OPEN ACCESS
ENERGY

Blueprint

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Executive Summary

We are living in times of great economic and social opportunity. Emerging technological, social and business innovations mean that it is now possible for more than 1 billion people to, for the first time, gain access to the modern electricity services that will radically transform their well-being.

Establishing universal electricity access creates practical opportunities for quality education, new business models, better health outcomes, clean water and support for agriculture. Clean renewable energy technologies will form the backbone of an energy transition that will mitigate the effects of climate change.

This opportunity has arisen because new and emerging technologies are ushering in a revolution in energy access in the developing world. It is now possible to deliver modern electricity services to remote regions via off-grid electricity and micro-grids powered by renewable energy sources. Low cost solar power, high-efficiency appliances that can connect to a simple and cheap modular micro-grid, data collection through mobile communication networks and mobile-based micro-payment channels are examples of innovations that offer a chance for genuine and lasting change.

Energy-poor communities now have the tools to empower their lives. Consumer awareness campaigns and local training programs have generated acceptance of these technologies that can provide a path out of poverty. Emerging demand, coupled with a willingness and ability to pay for modern energy services where they are needed most is gaining momentum. What's more, this demand is arising within the context of an established global framework – the United Nations Sustainable Development Goals. One of which – Sustainable Development Goal 7 (SDG 7) – is ensuring access to affordable, reliable, sustainable a modern energy for all. This is bringing many new and highly-focused actors into the energy access space. The supporting framework is there; now action is required by governments, NGOs and financial bodies take bold and urgent steps to reach the full potential of these opportunities.

Lack of affordable, sustainable energy access is not only a problem in the Global South, it is also a major concern in Canada's remote communities. Canada has 279 active remote communities that are not connected to the grid. Many of these communities are home to Indigenous peoples and the majority rely on diesel fuel for heat and power that is barged, flown or trucked in. Not only is this fuel expensive, reliance on it has significant negative environmental and social impacts. Clean energy innovations offer the possibility of Indigenous values of environmental stewardship to become aligned with their energy infrastructure, and for this to become a driver of economic development in these communities. Canada has an opportunity now to not only solve this domestic energy problem, but to become a leader in global efforts on improving energy access by sourcing and implementing solutions from within, and sharing them with partners in the developing world.

To address this opportunity, Waterloo Global Science Initiative (WGSI) has developed this Blueprint for achieving universal electricity access through our OpenAccess Energy Advisory Workshop (October 18–20, 2015), Summit (April 24–27, 2016) and engagement with energy sector researchers, leaders and advisors.

Implementing this pathway will involve creating an ecosystem in which a dynamic energy access sector can thrive. This new sector of the global economy will need thousands of new actors and institutions working across borders, with massive flows of investment, materials and expertise. It will require innovation, and that in turn will require policy coherence across nations, standardization of technologies and practices, and local entrepreneurs and end-users involved in decision-making so that service configurations match local needs and ability to pay.

Given this complexity, we direct our recommendations at national level policy-makers. Their role will be to ensure coherent policy planning for the sector that paves a clear path for its growth and is responsive to the fast-changing needs of key actors.

The pathway we recommend involves four clear steps, each of which requires the implementation of a number of strategies:

1. Enable – Establish national energy plans, and a policy and regulatory environment conducive to the creation of off-grid electricity services;
2. Align – Facilitate creative alliances between those seeking to provide electricity services and those who can finance the projects;
3. Empower – Build the human capacity to allow the sector to thrive – especially drawing on the strength of women and community members to deliver solutions at the 'last mile' through education, training and networking;
4. Incubate – Create financially sustainable platforms to help energy entrepreneurs succeed in creating sustainable energy businesses that can serve even the most difficult and impoverished markets.

Strategies for delivery of these solutions will depend on the geographic and cultural context in which they are sought. However, specific solutions can be broken down into multiple actions, all of which have been shown to be implementable and effective.

Enable

National level institutions must make the first move to establish universal energy access as a national priority. Though high level bodies such as the International Energy Agency (IEA) widely acknowledge off-grid as key piece in the energy access puzzle, it is currently neglected by most state-level regulators, largely due to its perceived novelty as a large-scale model for electrification. To allow cost-effective clean energy products and micro-grids an enhanced role in reducing energy poverty, policymakers must see beyond their historical reliance on grid-based electricity. They must utilize new tools to create energy plans for diffusion of off-grid electrification technologies and systems and open up these planning processes to new actors involved in the growing energy access sector to help advise on market or technological issues. The wealth of new technology involved also means that governments must also act to protect consumers from faulty or poorly-performing appliances and infrastructure by establishing and enforcing standards and certification.

Align

Governments need to construct innovative financial incentives and information dissemination programs to facilitate the involvement of many more private banks, venture capitalists, angel investors, and crowdfunding organizations in the energy access market. This will almost certainly involve re-thinking current incentive models to favour the emergence of a thriving renewable, off-grid energy market, and the restructuring of duties and levies in the energy sector.

Governments must also ensure that the application of public financing encourages and complements private sector participation in the sector. Development aid agencies should consider making investments in market-building activities and new entrepreneurial ventures, as these are critical to de-risking future private sector investment.

Empower

Energy access is a rapidly growing sector where policy support is urgently required to meet the human resource needs. There is currently a dearth of skilled workers in the energy access sector and relatively few accredited courses or curricula to fill the void. This is especially true in the developing world, where the sector has the potential to be an employment engine in the places where this is needed most. Indeed, even at the local, grassroots level, there is not enough knowledge about the benefits that access to clean, affordable, reliable and modern energy can bring. Capitalizing on local knowledge about motivations, cultural values and energy needs will be an essential part of the universal energy access journey. Governments must work together with NGOs and other organizations to offer energy education initiatives and support local energy champions who will be indispensable allies in developing appropriate energy solutions for their communities.

Women are an untapped power with the potential to make energy access a reality across the world. Women are highly effective business strategists, distributors of wealth and community thought leaders. They also stand to gain a great deal more from energy access programs. That is because of the disproportionate amount of time they invest in domestic tasks that can be mechanized once electricity services become available. Studies show that women tend to invest that freed-up time in economic activity, education programs, community-building and healthcare initiatives that benefit themselves, their families and entire communities. The path to SDG 5 – gender equality and the empowerment of women and girls – is intertwined with SDG 7, the establishment of universal energy access. With both goals achieved, eradicating poverty, inequality and threats to the climate will become significantly easier.

Photo credit: CC 2.0 Flickr user Tristan in Ottawa

Incubate

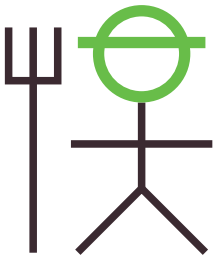
The final task facing governments is to ease the path of energy entrepreneurs. In the energy access sector, the customers of an energy service company are often the poorest of the poor, and several factors hinder attempts to deliver services to these markets in a financially sustainable way. Profits take time to accrue, necessitating the investment of patient capital that can wait for returns in the long-term. Businesses often rely on micropayments that can be subject to punitive charges. Customers frequently have no credit history and as a result can struggle to raise loans for capital investment.

These problems are not insurmountable. In a wide variety of geographic and cultural contexts government action in partnership with financial organizations and NGOs, has overcome each of them. It is possible – and necessary – to make the sector attractive and profitable for entrepreneurial activity, unleashing unprecedented economic growth through the establishment of thousands of companies led by capable and highly motivated individuals. This can be achieved through investment in entrepreneurial incubators and accelerators where motivated individuals have access to information, finance, mentors, technical facilities, and government assistance in order to support their creativity and ingenuity as entrepreneurs. Financial sector education initiatives could raise awareness of sectoral opportunities, allow funders to share risk with government or non-governmental bodies, provide high-quality, timely market data, and facilitate movement of capital across national borders.

There now exists a wealth of resources available to policy-makers at multiple levels of government to support energy access planning, financing and implementation. In recent years, the private sector has increasingly fostered partnerships with public sector institutions to create more impactful energy access projects. Small social enterprises, too, have made a surprisingly large impact in some of the world's toughest markets. Many are already running profitable businesses that sell solar lanterns, solar home systems and appliances, and building community micro-grids to serve rural villages.

With the emergence of affordable hardware, software and data channels that can inform this emerging market, the time is right to turn the energy access opportunity into a global economic success story. WGSI is optimistically looking forward to working with many partners in order to see this vision implemented.

Introduction



In the developing world
agriculture accounts for:

29% of GDP | **65%** of the labour force

Energy is fundamental enabler of human betterment. As United Nations Secretary-General Ban Ki-moon has remarked, "Energy is the golden thread that connects economic growth, social equity and environmental sustainability."[1] It isn't difficult to find examples that lend compelling support for his observation. In East Africa, families who were able to switch from kerosene to solar powered electric lighting, have found that the switch saved them an average of US$70 per year. The most common uses of these savings? Education for their children, improvements to their agricultural business and better food.[2]

The objective laid out by the United Nations as SDG 7 – universal access to affordable, reliable, sustainable and modern energy for all by 2030 – is a daunting challenge. Defined as such, solutions deployed to meet this challenge must not only be affordable for those living on less than US$5 per day, they must meet several challenging design criteria for success. They must be robust enough to operate reliably in remote environments where resources and skills to support their maintenance are in short supply, must not contribute to negative environmental or health impacts at point of use, must have low reliance on additional infrastructure, and must utilize modern and efficient technologies in order to provide maximum energy services that meet the most pressing needs of end-users in ways traditional options cannot.

Achieving SDG 7 is necessary if we are to solve a range of other problems. Poverty reduction and addressing climate change, for instance, both rely on creating a revolution in access to clean energy throughout the developing world by 2030. This makes SDG 7 the quintessential sustainable development challenge of the 21st century.

Emerging technological advances and innovations provide confidence in our collective capacity to meet it in ways that could not have been foreseen even five years ago. In the past, rural electrification goals were to be met through large centralized generation and distribution systems. We know now that grid extension is merely one of a suite of solutions and approaches to electrification. New modular and scalable off-grid power technologies are opening up possibilities for individuals to climb out of persistent poverty by making small investments in energy products and services. This makes their lives easier, more enjoyable and also more productive.

Access to energy frees up valuable time and money that can be invested elsewhere, leading down a path to greater economic freedom. That means meeting the challenge of SDG 7 will bring many more opportunities to achieve other sustainable development goals in areas such as agriculture, human health, climate change, education, and clean water.

