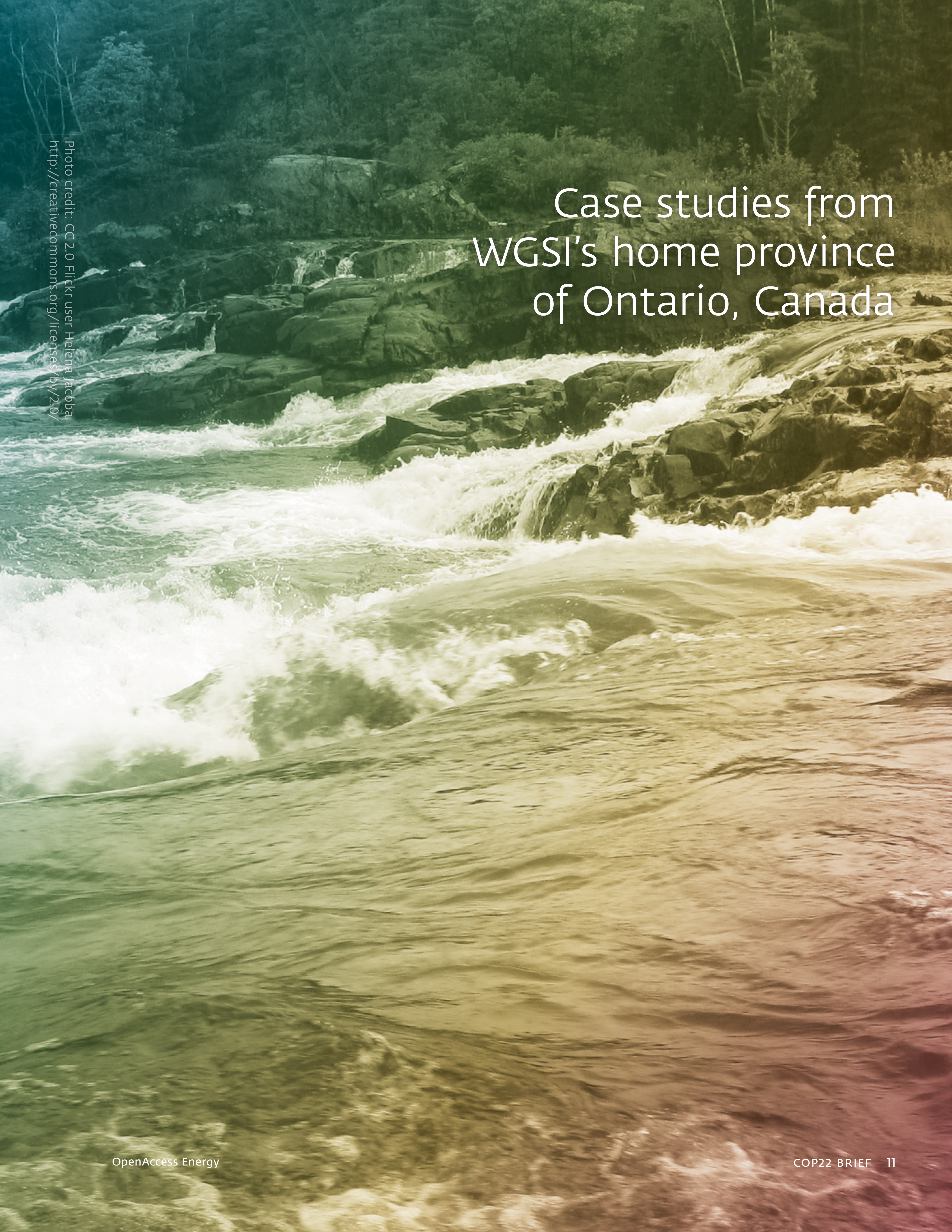

Case studies from WGSI's home province of Ontario, Canada

Case study: Dokis First Nation Hydroelectric Project[17]

Chiefs of the Dokis First Nation have long known they had a valuable resource in the flow of the French River that runs past their 250 person community. However, no one had managed to work out how a project could successfully harness some of the energy without significantly compromising the community's autonomy or resources.