Agriculture presents a particularly impactful opportunity for immediate and significant improvements to life in the developing world. In these regions, agriculture accounts for 29 percent of GDP and 65 percent of the labor force. Lack of energy significantly impacts agricultural yields due to constraints on irrigation, equipment – both maintenance and operation – and the opportunity to add value to produce through post-harvest processing.[3] With access to modern energy services rural areas can benefit from increased yields, a cold-chain infrastructure that reduces waste and information technologies that manage agricultural supply chains and connect producers with markets.[4]

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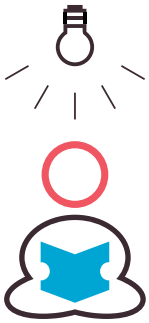

Today, only about
50% of students
from families in the planet's lowest income quintile attend primary schools that are connected to the grid

In business more generally, access to electricity can mean the difference between closing a shop at sundown, or keeping it – and the economic opportunities it creates – open into the evening. It means accessible power for the commercial and industrial equipment that can help pull entire communities out of persistent poverty. At home, being able to use electrical appliances can significantly save time and effort, allowing individuals the opportunity to earn income elsewhere and escape the trap of a subsistence lifestyle.[5]

When it comes to education, the impact of access to electricity is significant. Today, only about 50 percent of students from families in the planet's lowest income quintile attend primary schools that are connected to the grid.[6] Schools without electricity access are unable to stay open for after-school programs once the sun goes down, or in conditions of extreme heat or cold. Without electricity, schools are also unable to utilize information and communications technologies (ICT) such as computers and the internet.

An immediate benefit of even basic ICT capabilities is better tracking of students' educational attainment over time and across communities and regions.[7] In the long-term, there are high hopes that the effective adoption of these technologies will significantly improve teaching and resources for education in the developing world, especially when it comes to science and mathematics – subjects that make a huge difference to future income.[8, 9, 10, 11] Access to ICT will allow students to be able to conduct their own research, and teachers to build better lesson plans that draw upon knowledge beyond what is available in their often isolated communities. This is in large part due to the benefits of being able to access knowledge via the internet and other information networks. These can be reached through the mobile phones that are already commonly used throughout the developing world.

The educational benefits of electricity are not limited to the classroom. When students do not have electricity in the home, it reduces the time available to them to study and do homework. Early studies, including interviews with African teachers, have indicated that students in households where electric lighting is adopted tend to spend more time doing homework at night, have improved attendance records, and are more motivated in school.[6, 12]

Electricity is also a driver of improved public safety. Street lighting and lighting in homes and community buildings improve safety at night, especially for women, who can become housebound after dark because of the increased risk of sexual assault. Lighting can also reduce the threat of attack by dangerous animals. Around-the-clock electricity for public buildings such as police and other emergency service stations (and their training institutions) creates access to these vital public safety services for longer hours and improves service quality.[5]

Then there is the radical improvement to community health that electricity brings. Startlingly, the World Health Organization (WHO) estimates that globally, there are 4.3 million premature deaths per year that can be ascribed to indoor air pollution resulting from use of traditional sources of fuel.[13] This is more than for malaria, tuberculosis and AIDs combined,[14] and accounts for half of all premature deaths of

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Traditional sources of fuel cause:

An estimated
4.3 million
premature deaths per year
from indoor air pollution

1/2 of all premature deaths of
children under the age of 5

Approximately
300,000
deaths from fires every year

children under the age of five.[15] While the primary driver of this risk is combustion of fuels for cooking, kerosene for indoor lighting plays a major role as well. On top of that, kerosene and firewood are strong drivers of fire risk, the WHO estimates that more than 300,000 people die as a result of fires every year, with fire-related deaths ranking among the top 15 causes of death for people aged five to 29 globally. This risk is elevated in the developing world, in large part due to the everyday use of these dangerous energy sources within the home.[15] It is unlikely that electricity provision in impoverished rural areas will completely obviate the need and desire for traditional fuels for cooking due to the high levels of energy required to cook using electricity, but the move to electric lighting could itself have a significant impact on these statistics and help bring greater awareness of their risks.

Unreliable or non-existent electricity is also a significant impediment to professional healthcare provision, affecting childbirth and emergency treatment and severely limiting night-time services. Almost a billion people worldwide are served by health facilities that are without reliable access to electricity. This includes 46 percent of India's health facilities, and 25 percent of facilities in Kenya, where blackouts are frequent.[5] Ineffective sterilization procedures, lack of lighting and other electrically powered equipment for critical operations and difficulty communicating with and attracting medical specialists from outside are only some of the significant consequences of poor electricity provision.

At the systemic level a lack of electrically-powered medical cold storage means many vaccines delivered to developing countries are wasted before they can be used.[16]

Electricity access may also have more indirect cultural, economic or political benefits to individuals and communities. These may be harder to measure but nevertheless become powerful drivers of improved quality of life in the developing world. Renewable decentralized energy particularly offers significant opportunities in this area. A key area of opportunity is employment, as Deepak Nayyar, Professor of Economics at Jawaharlal Nehru University, points out. "For people who do not have the income to meet their basic needs, often in villages that have no energy access, employment opportunities are the only sustainable means of reducing and eradicating poverty," he says. "Moreover, employment creation and entrepreneurial activity mobilize the most abundant yet under-utilized resource in poor countries – the people for development."[17]

Early results and estimates regarding the employment creation potential of decentralized renewable energy are highly encouraging. According to the International Renewable Energy Agency (IRENA), nearly 4.5 million direct jobs can be generated by 2030 in the decentralized renewable electricity sector.[18] An estimated 15,000 jobs have already been created in the West African off-grid lighting sector alone, which is nearly equivalent to the number of people employed throughout the region as kerosene distributors.[19]

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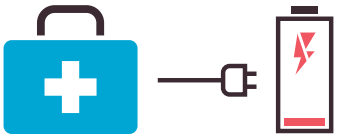
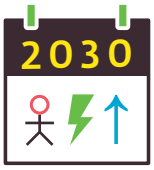


Health facilities without reliable access to electricity serve almost

1 billion

people worldwide



4.5 million

direct jobs can be generated by 2030 in the decentralized renewable electricity sector[20]

Achieving widespread access to reliable energy can have a significant impact on social welfare. This includes addressing issues of gender inequality and freeing large sections of the local population from the drudgery and inconvenience of tasks such as water collection and agricultural processing. Indeed, women, children and young adults have the most to gain from the adoption of these systems. Gender equality can be significantly enhanced by access to electrical appliances that reduce the time needed to perform the many household tasks that hamper women's freedom throughout the poorest regions in the world. There is evidence that decentralized electrification projects can benefit project effectiveness and also provide significant economic and social opportunities to the women involved.

Women have already become change-makers in a number of electrification initiatives, empowering their communities and themselves in the process. An example is the Barefoot Women Solar Engineers Association of Sierra Leone. Part of the Barefoot Power network that operates in dozens of countries across Africa and Asia, founded on the basis of providing electricity to the most inaccessible regions of the country by involving those who stand to benefit most from the technologies – women – as agents of change. The program provides training to women in how to promote, set up and operate solar energy technologies. The foundation of the program is to foster the independence of women and girls through compassion, dignity and respect.[21]

New energy technologies have even found their way into refugee camps. Emerging evidence shows that they can not only help with the provision of basic services, but also act as a protection against harm – literally a light in the dark – reducing incidences of violence against women in and round camps. With migration due to conflict and climate change on the rise in many impoverished regions, energy access technologies may become life-saving tools for those travelling a difficult road toward a better life.[22]

For young people eager to start their own businesses, electricity is a crucial asset benefitting their ability to find economic freedom. Many young people in rural areas migrate to urban areas to seek opportunity. However, the potential for new electricity access programs to provide direct employment and further economic opportunities with their rural villages promises to make staying home a more attractive proposition. Those who do still want to leave can benefit from advance information about life and opportunities in urban environments. Electrified villages can also provide the amenities that young people crave, from television to nightlife to opportunities for self-employment.[17] Enlivening local life and providing opportunities for energy impoverished individuals to not only benefit from but also help create their

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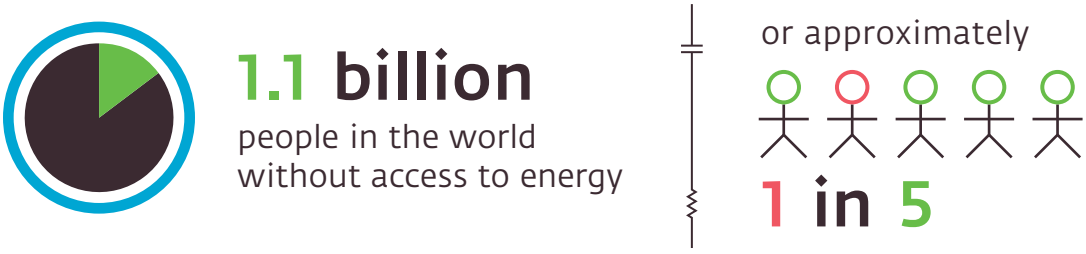
The bottom billion must be seen as agents, or participants, in a process who can shape their destinies, rather than as patients, or passive recipients of the benefits from development programs designed by benevolent governments or institutions.

Deepak Nayyar

Photo credit: Natalya Savka



new electrified communities must be central to energy access projects, wherever they might be carried out.

Another indirect benefit is the greater economic opportunity provided by the services that access to electricity provides. These include access to ICT infrastructure, education, training, and other resources. When equipped with these new tools, local innovation and entrepreneurship opportunities may be enriched. Access to electricity may also impact the political enfranchisement of poor communities by better connecting them with the world around them and the avenues available for asserting their political rights.[23] With a reliable source of electricity, infrastructure for greater political connectivity and organizational capability can be enabled.

With the advantages of providing universal electricity access made clear, we must turn our focus to how this vision can be made a reality. Despite many decades of global efforts directed at mass electrification, we have failed to deliver modern electricity services to approximately one-third of the people on Earth. Over a billion people continue to live without access to electricity and a further billion have unreliable access.[24] According to the IEA most optimistic scenario for future energy access, the number of people worldwide without electricity in the year 2030 is projected to remain above 1 billion. In sub-Saharan Africa the problem is projected to get worse, not better. The fact that population growth is outstripping electrification means that by 2030 the number of people without electricity will have risen by 19 percent from 2009 levels.[25]

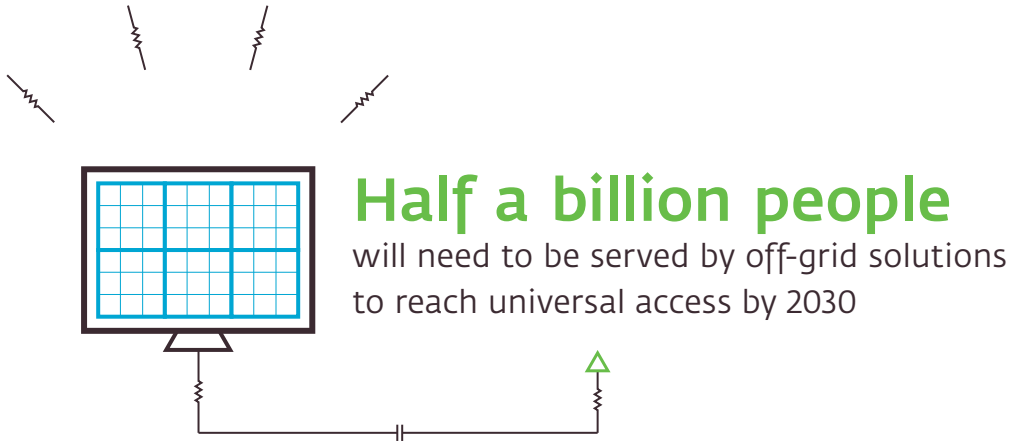
Clearly, our approach to opening up energy access has to change. We are struck by Nayyar's point that, "The bottom billion must be seen as agents, or participants, in a process who can shape their destinies, rather than as patients, or passive recipients of the benefits from development programs designed by benevolent governments or institutions."[17]

While we would argue that the 'bottom billion' is not a monolithic block, and that opening up energy access for all its groups will require differentiated approaches, we certainly agree with Nayyar that providing global access to energy will not result from imposition of external 'solutions.' Energy for all is a goal laid out by global bodies but its achievement depends on partnership. In this Blueprint we now lay out the necessary steps towards establishing the required partnerships, and explore the energy access solutions these partnerships can promote. In a set of Solution Spotlights compiled here and through Discourse Media's Power Struggle platform, an on-going journalistic exploration of energy challenges and solutions, we delve deeper into some of the details, and offer further implementable and scalable pathways that will help establish effective, lasting, universal energy access.