A key change came at the policy level. The First Nation Lands Management Act removed barriers that had prevented First Nations communities from engaging in effective partnerships with outside institutions to manage their resources. It put the Dokis in a position to sit at the table with various companies that could partner in the hydro project and provide expertise and resources in areas where the community was internally lacking.

The Okikendawt Project uses excess water flowing over an existing dam to drive a 10MW turbine. A power purchase agreement allows the Okikendawt Project to sell 100% of its power to the Ontario Power Authority for a forty year term through a Feed-in-Tariff (FIT) program.

There was also a need for energy education within the community. Lumos Energy, a clean energy consultancy that works with Indigenous communities, has been advising the Dokis First Nation for over seven years. The Dokis hired Lumos Energy to help the council navigate the bureaucratic process including the role of permits and environmental assessments in addition to supporting brokering and financing.

Access to this expertise meant that the community could understand the potential, the process and the pitfalls. Project partners also had to be educated about Dokis values concerning their environment and culture; mutual trust and respect was essential to success. Denise Restoule, Dokis Nation Chief, says that the community's ability to co-develop the project is what changed it from an idea to a reality.

This grid-connected project provides valuable lessons on policy and partnership that can be applied to off-grid communities.

Case Study: Deer Lake Hybrid Solar Project[18]

Deer Lake First Nation is a small community of approximately 1,100 people. It has no access to the grid and pays close to $2.7 million CAD for diesel every year to satisfy the energy need of the community. Despite these high costs, it is not prudent for Deer Lake or many other off-grid communities to abandon diesel generators entirely. A better approach is to offset diesel electricity generation with renewables as part of a transition strategy. A recent installation at Deer Lake First Nation Elementary School, for example, has given its users a hybrid photovoltaic (PV) system that will work alongside existing diesel and hydro resources.

The PV system, installed in a partnership between Canadian Solar and NCC Development, a company formed by the Chiefs of six First Nations communities, has cut the community's annual energy bill by $92,000 CAD, created part-time employment opportunities, reduced diesel fuel consumption by 31,000 liters per year and cut carbon emissions by 99 tonnes annually.

Case Study: Watay Power Project[19]

Energy access is not just about power generation – transmission is another major factor in redressing the inequity in electricity access, as the Watay Power Project demonstrates.

Here, again, the First Nations communities are the primary actors. Twenty-two First Nations communities have formed Wataynikaneyap Power in partnership with FortisOntario and RES Canada. The company is an initiative built on the mandate and support of the communities and will develop, own, and operate new transmission facilities in Northwestern Ontario.

The Ontario government has acknowledged that the project is run by an "unprecedented partnership" between First Nations groups and private companies. Its support is shown by the grant of a license to connect these communities to the grid.

The aim is to connect 17 remote First Nation communities currently powered by diesel generators. Wataynikaneyap engaged PricewaterhouseCoopers to perform financial feasibility assessments. The company found that the transmission line project would avoid $3.4 billion CAD in fuel costs over 40 years.

17. Government of Canada, (2016). Dokis First Nation Okikendawt Project. Indigenous and Northern Affairs Canada. Retrieved from: https://www.aadnc-aandc.gc.ca/eng/1459449220161/1459449341752
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19. Wataynikaneyap Power, (2016). Our Story. Retrieved from: http://wataypower.ca

If it goes ahead as hoped, the project will create approximately 770 jobs during construction and some on-going jobs during operations and maintenance over the next 40 years. It will also reduce greenhouse gas emissions by an estimated 6.6 million tonnes and save taxpayers over $1 billion CAD because of the reduced need for subsidies on electricity generated by diesel.

Construction is due to start in late 2018. Wataynikaneyap sees this as a starting point for First Nation power generation initiatives, pointing out that First Nations wish to own, control, and benefit from development in their traditional homelands.