23. Jacobson, A. (2007). Connective power: solar electrification and social change in Kenya. World Development 35, no. 1: 144-162.
24. IEA. (2014). World energy outlook 2015. Retrieved from: http://www.worldenergyoutlook.org/weo2015/
25. IEA. (2010), World energy outlook 2010. Retrieved from: http://www.worldenergyoutlook.org/media/weo2010.pdf

1. Proactive governance

Implement coherent energy policy that facilitates energy access



1.1 Overview

Access to energy is an issue of equity. It is one of the basic foundations on which governments can ensure a fair, inclusive and stable economic and social life for their citizens. Jurisdictions that today benefit from a high level of energy access owe that to state-led action that regarded energy access as a public good, and often subsidized costs that could not be met through market economics.

It is no surprise, then, that the predominant model of service delivery in the past has been government-led programs of centralized grid-based generation and distribution of electricity. This strategy has found widespread success in many jurisdictions, allowing most developed countries to officially reach 100 percent electrification rates for their citizens.

However, reliance on this model alone has left over a billion people globally in the dark. In many cases, grid extension is touted as an economically viable solution but existing grid capacity is not taken into consideration resulting in system constraints and black outs. Off-grid electrification based on renewable sources must now be employed on a massive scale in order to help fill this gap. The IEA estimates that approximately half of the billion people without electricity today will need to be served by off-grid solutions if we are to reach the global target of universal access to modern energy by 2030.[26] Small, modular renewable energy technologies and systems have become increasingly affordable and private sector actors are lining up to provide these energy solutions.

Realizing the potential of these alternative options for energy provision will require a number of policy shifts. To date, energy infrastructure and policy has been largely focused on grid-connected systems. As a consequence, these systems have become privileged by default, and there is an urgent need to redress the balance. So while grid extension coupled with grid decarbonization policies merit attention, national energy policies concerning off-grid technologies are of particular concern.

The off-grid space currently sits outside the scope of most regulatory authorities, and off-grid initiatives are largely left to fend for themselves in terms of economics, planning, regulation and enabling strategies. Strong policy support with clear goals and targets for access to modern energy services is required to create an unprecedented opportunity for the world's poorest people to become active participants in their economic destiny.

26. IEA. (2011) Energy for all: Financing access for the poor. Retrieved from: http://www.worldenergyoutlook.org/media/weowebsite/energydevelopment/weo2011_energy_for_all.pdf

Photo credit: Natalya Savka

1.2 Seven actions required to create a policy environment that enables energy access

1.2.1 Clearly delineate responsibility between government departments

A significant barrier to progress in achieving energy access is the issue of distributed responsibility within government. It is vital that responsibilities for planning and implementation are clearly defined and assigned, that co-operation frameworks are established, and that the priorities of relevant departments are coordinated. Industry groups, end-users, financiers and technologists should also have one clearly-defined point of access to government decision-making bodies.

Mali provides a good example of how this can be achieved. The Malian government designated the Agency for the Development of Domestic Energy and Rural Electrification (AMADER) as the central authority for rural electrification. AMADER established its Intersectorial Coordination Committee (CCI) to deal with all questions relating to AMADER's general rules, and the allocation of permits and funding. Every government ministry whose work contributes to reducing poverty gets a seat on the CCI committee. Also represented are rural energy users, including domestic consumers, retailers and farmers, and representatives of rural elected councils. The CCI committee acts as a facilitator, creating and supporting links between the various governmental and private structures, local authorities, development players and the not-for-profit sector.[27]

It is worth noting that unclear lines of responsibility can have an effect on energy access in the developed world too. In Canada, a lack of clarity in communication and process has exacerbated the problems of off grid communities. Consider that in the province of British Columbia, a First Nations group initiating an energy project must manage provincial and federal regulations in addition to the strategic priorities of BC Hydro, necessitating overlapping work throughout the process.[28]

1.2.2 Coordinate between sectors

When making decisions about the scope and priority of projects such as grid extension, micro-grid installation, stand-alone solar and so on, governments too frequently act unilaterally. Experience shows that successful off-grid projects receive input, from the very earliest planning stages, from end-users, small enterprises, utilities, financiers, technology companies, and local government authorities. An example is provided by India's Clean Energy Access Network (CLEAN), which forms a coherent group of energy access

27. Masse, R. & Watchueng, S. (201). Multi-sectoral coordination and rural electrification in Africa. African Association for Rural Electrification. Retrieved from : http://www.club-er.org/images/slideHomePage/Bleu%20CoordMultiSect_GB_BD.pdf
28. Kekinusuqs (Sayers, J.). (2015). B.C. First Nations Energy Toolkit. B.C. First Nations Clean Energy Working Group. Retrieved from: https://www.cleanenergybc.org/wp-content/uploads/2016/04/BC-FN-Toolkit.pdf

stakeholders that, among other things, interacts with the country's Ministry of New and Renewable Energy. Though only established in 2015, it has already been influential in persuading the Indian government to include energy access as a priority sector for loans (see sidebar).

Mali also provides an example here. The Malian Multisectoral Committee for Energy was formed in 2004 from 12 ministerial departments, NGO representatives, consumer associations, chambers of commerce and industry, and energy trade associations. Multisectoral action has attracted more than 60 energy service companies to the sector in Mali. Malian government initiatives such as this have helped boost rural electrification rates in Mali from 1 percent in 2000 to 15 percent just ten years later.[27]

The role of government should be to facilitate and motivate connections within the energy sector to ensure provision of the highest quality energy access possible for the highest number of people on a cost-efficient and financially sustainable basis, recognizing historic bias against rural and difficult-to-reach populations.

1.2.3 Use external resources and metrics to reach clearly-defined goals

Successes achieved in locations such as Mali and India have not simply been a result of special, favorable circumstances or resources within those countries. These governments have purposefully tapped into the external expertise available to them through working with multilateral institutions and NGOs and – as a by product – attracted private sector interest and finance to implement their plans.

It is a simple fact that no government has all the expertise it needs to implement such an ambitious agenda. When it comes to implementation, a number of different bodies besides supra-national organizations are on hand to help direct government decision-making. One useful resource is the Global Tracking Framework (GTF) created by the UN Sustainable Energy for All (SE4ALL) program.[29] GTF was co-developed with the IEA to be the definitive global energy access measurement tool.

The GTF measures access across eight areas covering energy supplies and services, household and community energy services and employment-based metrics. It also recognizes

India's energy planning initiative

In June 2016, India's Ministry of New and Renewable Energy published a National Policy for Renewable Energy-based Micro and Mini Grids. This consultation document outlines proposals to deploy 10,000 renewable energy-based micro and mini-grid projects in parts of the country that lack any (or any reliable) electricity access. The document discusses proposed solutions and implementations for consideration at the State level, and encourages collaboration with energy service companies and private investors. The plan is to create 500 MW of capacity, with a view to establishing electricity access for a portion of the 237 million Indians who have none.

India is already carrying out grid extension projects. The new document aims to spur investment in off-grid programs by delineating the scope of the grid extension program. It identifies 14,204 villages that will be served by grid extension and 3,449 that will need off-grid generation infrastructure.

The paper suggests collaborations between energy service providers, banks, public sector groups, and village-level leaders and administrators are key to successful implementation, and proposes that State Nodal Agencies, which deal with renewable energy on a state level, could provide a suitable single point of access for coordinating project implementations and soliciting stakeholder input.[34]

29. Practical Action. (n.d.) Measurements and definitions. Retrieved from: http://policy.practicalaction.org/policy-themes/energy/total-energy-access/measurements-and-definitions
30. Jairaj, B. (201). Shining a light on electricity governance. World Resources Institute. Retrieved from: http://www.wri.org/sites/default/files/wri12_report_4c_egi_outcomes.pdf
31. Reiche, K., Tenenbaum, B. & Torrese de Mastle, C. (2006). Electrification and regulation: Principles and a model law. World Bank Group Energy and Mining Sector Board. Retrieved from: http://siteresources.worldbank.org/INTENERGY/Resources/EnergyPaper18.pdf

the benefits of decentralized systems in providing a variety of energy services.[28] The need for a nuanced understanding of energy service delivery to align with local, regional, national and international agendas must be part of the ongoing dialogue. A have/have-not dichotomy misses many key aspects, particularly the quality of services as they relate to human health, community well-being and economic development.[7]

The use of advanced energy access metrics, alongside greater integration of energy access agendas between local, regional, national and international agencies, can sharpen energy access efforts worldwide. Capacity-building together with co-ordination between the various public-sector levels can both benefit the efficacy of electrification projects and have wider benefits.

Another useful tool is the World Resources Institute's (WRI) Electricity Governance Initiative (EGI).[30] This has helped 10 countries in assess their national electricity governance and possible improvements. The EGI toolkit, which is tailored to the sector, is a guided research tool that allows partners to develop a common language with policymakers, proactively engage in decision-making in the sector and provide suggestions and options to overcome governance gaps that are found during the assessment process.

Additionally, we recommend the Electrification and Regulation Principles developed for the World Bank.[31] This report presents a set of regulatory principles that are simple and easy to comply with, discusses whether energy projects should be delegated or contracted out depending on the type of entity involved and the need for affordable, achievable quality standards. The report also contains detailed examples of emerging regulatory practices and suggests the elements necessary for a legal framework.

1.2.4 Ensure decision transparency

Both long term strategic planning and short term regulatory and policy decisions must be transparently made and communicated effectively to all concerned parties. Everyone in the sector needs to know what government policy and actions will be, and as far in advance as possible. Investments in off-grid systems, for instance, can be severely impacted by sudden centralized investment. As a 2007 report from the knowledge-sharing SEEP Network stated, "Energy lending and markets for energy services and products can be adversely impacted, if not decimated, by a national electricity grid extension, if such initiatives go forward unannounced to the energy service market or a government initiates a fully subsidized technology giveaway program."[32] In 2003, the government of the Dominican Republic initiated a give-away program for home solar systems that almost destroyed the commercial solar market in one province. A spectacular fall-off in home solar installations in Bangladesh in 2016 has been partly attributed to "an unplanned expansion of grid-based electricity by Rural Electrification Board."[33] A better example has been shown by the Indian government, which in 2016 announced transparent plans for grid extension in some regions and commitment to off-grid installations in others (see sidebar).[34]

1.2.5 Incentivize off-grid electricity

Energy subsidies aimed at providing access require careful consideration, and need to be implemented in ways that do not adversely affect the end-user.[35] Options for using renewable off-grid electricity services are now sufficiently robust and affordable that they can compete with traditional technologies like kerosene lamps in the absence of subsidies. Kerosene has long been subsidized in many developing world energy markets, and it now makes sense for electric lighting technologies to be treated similarly, especially since they can reduce the adverse health effects of burning kerosene while delivering a superior service to end-users in terms of the amount of light provided.

While it makes sense for governments to incentivize energy use so that the uptake of clean, renewable sources of energy is not unfairly hindered, the exact form subsidies should take is a complicated matter.[36] Subsidies are useful when supply and demand are out of sync, and when a lack of income and resources prevents individuals or communities from achieving an accepted minimum standard of living. The shortcomings of subsidies are well-documented: they can skew a market away from maximum operational efficiency and can, in many cases, fail to help those most in need.

32. Morris, El., Winiecki, J., Chowdhary, S. & Cortiglia, K. (2007). Using Microfinance to expand access to energy services. USAID. Retrieved from: pdf.usaid.gov/pdf_docs/Pnadm641.pdf
33. NTVOnline. (2016). Six million solar home system bid faces setback. Retrieved from: http://en.ntvbd.com/bangladesh/41581/Six-million-solar-home-system-bid-faces-setback
34. Indian Ministry of New and Renewable Energy, SPV Division. (2016). National policy for renewable energy based micro and mini grids. Retrieved from: http://mnre.gov.in/file-manager/UserFiles/draft-national-Mini_Micro-Grid-Policy.pdf
35. UNESCO. (2008). Reforming energy subsidies. Retrieved from: www.unep.org/pdf/pressreleases/reforming_energy_subsidies.pdf
36. GIZ. (2009). Energy Subsidies: Why, when and wow? A think piece. Retrieved from: https://www.giz.de/expertise/downloads/gtz2009-en-energy-subsidies-a-think-piece.pdf

WRI has recommended that governments change existing subsidy for kerosene, for example, to a subsidy based on lighting.[37] This facilitates consumer choice and stimulates innovation. Subsidies also need to be accessible through more streamlined application processes in order to make them easier to claim. The Indian government has recently implemented direct benefit transfer cash payments to kerosene users in some districts.[38] This measure has been shown to reduce kerosene use, undermine the profitability of kerosene sales and give users the option of using other technologies.

Small-scale operators often need flexibility in this area, with an ability to tailor their product offering to their customers' requirements and ability to pay. Kenya's feed-in tariff policy is an example of positive action: it now promotes the introduction or increased use of privately owned renewable-energy power plants or hybrid systems.[39] It is worth noting that the implementation of such measures involved Kenya's Electricity Regulatory Board, an autonomous, independent regulator with a wide-ranging mandate for consumer and environmental protection, and approval of financial agreements.[40]

1.2.6 Establish appropriate duties and levies

It can be tempting for a government in a developing nation to see newly established business sectors as opportunities to raise much-needed funds through taxation. Many nations have long charged severe import duties on renewable energy and micro-generation equipment. However, this has had only short-term benefits for governments as the imposition of duties pushes up prices, limiting the market and hampering long-term sector growth.

Lighting Africa has argued that the strategic setting of import duties is an area where "government actions can propel a portion of the consumers who are now in the poverty market into the commercial market." Its concern is with customs duties on solar lanterns but the same is true in several areas of the energy access market.[41]

There is good reason to charge import duty in some cases – when local manufacturers rely on import duties to keep their overseas competitors in check, for example. Often manufacturers based outside the country will be able to source cheaper raw materials, and an import tax can level this playing field, giving locally owned and operated manufacturers of energy infrastructure a better chance to contribute to the local economy through job creation and payment of taxes. It is worth noting that Vietnam's success in rural electrification was built on import tax exemption for goods which could not be produced domestically. Measures included four years of corporation tax exemption and a government obligation to purchase all electricity generated from renewable sources.[42]

Value-added tax (VAT) provides another good example of the need for well thought-out, transparent and long-lasting policies as sudden imposition or repeal can have an enormous effect on the affordability of consumer goods in the energy value chain. In Kenya, a 16 percent VAT levy was introduced on imported renewable energy products in 2013 and then lifted in 2014 causing prices to fluctuate rapidly. SunnyMoney

37. Bairiganjan, S., Cheung, R., Aglipay Delio, E., Fuente, D., Lall, S. & Singh, S. (2010). Power to the people: Investing in clean energy for the base of the pyramid in India. World Resources Institute. Retrieved from: www.wri.org/sites/default/files/pdf/power_to_the_people.pdf
38. DNAIndia. (2016). Government to transfer kerosene subsidy directly to bank accounts from April 1. Retrieved from: www.dnaindia.com/money/report-govt-to-transfer-kerosene-subsidy-directly-to-bank-accounts-from-april-1-2161484
39. Van Landeghem, L. (2016). Private sector engagement: The key to efficient, effective energy access for refugees. Moving Energy Initiative. Retrieved from: https://www.chathamhouse.org/sites/files/chathamhouse/publications/research/2016-05-19-mei-private-sector-engagement-landeghem.pdf
40. Institute of Economic Affairs. (2015). Situational analysis of energy industry, policy and strategy for Kenya. Retrieved from: https://www.africaportal.org/dspace/articles/situational-analysis-energy-industry-policy-and-strategy-kenya
41. Lighting Africa. (2012). Policy report note – Ghana. Retrieved from: http://www.ecowrex.org/system/files/documents/2012_policy-report-note-ghana_lighting-africa-ifc.pdf
42. Nam, P.K., Quan, N.A. & Binh, Q.M.Q. (2012). Investment incentives for renewable energy in Southeast Asia: Case study of Viet Nam. International Institute for Sustainable Development. Retrieved from: http://www.iisd.org/pdf/2013/investments_incentives_viet_nam.pdf
43. Meza, E. (2014). Kenya rescinds VAT on solar products. PV Magazine. Retrieved from: https://www.pv-magazine.com/2014/06/11/kenya-rescinds-vat-on-solar-products_100015379/
44. Government of the Republic of Kenya. (2012). Finance act 2012. Retrieved from: http://kenyalaw.org/kl/fileadmin/pdfdownloads/Acts/Finance_Act_57of2012_.PDF
45. Shahzad, K. (2016). Federal budget 2016-17: Custom duty of LED lights, solar panels slashed. Daily Pakistan. Retrieved from: https://en.dailypakistan.com.pk/business/federal-budget-2016-17-custom-duty-on-led-lights-solar-panels-slashed/
46. CLASP. ()n.d.) Our mission. Retrieved from: http://clasp.ngo/WhoWeAre/AboutUs
47. Global LEAP. (n.d.). The Global LEAP awards. Retrieved from: http://globalleap.org/awards/
48. Lighting Global. (n.d.). Our impact. Retrieved from: https://www.lightingglobal.org/about/our-impact/
49. Murphy, D. & Sharma, A. (2014). Scaling up access to electricity: The case of Lighting Africa. World Bank Group. Retrieved from: http://documents.worldbank.org/curated/en/804081468200339840/pdf/88701-REPF-BRI-PUBLIC-Box385194B-ADD-SERIES-Live-wire-knowledge-note-series-LW20-New-a-OKR.pdf
50. Erboy Ruff, Y., Mahendru, V., Sebellin, P., Johnson, P. & Jacobsen, A. (2016). Quality standards for energy access: How international standards can support off-grid electrification in developing countries – webinar transcript. Clean Energy Solutions Center. Retrieved: https://cleanenergysolutions.org/sites/default/files/documents/2016-05-11-transcript.pdf

welcomed this change – as it made their imported products more affordable – but local manufacturers pointed out that the measure made their position more difficult (see sidebar).[43]

Finally, problems can occur when duties are charged on financial transactions such as those that take place on mobile phone networks. In Kenya, the Finance Act of 2012 introduced a 10 percent excise duty on transaction fees for all money transfer services provided by mobile phone providers, banks, money transfer agencies, and other financial service providers.[44] When the sector depends on mobile micro-payments – as many rural energy access businesses surely will – levies on transaction fees may kill larger tax opportunities presented by established, thriving businesses.

1.2.7 Establish appropriate quality standards

Direct experience of equipment that suffers frequent breakdowns or even terminal failure shortly after installation or reports of injury will put energy access programs in jeopardy across a region. A few stories of poor quality goods and accidents can have a chilling effect on even the most promising market. So, while every effort should be made to encourage technological innovation and entrepreneurship, it is vital that the government acts to define and uphold quality standards in products that enter the energy access market.

There are several leads to follow here which advocate for energy efficiency standards, quality standards, and labels for appliances, lighting, and off-grid energy systems in the developing world. CLASP has worked in over 50 countries on six continents since 1999, helping governments structure and evaluate policies and programs for energy efficiency.[46] The Global Lighting and Energy Access Partnership (Global LEAP)'s flagship awards competition annually identifies the world's most efficient off-grid appliances.[47] Lighting Global has verified the quality of more than 100 products from 30 manufacturers, enabling 29 million people to have their basic lighting needs met by quality-verified solar lighting products.[48]

The Kenyan government has adopted a quality standard for solar lighting that was developed by Lighting Africa but adopted as international standard by the International Electrotechnical Commission (IEC).[49] Such standards are vital to counter market spoilage caused by poor customer experiences. IEC has standards for a wide variety of electricity access-related issues: micro-grid design, micro-grid optimization, energy metering, installation, testing and operation, integration with a main grid and others.[50]

Certification can also be branded onto quality-verified products, which can drive sales. It is worth noting that competition between energy access enterprises – especially those backed by investors hungry for profits – can sometimes result in poor quality installation, equipment or operation techniques, and so government-mandated quality standards should be clear and communicated to business communities at the earliest possible point in discussions of energy access opportunities. There should also be provisions for inspection, and for penalties for non-compliance.

Import versus domestic manufacture – the role of tariffs

Many developing world countries are facing a dilemma when it comes to the manufacture of solar PV panels. Though it is desirable to support domestic manufacture, which creates jobs, the difficulties encountered in the market mean this can slow deployment of solar energy generation infrastructure.

Making low-cost solar panels relies on cheap electricity and large capital investments, because it benefits from economies of scale. For this reason, the global market for solar PV panels is dominated by large-scale Chinese manufacturers that receive significant government support. The Chinese output has been so large that China has been accused of dumping cheap solar panels into global markets to crush competitors. This has resulted in many countries imposing weighty anti-dumping tariffs on imports of Chinese PV panels. In an effort to avoid these tariffs, Chinese manufacturers have built factories in developing countries such as Vietnam, creating local jobs and stimulating the economy.