Education and facilitation

A number of other important cross-sector capacity building initiatives are under way. TREC Education,[20] for instance, runs energy education programs for Indigenous peoples (including children) throughout Ontario, creating an awareness of renewable energy options and opportunities in on- and off-grid communities.

First Nations communities in British Columbia have access to the BC First Nations Clean Energy Toolkit[21] developed by Judith Sayers, a lawyer, strategic advisor and former Chief of the Hupacasath First Nation. The Toolkit explains available clean and renewable energy options and how communities can begin the process of exploiting them. It includes information on the best ways to explore pre-feasibility, feasibility, developing, financing and relationship building, as well as offering a comprehensive directory of resources.

The province of Alberta has also recently committed $2.5 million CAD towards the cost of installing solar panels on community buildings such as offices, medical centres and schools in on-grid First Nations and Métis communities.[22] Another stream of funding will go towards energy audits to find ways to reduce emissions and energy costs. There are difficulties, however, with properties occupied by non-owners, who have little incentive to carry out energy efficiency measures. Hydro Quebec is contributing to the Quebec's provincial Plan Nord strategy by investing over $4 billion CAD in generation and transmission facilities to convert off-grid systems to cleaner and less expensive energy sources. [23]

Knowledge-sharing is critical to success over the long term and is becoming part of the energy development narrative. The 20/20 Catalysts Program,[24] an intensive summer program designed to develop energy champions within Indigenous communities across Canada, is working to develop a Canada-wide Indigenous Clean Energy Network to facilitate knowledge sharing between communities with experience developing clean energy projects and those who are just beginning the journey.

The path forward

Despite the successes to date, much remains to be done. There is a need for reliable and publicly accessible data about different communities' current and future electricity needs to effectively determine the market opportunities that will help governments leverage their investments in energy access for greater impact. It is also critical that governments commit to and follow through on making investments in the communities that stand most to gain from them – especially in terms of access to basic quality of life services and enhanced economic opportunity. These communities need to be Canada's top priority when it comes to green infrastructure development. Uncertainty about funding can not only jeopardize a specific project, it can also cause private investors to avoid the whole sector, making it difficult for remote communities to finance what can be extremely costly infrastructure.

Across federal, provincial and territorial governments there are around 40 funding programs that conduct research, carry out pilot studies and work in other ways to improve energy access in remote communities.[25] The solutions Canada finds to its remote communities' energy access problems can be part of the global solution to energy access. At the very least, there is an important early lesson here: energy access is not a quick fix, but needs to be acknowledged as a long-term goal that will take effort, resources, strong partnerships and time to achieve.

WGSI believes that solutions developed elsewhere in the world can also be applied in Canada. We are in the process of gathering and exploiting global expertise to tackle a worldwide problem, and welcome your input, feedback and collaboration, as we explain in the next section.

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Call for collaboration

WGSI's expertise lies in convening facilitated conversations to advance breakthrough thinking. We have already brought together a multidisciplinary, multinational, and multigenerational group of stakeholders, experts and advisors to develop an actionable framework for addressing this complex global issue.

Our group's initial conclusions and recommendations are laid out in the first section of this document. Subsequent months of discussions, research and activity have enabled us to deepen and broaden these recommendations. Our in-depth analysis of the best paths forward for establishing universal electricity access will be laid out in full in a document to be published in January 2017. This will be followed by a prolonged period of strategic implementation, network creation and other support activities.

WGSI recognizes the importance of wide and varied collaboration in the energy access space. In any "grand challenge" scenario, many efforts are unknowingly duplicated and valuable ideas are lost in the silos of disciplines. That is why we welcome further input to our current and future phases. To that end, we are seeking new partners with whom we can collaborate to implement the political, legal, technological, educational and other changes necessary for achievement of global energy access.

We look forward to hearing from you.

Contact: info@wgsi.org

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