Aware of the need to stimulate solar energy access projects, some governments have now removed all import duties from solar equipment and reduced import tariffs on related products. However, this adversely affects local manufacturers, who struggle to compete with cheap imports.

Strategies to resolve this problem include reducing import duties on parts only and encouraging investment in local assembly facilities. Pakistan, for instance, has reduced duty on the import of parts for LED lights from 20 percent to five percent. This is designed to stimulate local manufacturing while simultaneously facilitating growth in the renewable energy market.[45]

2. Fair market

Reshape the financial environment to facilitate energy access

2.1 Overview

The wide gap between energy investments in the Global North and South presents perhaps the most significant challenge to universal energy access. According to the African Development Bank (AfDB), US$547 billion must be invested to implement its scenario of universal access to reliable and increasingly cleaner electric power in all the 53 countries in Africa by 2030. This averages out at over US$27 billion per year, yet total funding to the energy sector in sub-Saharan Africa has averaged only about US$2 billion per year.[51]

The SE4ALL 2016 Energy Access Practitioner Network survey cites access to finance as the number one challenge facing energy access efforts worldwide.[52] Investors that took part in the survey gave a number of reasons for this, including the limited track record of industry players, lack of support from local banks in local currency, insufficient knowledge of investors, and foreign currency risk.

Essentially, energy investments in developing countries are disproportionately low due to elevated risk that is difficult to quantify, and the uncertain regulatory and investment environments in these regions. Novelty is also a problem as investors must prepare to operate in a new and rapidly changing sector with severely limited knowledge and experience. Furthermore, the end-users that make up this market are a largely unknown quantity for business leaders. In sub-Saharan Africa, for example, the 600 million people without electricity are some of the poorest people on the planet and the majority of them live in remote rural areas. Their consumption behaviour and ability to pay for energy services is not well documented.[53]

Without large scale investments in sub-Saharan African countries and others facing low electrification rates, a transformation of energy systems to achieve universal energy access is simply not possible. Fortunately, there are a number of ways in which access to finance can be increased through the participation of private actors and international finance institutions. First, though, this financing space must be de-risked by domestic regulatory actions and flexible support from risk-tolerant financial institutions across the globe. By breaking down the barriers to finance that persistently leave energy impoverished countries to fend for themselves, we can bring online the necessary investments through a variety of increasingly proven finance-related actions, highlighted below. The Solutions Spotlight section contains a list of further mechanisms and institutions that can support energy access projects (see page 50).

2.2 Six actions that will deliver finance for energy access

2.2.1 Lead financiers to energy access opportunities

Improving the knowledge that financiers have of the energy access sector is of central importance. Standardization of due diligence processes and project assessments will help to streamline these processes and reduce the time needed for financial analysis of proposed investments. Creation of best practices guidelines for financing off-grid projects and standardizing data collection and data sharing can provide frameworks and information to help financial institutions with little prior knowledge of the sector to increase the speed at which they are able to assess their investment options. A number of investors are already taking action in this regard and openly share their learnings for others to use. One example is Vulcan Impact investing, which owns ten micro-grids in Kenya and is working with their private sector partner Steama.co to generate data and information about these projects which has been collated into a report that is freely available on their website.[54] Acumen Impact Investing is another forward thinker. Having recently acquired the research arm of a sector leader, SolarAid, they are working

51. UNEP. (2012). Financing renewable energy in developing countries. UNEP Finance Initiative. Retrieved from: http://www.unepfi.org/fileadmin/documents/Financing_Renewable_Energy_in_subSaharan_Africa.pdf
52. Porcaro, J. (2016). State of play and potential for scale in sub-Saharan Africa. SE4ALL Energy Access Practitioner Network – Energy Access "Movers and Shakers" Showcase Webinar. Retrieved from: https://cleanenergysolutions.org/sites/default/files/documents/movers-and-shakers-jem-porcaro-25-10-16.pdf
53. Zhang, Y-F., Parker, D. & Kirkpatrick, C.J. (2007) Electricity sector reform in developing countries: an econometric assessment of the effects of privatization, competition and regulation. Journal of Regulatory Economics (33)2:159-178.

BBOXX

A company that began as a not-for-profit collaboration between three UK-based engineering students, BBOXX now aims to provide 20 million people with electricity by 2020. BBOXX designs, manufactures distributes, and finances solar panels, batteries and plug-and-play energy efficient DC appliances such as televisions, radios, lighting units, and phone chargers.

Its typical customer lives off-grid in rural areas, and earns US$150 per month by farming small plots or fishing. Energy, in the form of kerosene, battery and phone charging purchases uses around US$10 of household income per month.

According to company statistics, BBOX's customers, which are mostly in Kenya and Rwanda, have saved US$2.4 million in energy expenses and offset over 40,000 tonnes of CO2.

Data access through mobile phone networks is central to BBOXX's business model. The company collects real-time data on power generation and usage, system performance and location of its units to within one kilometre via 2G signals and SMS in the case of poor signal availability. It also monitors customer payments and can shut units down remotely in the case of non-payment, reactivating them when payment has been made.

This data traffic is crucial to BBOX's investors, as it provides understanding of the market potential as well as securing payment adherence and company performance. Funders include private equity funds, merchant banks, foundations and environment-focused finance organizations.[57]

to enhance data collection and sharing about energy access markets and to publish their findings openly for other investors to learn from.[55]

It is worth emphasizing the opportunity afforded by new digital information technologies that can be coupled with the provision of energy – especially electricity. Even in the developed world, energy providers and consumers are only just starting to take advantage of these opportunities. A 2015 report funded by the US Department of Energy, titled Value of Customer Data Access, makes it clear that the benefits run both ways. "Access to data allows customers to evaluate available options and make informed decisions, which in turn empowers them to embrace a new role as active and engaged market participants. Utilities benefit from information availability and evolving technologies. With access to customer data, many utilities have achieved significant cost reduction and operational benefits."[56]

An example is BBOXX, a solar solutions supplier operating in Rwanda, Kenya, Burkina Faso, Colombia and a range of other locations. Its hardware transmits and receives data and instructions (see sidebar). The company knows immediately if hardware is malfunctioning, disconnected or stolen. Of particular importance to financiers supporting the company is the ability to log customers' energy usage, disable services when payments are missed and to reactivate services when payments are made. For the customer, the application of data-enabled energy services means better after-sales service, which drives further demand.

The importance of data to the emergence of the newly-connected energy market means there is also a huge opportunity here for businesses that source and supply reliable market data. Government agencies and NGOs can and should forge pathways for businesses to establish themselves in this space.

The emergence of the off-grid sector brings another significant and often unappreciated opportunity for financiers. Off-grid technologies can be deployed at whatever scale is most appropriate given market conditions and thus do not need to be as capital intensive as large centralized electricity supply additions. While this space is changing rapidly, a number of companies are having success in building their customer base. Investors who might have once seen investments in developing world energy infrastructure as too costly now have a new and growing set of investment options to consider.

54. Blodgett, C., Moder, E., Kickham, L & Leaf, h. (2016). Powering productivity: Early insights into mini grid operations in rural Kenya. Vulcan. Retrieved from: http://www.vulcan.com/MediaLibraries/Vulcan/Documents/Kenya-Mini-Grids-White-Paper-VI2.pdf
55. Acumen. (2016). Acumen acquires Solaraid's off-grid energy research and impact division. Retrieved from: http://acumen.org/blog/acumen-acquires-solaraids-off-grid-energy-research-and-impact-division/
56. National Association of Regulatory Utility Commissioners. (2015).Value of customer data access: Market trends, challenges and opportunities. Retrieved from: pubs.naruc.org/pub/536E2C7B-2354-D714-51CE-F035BA50FAA1
57. BBOXX. (n.d.). Impact. Retrieved from: http://www.bboxx.co.uk/customers/

2.2.2 Involve financiers early

Involving financiers in the early stages of business model development for aspiring off-grid companies is essential. Not only will it provide an avenue for financiers to gain specialized knowledge of the sector, new entrants to the sector will benefit from the perspective of financiers who ultimately must be engaged in order to bring their solution to market.

This is particularly important in the micro-grid space. Here, one of the biggest barriers to success is the setting of appropriate tariffs that will ensure financial sustainability. Financial experts can help developers to make these decisions – in consultation with local end-users – so that once a micro-grid system is installed there is a robust financial stream and ownership/incentive structure to ensure its maintenance and operation over time.

Partnerships between financial institutions and business accelerators or industry associations that serve the off-grid space may provide a pathway to collaboration. A number of impact investment firms, such as Acumen and Vulcan, are already engaged in such activities and provide a model that may be replicated by other institutions who see value in developing the expertise to take advantage of the growing opportunities presented by this emerging sector.

There is another good reason for financiers to get involved early. For many remote rural energy customers, their purchase of off-grid energy services and systems represents the first time that they have created any record of their status as consumers. A potentially powerful use for this data might be to encourage the creation of credit scores for these individuals which may assist them as they continue to climb the energy and economic ladder. This works for both sides, allowing customers to access financing for additional energy or other purchases more easily, and creating new credit-worthy consumers for financial products.

2.2.3 De-risk investments

There are a number of strategies that can reduce investment risk. One example is bundling. While many investors, especially venture capital firms, try to pick winners, a wiser approach may be to invest in a diverse array of projects and companies across the energy access sector to hedge against the various risks. Besides minimizing investment risks, bundling of projects also serves to increase both the attractiveness and visibility of smaller projects making them more appealing to a wider array of investors. Changes in political circumstances, flawed market analyses or changes to tariff structures within a single country can severely impact an individual company, but it is unlikely that such shifts would undermine the entire sector. That means diversified investment portfolios will almost always survive, as long as the sector as a whole continues to grow. Offering patient capital is another de-risking solution. By allowing projects time – a decade or more – to generate a return on the investment, strategic investment is more stable through moments of political, social or economic upheaval.

Guarantees and hedging instruments are needed to increase the attractiveness of investments from traditional sources of finance. The Multilateral Investment Guarantee Association and Currency Exchange Fund can be leveraged to mitigate these risks and attract investments to underserved markets in sub-Saharan Africa and elsewhere in the developing world. International finance institutions, also have an opportunity to back power purchase agreements and mitigate risks stemming from unstable policy environments.

While reduction of risks through the creation of stable regulatory environments, knowledge sharing and other actions is important, the large uncertainties regarding how the sector will evolve cannot of course be entirely reduced. The proliferation of risk tolerant investment instruments will therefore be a crucial source of much needed capital.

2.2.4 Pursue public-private partnerships

Financiers should be given the opportunity to jointly fund projects through public-private partnerships. Such partnerships can shift risk from the private sector investors to their public sector partners who are more patient and less risk averse. Aid agencies and national/international development funding institutions have a critical role to play in advancing opportunities for public-private partnerships and de-risking the space by investing in projects that are too risky to attract private sector funds.

Increasingly, development funding institutions are shifting away from the traditional model of charity-style giving and taking a larger role in funding social enterprises and new energy access start-ups. The US Agency for International Development (USAID) runs Development Impact Ventures, which provides a fantastic example of this strategy in action.[58] Through a staged process that provides increasing amounts of funding to development-oriented enterprises that meet predetermined benchmarks they are able to seed a large number of new ideas and businesses to get them started and ensure that larger investments are funneled toward proven business models.

58. USAID. (n.d.). About DIV. Retrieved from: https://www.usaid.gov/div/about
59. Arc Finance. (2014). Crowdfunding in the energy access space. Renewable Energy Microfinance and Microenterprise Program. Retrieved from: http://arcfinance.org/pdfs/pubs/REMMP_Briefing_Note_Crowdfunding.pdf

Government funders and international aid organizations must be in tune with private sector lenders and aware of the barriers to investment that they face. This will enable them to de-risk the sector and fill gaps themselves. Investing in market-building activities such as consumer awareness campaigns (and consulting with the private sector regarding their implementation) can also act to prime the pump for the future success of market-based solutions.

One way in which development aid institutions have acted to reinforce emerging markets and till the soil for energy access enterprises is by providing results-based financing (RBF). These incentive programs provide funding to entities that serve Base of Pyramid markets. Finance is tied to the results that are engendered – for example, a set fee paid to developers for each household that is electrified through their actions. When properly administered, this guarantee of financial return for services delivered can help to incentivize private actors in regions where they otherwise would not operate.

Find out more in our Solution Spotlight – Results-based funding with EnDev (page 50).

2.2.5 Develop peer-to-peer funding

An increasingly popular source of low-interest capital that is beginning to permeate the social enterprise space is peer-to-peer funding, where many individuals can make small investments in projects or organizations that they wish to support. Projects benefits from interest-free capital of whatever magnitude suits the cause, and a network for advertising and awareness-raising. A number of peer-to-peer financing campaigns, such as Kiva, Milaap and Sunfunder, have been used to generate capital for energy access enterprises and projects, and have even helped to attract larger institutional investors to the sector.[59]

There are a wide variety of financing mechanisms and institutions that can be leveraged to expand access to finance for the energy access sector.

We highlight a number of these in our Solution Spotlight – Innovative financing mechanisms and institutions (page 52).

2.2.6 Stimulate innovation

Development aid agencies and international finance institutions should seek to use their investments and clout to spur innovation in key areas. Funding competitions and awards for innovation and success can draw much needed attention and expertise into the space, creating an engine of technological ingenuity that will open up new markets over time through cost and performance improvements. An active space for this kind of work is in appliance efficiency, one of the lesser known but most promising avenues for reducing cost of off-grid energy services. The Global LEAP awards are an outstanding example in this regard, holding competitions that promote the development of efficient lighting, televisions, fans, and refrigerators.[47] These initiatives require philanthropic and public funding to maintain their impact and evolve alongside the sector that they serve.

Innovation capital can also help move ideas from research labs into the field. The Blum Center for Developing Economies at UC Berkeley, for instance, funded the transition of energy technology company Gram Power from the lab to rural implementation projects in India.[60] Many more companies like Gram Power are waiting to be born in the laboratories of universities and colleges across the developing and developed world. What they need more than anything is the financial and institutional support to create a solid foundation for growth in the emerging markets that they ultimately intend to serve.

Without technological innovation and investment in research labs, many of the current opportunities in the energy access sector would not exist. One example comes from ME SOLshare, a small but award-winning energy access company operating in Bangladesh. SOLShare was born in a research lab at the Technical University of Berlin, half way across the world from the markets that it now serves. It uses cutting edge technology to connect solar home systems that have already been sold through a successful government incentive program. The connection allows consumers to share, buy and sell energy with each other, and with their neighbors who may not even have a solar panel themselves.

Find out more in our Solution Spotlight – Connecting Bangladesh's solar home with ME SOLshare (page 54).

60. Lyons, K. (n.d.). Gram Power. Blum Center for developing economies. Retrieved from: http://blumcenter.berkeley.edu/news-posts/gram-power/

3. Empowered people

Equip citizens to contribute to new energy access solutions

3.1 Overview

The participation of a wide variety of talented people will be crucial to establishing global energy access. According to a report from the Miller Center for Social Entrepreneurship at Santa Clara University, between 7,000 and 20,000 new enterprises will be needed in order to eliminate global energy poverty with a market-driven approach.[61] These new enterprises will need to be staffed by thousands of employees, many of who have specialized training and experience. However, there is a major lack of human capital in the energy access sector because decentralized energy provision in the developing world is a relatively new concept. The need for specialized talent is most pronounced in the developing world contexts where these new enterprises must operate, adding another layer of difficulty to this capacity-building challenge.

One hidden consequence of the existing lack of knowledge is a lack of demand. End-users, politicians, civil servants and finance agencies lack knowledge about benefits, technology, market opportunities, business models, demand dynamics, and success stories. As a result, many energy access opportunities remain unexplored, and will continue to be until energy education initiatives of various kinds make the benefits and opportunities inherent in the new paradigm of universal energy access clearer to key participants, particularly the consumer.

Even with strong demand for modern energy access technologies in place, there is a significant need to train those who will be involved in their creation, diffusion and operation. The technical details of these energy systems and components, such as solar panels, wind turbines, batteries, and so on, are rarely taught in schools and colleges in the developing world. This makes it difficult to find people qualified to design, install, maintain, and repair the systems.

Another gap is in the equipping of energy entrepreneurs for success, something we consider important enough to give its own section (see page 32).

Finally, journalists and other media professionals can contribute with nuanced reporting on this dynamic global development sector, creating demand through storytelling. Although programs that educate individual communities about the benefits of energy access are useful, they are also labour-intensive. Getting information in local vernacular to the most energy deprived through local media like community radio is key, especially in countries which have widespread energy poverty in rural areas that are not reached by national media.

Each of these audiences require different sets of programs to drive capacity growth, which must be tailored to local needs and contexts in order to drive bottom-up interest and engagement.

3.2 Six actions that will empower communities to access energy

3.2.1 Establish demand-raising energy education initiatives

The development of new energy access projects depends upon demand. Energy-isolated communities may be unaware of the technologies available that match with their specific energy resources and community needs. By helping to provide this information, governments and other organizations can empower communities to instigate new projects and help ensure that they are sustainable over time. The work of TREC Education[62] and Lumos Energy[63] provide good Canadian examples of this strategy at work. Finding and supporting energy champions – individuals who have the skills and motivation to advance their community's energy agenda – is a powerful means to establishing a community's

61. Miller Center for Social Entrepreneurship. (2015). Universal energy access: An enterprise system approach. Santa Clara University. Retrieved from: http://static1.squarespace.com/static/55036eefe4b0fe6c8e833e4a/t/560abee9e4b003cfd1815f5f/1443544809216/Universal+Energy+Access+-+Miller+Center+White+PaperJG.pdf
62. TREC Education. (n.d). About. Retrieved from: https://treceducation.ca/
63. Lumos Clean Energy Advisors. (n.d.) About. Retrieved from: http://indigenouscleanenergy.com/connect/about/

Photo credit: UNHCR/S.Ostermann

voice. The model of the Young African Leaders Initiative provides a framework for helping individuals achieve skills that will help their communities.[64]

NGOs can also work to educate government officials, provide advice on policy and planning processes, and work with private enterprises to develop market intelligence and ensure that solutions are responsive to end-user needs. A further role for NGOs is to assist journalists and media outlets in covering energy access stories by providing support in the form of case studies, fact sheets and even financial assistance. Discourse Media, provides an example through its Power Struggle platform which – partially funded by WGSI – provides in-depth coverage of the universal human dimensions of energy poverty across the globe, from Zimbabwe to Kiribati to Transylvania.[65]

Finally, it should be noted that private marketing firms have been particularly effective contributors to previous consumer awareness campaigns, and a combination of public sector, private sector, and NGO-led initiatives that support sector growth through a full ecosystem approach will be the most effective way to create sustainable demand and supply.

Pioneered by Lighting Global, the World Bank's platform for supporting growth of the off-grid solar market, comprehensive consumer awareness and social marketing campaigns have emerged as highly successful market building initiatives for the energy access sector in Africa and Asia. By employing a holistic approach that both creates demand and helps distributors to meet it, Lighting Global and others have helped to fill the marketing and awareness gaps that small enterprises aren't able to address on their own.

Find out more in our Solution Spotlight – Growing bottom of the pyramid demand with Lighting Global (page 56).

3.2.2 Establish a diverse skills training portfolio

Energy access companies, and social enterprises more generally, often struggle to find the right talent. Energy access requires well-trained, skilled, motivated human resources to develop and implement energy service delivery in the most difficult markets and environments on the planet. Most countries that lack energy access also lack programs to create such a workforce. Leaders in this space include India's National Skills Development Corporation, which uses public-private and public-public partnerships to set up schemes that offer financial incentives for completing skills training. In order to avoid conflicts of interest, the rewards themselves are wholly funded by India's Ministry of Finance, and the assessment and training bodies are separate.[66] Though there will be no universal strategy that can be applied to all geographic contexts, but there is clearly scope for many kinds of partnership in such initiatives.

At the college level, standardized and certified training programs for technical, business and design competencies related to energy access are essential. These should be established and organized by national funding agencies and aim to offer a systematic and consistent training independent of specific company interests and components. It is equally important that manufacturers, installers and distributors of energy access hardware are consulted and included in program development. It would also be useful to establish a short course that familiarizes banking professionals with issues relating to renewable energy project finance, such as how to analyze projects that have no existing balance sheets or assets.

It is also worth pointing out that employment matchmaking sites such as the Alliance for Rural Electrification's Off-Grid Job Platform demonstrate a route to ensuring suitably qualified individuals find appropriate positions.[67] A post-graduate program that places bright young people inside energy access companies (ideally on a rotation basis so as to give a broad look at the industry) can also open up new

64. Young African Leaders Initiative. (n.d.). About YALI. Retrieved from: https://yali.state.gov/yali-africa/
65. Discourse Media. (n.d.) About Power Struggle. Retrieved from: http://discoursemedia.org/power-struggle
66. National Skill Development Corporation. (n.d.). Organization profile. Retrieved from: http://www.nsdcindia.org/organisation-profile
67. Alliance for Rural Electrification. (n.d.). Off-grid job platform. Retrieved from: http://ruralelec.org/job-platform

thinking and opportunities, especially when used to empower members of energy-isolated communities, whose lived experience can be a powerful catalyst for innovation.

Technical training can also be successfully integrated into broader technology transfer and diffusion programs. The SOLTRAIN project, for example, has not only developed 187 solar thermal demonstration projects across Southern Africa, but helped to develop a workforce of over 2,000 trained individuals through over 80 training courses and 25 stakeholder workshops. By undertaking a capacity-building approach, SOLTRAIN is working towards a sustainable, long-term diffusion of this underutilized technology.

Find out more in our Solution Spotlight – Improving resilience with SOLTRAIN (page 57).

3.2.3 Focus on empowering women

Women have a vital role to play in energy access. Gender equality can be significantly enhanced by access to electrical appliances that reduce the time needed to perform the household tasks such as water and fuel collection. Throughout the developing world, women currently spend three to five times as long as men on domestic chores including cooking which exposes them to high levels of indoor pollution.[68] The time and energy saved by energy access and improved health outcomes will benefit them greatly, and can be channeled into education and economic initiatives, making women a powerful social and economic force and significant contributors to development. Like the ENERGIA, the International Network on Gender and Sustainable Energy,[69] and other organizations, we believe meeting SDG 7 will help to accelerate the completion of SDG 5's goal of establishing gender equality.

The need for such gender-focused efforts cannot be overstated. Studies have demonstrated that women face significant barriers in the quest for energy access. Female entrepreneurs, for example, encounter longer grid connection delays than their male counterparts, and are more often victims of extortion, in the form of demands for bribes to receive a connection.[70]

The electrification of rural communities in South Africa[71] and Guatemala[72] both produced a nine percentage point increase in female employment with no comparable increase in male employment. This increase in productive employment can be traced back to the increased efficiency in domestic chores, which frees up significant amounts of time. This has significant repercussions. According to World Bank figures, economic empowerment of women results in wide societal benefits. In Brazil, putting income in a mother's hands increases a child's survival chances by around 20 percent. In Kenya, the child will be about 17 percent taller because women tend to

68. OECD. (2014). Balancing paid work, unpaid work and leisure. Retrieved from: http://www.oecd.org/gender/data/balancingpaidworkunpaidworkandleisure.htm
69. OECD. (2014). Balancing paid work, unpaid work and leisure. Retrieved from: http://www.oecd.org/gender/data/balancingpaidworkunpaidworkandleisure.htm/access/
70. Alstone, P., Niethammer, C., Mendonca, B. & Eftimie., A. (2011). Expanding women's role in Africa's modern off-grid lighting market. Lighting Africa. Retrieved from: http://www.esmap.org/sites/esmap.org/files/gender_lighting_highres_LOW%20RES.pdf
71. Dinkelman, T. (2007). The effects of rural electrification on employment: New evidence from South Africa. Princeton University. Retrieved from: https://www.princeton.edu/rpds/papers/dinkelman_electricity_0810.pdf
72. Grogan, L. & Sadanand, A. (2009). Electrification and the household. Retrieved from: http://microdata.worldbank.org/index.php/citations/2036
73. wPOWER. (2014) wPower Hub Report 2013-2014. University of Nairobi, Kenya. Retrieved from: http://wpower.uonbi.ac.ke/wpower-hub-releases-the-201314-annual-report/

Photo credit: Julien Simery/UNESCO

invest more in health and nutrition. Empowering women economically raises agricultural productivity by around a fifth in sub-Saharan Africa. It also benefits communities and local economies. Female entrepreneurs have been shown to be twice as capable and successful as men.[73] They are also more socially connected, meaning that their success stories are more widely known and thus more influential in driving further interest and innovation.

Access to energy also has indirect benefits for women. Community street lighting reduces the incidence of violent attacks on women. Being able to watch television increases women's awareness of health, education, equality, and domestic violence issues. An Asian Development Bank study in Bhutan noted that less time spent on domestic chores also gave women the opportunity to attend village meetings and voice their concerns.[74]

As well as supporting energy access projects, governments can support gender equality efforts by creating enabling conditions to ease the flow of finance to women. A lack of legal and regulatory tools supports that address the needs of women, as well as cultural practices that, for example, limit property ownership stand in the way of women being able to access the financial tools they need to succeed.[75] According to the AfDB, only 16 to 20 percent of women in sub-Saharan Africa are able to access long-term financing from formal financial institutions. The median capital available to male entrepreneurs is more than twice that of women. In Kenya, women own 48 percent of small businesses, but access only seven percent of the available credit. In response they have established a plan to create a US$3 billion Affirmative Finance Action for Women in Africa fund to help end this disparity.[76]

3.2.4 Establish networks that empower remote and Indigenous communities

With capacity-building initiatives like those highlighted above put in place, it is inevitable that networks of interested and mutually supporting parties will emerge. These networks, which will be of particular importance to those in Indigenous and remote communities, will become the load-bearing structure for the work of establishing energy access. It is vital that governments and NGOs act to foster and support networking efforts, so that small-scale efforts become scalable, solutions and resources are shared, and the emerging energy entrepreneurs become a powerful force in the market.

Australia's Centre for Appropriate Technology[77] and Canada's emerging Indigenous Clean Energy Network[63] are examples or organizations already working specifically to connect Indigenous communities engaged in energy project. We recommend they, and other networks for remote communities like the Arctic Energy Alliance[78] and the Renewable Energy Alaska Project,[79] continue to look for ways to link with others and establish larger knowledge sharing networks.

For a more in-depth look, see Energy access – the Canadian context on page 36.

74. Asian Development Bank. (2010). Asian Development Bank's assistance for rural electrification in Bhutan: Does electrification improve the quality of rural life? Retrieved from: https://www.oecd.org/countries/bhutan/46757667.pdf
75. Jideonwo, J. (2016). Getting women off the financial sidelines: Iniiatives for gender equality in Africa. African Developmen Bank Group. Retrieved from: https://www.afdb.org/en/blogs/investing-in-gender-equality-for-africa%E2%80%99s-transformation/post/getting-women-off-financial-sidelines-initiatives-for-gender-equality-in-africa-15546/
76. AdDB. (2016). Is it what they need? Experts debate AfDB's new affirmative finance action for women in Africa. Retrieved from: http://www.afdb.org/en/news-and-events/article/is-it-what-they-need-experts-debate-afdbs-new-affirmative-finance-action-for-women-in-africa-15748/
77. Centre for Appropriate Technology. (n.d.). Our Story. http://www.cat.org.au/who-we-are/
78. Arctic Energy Alliance. (n.d.). About us. Retrieved from: http://aea.nt.ca/about-us
79. Renewable Energy Alaska Project. (n.d.). About Renewable Energy Alaska Project. Retrieved from: http://alaskarenewableenergy.org/index.php/about-reap/

3.2.5 Share experiences and resources across development sectors

There are several opportunities for governments to avoid re-inventing the wheel by integrating resources and expertise for energy access with other areas such as healthcare, education, sanitation, and agriculture.

For healthcare professionals, the return on investment in energy access will be significant. Many healthcare issues cannot be adequately resolved without the communities in question establishing reliable access to electricity. From refrigerators that keep vaccines from spoiling, to properly-lit operating theatres, to clinics that can safely operate during the hours of darkness, energy is vital to effective healthcare. Beyond the hospital, domestic refrigeration facilities reduce the occurrence of food poisoning, electrically-operated water-pumping and sanitation stations help prevent outbreaks of dysentery, cholera and other water-borne diseases and modern, reliable electrically-powered agricultural processing equipment reduces the incidence of workplace accident and injury. All these measures reduce the burden on healthcare services.

Healthcare professionals have significant experience that will benefit energy access programs. Even basic healthcare innovations often have to be 'sold' to communities through health education programs. Similar education initiatives are necessary for energy access programs. Health education professionals who have worked in the same communities will already have a good sense of what matters to them, and how new opportunities are best presented. To ignore this wealth of expertise is to waste a valuable resource.

Education, too, is widely seen as a pillar of economic and social development, and the providers generally have extremely high standing within their communities. As such they are valuable allies in establishing positive attitudes towards energy access projects. They also understand the way people within a local community think, and what is valued. That means they will be useful consultants when developing strategies for establishing and maintaining energy services in a particular community.

As with healthcare, education services stand to benefit enormously from energy access. The presence of electric lighting makes after-dark teaching and learning possible, radically extending the school day. Internet access, which relies on electricity access, facilitates learning from and communication with the wider world. The need to train local operators, technicians and service personnel for energy infrastructures means that establishing energy access also opens up new opportunities for course and curriculum development, potentially augmenting an educational institution's income.

Collaboration between energy access and agriculture programs would also be mutually beneficial. Agricultural activities that seek to add value to the supply chain of agricultural produce tend to require electricity for processing. A generic example is the freezing of produce to enable overseas shipping to larger, more lucrative markets. A specific example is the work of Promethean Power Systems, which provides thermal battery chillers that allow cows' milk to find a market beyond the immediate locality of rural dairy farmers in communities where access to electricity is intermittent.[80] Developing this technology, which is slightly more expensive than running a diesel generator to power a conventional refrigerator, involved liaising with both farmers and those who might be willing to lease access to electricity supplies serving infrastructure such as mobile phone masts.

Many farming-focused development projects have put considerable effort and resources into communicating the benefits of their innovations to end-users. This experience is a resource that those seeking to establish energy access projects would do well to tap.

NGOs and academic institutions should also be encouraged to partner with those who have on-the-ground experience. In particular, designers of technological solutions need to work closely with, and in proximity to, end-user communities in order to ensure the real-world value of their products is optimized. Design-to-value is an under-exploited paradigm that can be applied to development technology.[81] Research should be embedded within end-user communities – who are ultimately the experts in value assessment – and employ the principles of iterative design in order to ensure products are fit for purpose.

80. Promethean Power Systems. (n.d.) About us. Retrieved from: http://coolectrica.com/about-us/
81. Fritzen, S., Nick, H. & Wullenweber. (2013). Capturing the full potential of design to value. McKinsey. Retrieved from: http://www.mckinsey.com/industries/consumer-packaged-goods/our-insights/capturing-the-full-potential-of-design-to-value

Small energy access companies often lack the funds necessary to pay salaries that can attract strong foreign talent. On top of this, it is often difficult to convince those in the developed world to commit to moving to a developing country.

3.2.6 Establish incentives for premium workers

For understandable reasons, the best young graduates in the developing world are often attracted to high paying jobs in finance or the development sector. It can be extremely difficult to attract local talent to work at a start-up which is inherently less stable than a larger, more established business. What's more, many talented mid-level managers leave the country for what they perceive as better opportunities.

This barrier is not just about home-grown talent, however. Small energy access companies often lack the funds necessary to pay salaries that can attract strong foreign talent. On top of this, it is often difficult to convince those in the developed world to commit to moving to a developing country.

Several strategies could be used to draw highly skilled workers into the energy access sector. One is to establish a pool of funds that could subsidize salaries of highly qualified repatriates who have moved abroad but want to come back, but are discouraged from doing so by higher salary expectations. Some universities already operate such a system, though not for energy access purposes. Convincing people to repatriate for longer periods is particularly difficult, and might benefit from an NGO or government-led recruiting platform that vets candidates and connects only the best current or recently-graduated students with energy access jobs would be immensely valuable. This could be paired with a funding pool that would act as a merit-based scholarship for candidates, funding a stipend to incentivize more talented people to work in this field. It is worth noting that a climate of increasing investment in a field – green technology, for example – encourages skilled workers to take note of the enhanced job prospects and move into that area, often without specific lures.[82]

Taking the idea further, universities or other organizations in the developed world could sponsor scholarships that enable high achieving college students from low energy access countries to study abroad for graduate school for one or two years – ideally, with a commitment to return and work in their home country for a specified minimum period. These students could be paired with peer mentors in their program or in the field. Precedents for this, the MasterCard Scholars Program,[83] the Carnegie-Mellon Innovators Forward Fellowship Fund,[84] and the SMART Africa Scholarships Fund,[85] are already in operation. Although this scheme does not specify the area of study, it will be critical for a similar energy access program to specify the areas of study particular to energy, such as public policy, electrical engineering or entrepreneurship. Such a program could stipulate that students return to their home countries after their studies. It could also partner with ministries of energy and rural electrification authorities to create positions for graduates of the program. This would create a capacity-building engine that recruits, develops and retains top talent where it is needed most in the energy access sector.

Such a program could imply graduate exchange programs between universities, offering experience and knowledge gained in countries that have already implemented off grid systems successfully. It could also lead to more effective knowledge transfer between academic and practitioner institutions in the developed and developing world.

82. OECD. (2011). Towards green growth. Retrieved from: http://www.oecd.org/env/towards-green-growth-9789264111318-en.htm
83. MasterCard Foundation. (n.d.). The MasterCard Foundation scholars program. Retrieved from: http://www.mastercardfdn.org/the-mastercard-foundation-scholars-program/
84. Carnegie Mellon University. (2014). Carnegie Mellon University launches fund to accelerate engineering education in Africa. Retrieved from: https://www.cmu.edu/rwanda/news/2014-12-04-cmu-launches-fund.html
85. Smart Africa. (n.d.). Smart Africa scholarship fund. Retrieved from: https://smartafrica.org/?Smart-Africa-Scholarship-Fund

4. Success through diversity

Create an environment where energy entrepreneurs and their evolving business models can thrive

4.1 Overview

Although there is an enormous amount to be gained from achieving the three solutions we have highlighted so far, they are fairly general, broad stroke approaches to facilitating and sustaining energy access. Here we focus on a very specific and important solution: energy entrepreneurship. There is every indication that this is the key that will unlock SDG 7.

Across the world governments, economists and thought-leaders are championing the importance of entrepreneurs and innovators. That is because entrepreneurs have driven growth in many emerging economies causing governments to encourage a more of the same approach. A strong set of motivated change-makers can certainly have profound effects on a country's economy, standing and social conditions. As Wim Naudé of the Maastricht School of Management has pointed out, "Global development is entering a phase where entrepreneurship will increasingly play a more important role."[86] That is partly because donors have been shifting focus towards private sector development in the least developed countries.

The role of entrepreneurs is certainly important for energy access, and networks of motivated citizens are achieving profound innovations in energy services delivery.[87] However, the global energy access market is an extremely divergent space, representing a plethora of small segments across many countries and regions. The opportunities represented by this vast and diverse market cannot all be met using a single business model. Therefore, the global task of increasing energy access will involve many and diverse entrepreneur-driven models, which will all need room to co-exist, compete, evolve, and thrive.

Despite the promise, energy entrepreneurs who are trying to open up new energy markets with new technologies face difficult economic and social conditions. The majority work within contexts that are unconducive or even hostile to innovation, and where grassroots innovations struggle to survive and grow.[88] As a result, some of the highest potential market opportunities, such as the deployment of highly efficient direct current (DC) appliances, remain largely untapped. Many other market opportunities are probably yet to be identified.

Many of the solution points from previous sections of this document can and should be tailored to the specifics of energy entrepreneurship, in ways that we lay out below.

4.2 Three actions that will allow energy entrepreneurship to flourish

4.2.1 Physical spaces that bundle support for energy entrepreneurs

In the developing world, innovation often exists at the grassroots level simply because a large proportion of the population is under 35 and many young people have to innovate to make a living.[89] In the energy access sector, however, this is challenging because of the difficult business environment explored in Section 2.

Creating energy entrepreneurship ecosystems within which energy entrepreneurs can flourish will be vital to the struggle to expand energy access. Physical facilities such as incubators, innovation labs, business offices and tinkering space are crucial to many entrepreneurs who discover what works in their chosen area by exploring and doing.[90] Such facilities should also offer access to mentors and networks because learning from experienced peers accelerates the success of entrepreneurship ventures. Entrepreneurs also need access to reliable information

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87. Van Der Schoor, T., Van Lente, H., Scholtens, B., & Peine, A. (2016). Challenging obduracy: How local communities transform the energy system. Energy Research & Social Science, 13, 94-105.
88. Hargreaves, T., Hielscher, S., Seyfang, G., & Smith, A. (2013). Grassroots innovations in community energy: The role of intermediaries in niche development. Global Environmental Change, 23(5), 868-880.
89. UNFPA. (2014). The power of 1.8 billion: Adolescents, youth and the transformation of the future. Retrieved from: http://www.unfpa.org/sites/default/files/pub-pdf/EN-SWOP14-Report_FINAL-web.pdf
90. Agbemabiese, L., Nkomo, J., & Sokona, Y. (2012). Enabling innovations in energy access: An African perspective. Energy Policy, 47, 38-47.

from market intelligence and technology updates to legal and regulatory changes. Finally, these centres should make available a suite of tools, resources and guidelines for business model development. These can help entrepreneurs to design innovative models that work in their particular context.

The World Bank has supported the creation of eight Climate Innovation Centers: in Kenya, Ethiopia, India, South Africa, Vietnam, Morocco, the Caribbean, and Ghana. These are hubs that deliver a wide range of support and resources to budding entrepreneurs aiming to serve these markets with clean energy solutions.

Find out more in our Solution Spotlight – Incubating entrepreneurs at the World Bank's Climate Innovation Centers (page 58).

4.2.2 Market intelligence

It is equally important to help entrepreneurs fully understand their prospective customers during business model development and communicate the viability of their model to those who can finance it. When entrepreneurs are also designers of their product – which is often the case with energy access start-ups – the need for deep market intelligence to understand end-user needs is even more important. Networks of humanitarian engineers, many of which are founders of social and profit-making enterprises dedicated to the diffusion of the technologies they create, can also help to support these entrepreneurs in recognizing the potential pitfalls that they can find themselves in if they do not understand their customers deeply enough. Engineering for Change, for example, is a non-profit dedicated to popularizing design for development principles, and currently manages a library of energy access technologies and solutions to support user-centric design in the sector.[91]

There are lessons to be learned here from other sectors as well, such as telecommunications. In Africa, mobile telecom companies have allowed small-to-medium size entrepreneurs to franchise brand names and open centers that sell phones, calling credit and other services. Their training programs channel natural inclinations to innovation, providing technical training and business/entrepreneurship training, and can teach skills that will have immediate payback for energy access. Emerging energy access enterprises should also look to harness local creativity and entrepreneurial spirit in order to enhance the diffusion of their products and services.[92]

While big data and the internet of things may seem like high-tech concepts suited to the developed world, their application in the most remote areas of the globe may create huge market building opportunities for the off-grid energy sector. SteamaCo and other enterprises are already successfully applying these platforms to support remote monitoring, operation and after sales service for off-grid energy technologies, from small solar home systems and solar irrigation pumps to larger village scale micro-grids.

Find out more in our Solution Spotlight – Harnessing data from remote energy markets with SteamaCo and Vulcan Impact Investing (page 59).

4.2.3 Establish supportive policy frameworks

For entrepreneurs to thrive, governments must create well-defined regulations, well-crafted incentives and a reliable safety net that allows entrepreneurs to start again if their business fails. These should be formed in consultation with networks of entrepreneurs to avoid the problem of small scale entrepreneurs struggling to negotiate favourable terms with larger market players.[93] Such initiatives are rare in the developing or developed world but Ofgem, the UK's energy regulator, has launched a program, Innovation Link, that works with energy entrepreneurs to establish a regulatory framework that supports new types of business in the energy space.[94] An example of a similar initiative is the Canadian MaRS Network. Besides offering a suite of resources and access to financiers, MaRS helps entrepreneurs in a variety of sectors to negotiate, and sometimes re-negotiate, regulatory issues.[95] Energy entrepreneurs also need governments to formulate quality standards and certification, as discussed in Section 1.[96, 97]

91. Engineering for Change. (n.d.). Solutions library. Retrieved from: http://solutions.engineeringforchange.org/
92. Castella, G., Jeanloz, J. & Voillat, J. (2016). Scaling Social Businesses at the Base of the Pyramind – 25 Years of Lessons Learned Webinar. Retrieved from: https://www.engineeringforchange.org/webinar/scaling-social-businesses-at-the-base-of-the-pyramid-25-years-of-lessons-learned/
93. Ravindranath, N. H., & Balachandra, P. (2009). Sustainable bioenergy for India: technical, economic and policy analysis. Energy, 34(8), 1003-1013.
94. Ofgem. (n.d.) The Innovation Link. Retrieved from: https://www.ofgem.gov.uk/about-us/how-we-engage/innovation-link
95. MaRS. (n.d.). Startups. Retrieved from: https://www.marsdd.com/startups/
96. Marshall, J. (2013). Solar energy solutions for the developing world. Ensia. Retrieved from: https://ensia.com/features/solar-energy-solutions-for-the-developing-world/?viewAll=1
97. CLASP. (n.d.). Our programs. Retrieved from: http://clasp.ngo/en/OurPrograms/CurrentPrograms/CleanEnergyAccess

4.2.4 Open access to financial support

Although we have already discussed finance issues in Section 2, it is worth emphasizing the central role of financial assistance in helping energy entrepreneurs establish their businesses.

Traditionally, investors prefer larger enterprises that have better resources for connecting with large numbers of customers.[98] They are also reluctant to engage early, especially in businesses that face high transaction costs and high risk.[99] Risk-averse financiers tend to try to pick winners from among the plethora of energy innovations, or see tried and true, less innovative models as more viable than others. Information is a big issue here: financiers often don't have enough data on which to base their decision-making and so opt for what they know.[100] Ironically, many of the less risk-averse financiers adopt a strategy where they simply opt for the newest technology and look to invest in the next big thing. This strategy also precludes them from investing in elegant, low-tech solutions such as efficient, low power DC appliances.

Solving this matrix of problems requires government, philanthropic or NGO-led investment in a framework of supporting ecosystems that connect many actors in the energy entrepreneurship space. Evidence shows that when these ecosystems are well resourced and well designed, energy entrepreneurs are highly successful.[101] Solar Sister is an example of a program that utilizes the power of local entrepreneurs to market energy access solutions. This peer-to-peer sales solution allows women to tap into their social networks to find customers for clean energy lights and cookstoves, with the Solar Sister program providing hardware, logistical support and cashflow solutions.[102] Governments can partner with such programs to maximize their chances of success.

Crowd funding and angel investors are two other emerging responses to the ongoing issue of raising funds with which entrepreneurs can trial their ideas. SunFunder,[103] SunnyMoney,[104] Kiva,[105] and Mosaic[106] are among a host of emerging and established companies demonstrating that crowdfunding can attract energy investment in the developing world because it doesn't require huge commitments from anyone. Angel investors are often extremely supportive of nascent ideas and fully aware (and tolerant) of the financial risk. They also network together well, sharing opportunity, research findings and due diligence, all of which takes the heat off the entrepreneur.[107] Governments need to work in partnership with such investors, researching, evaluating and establishing the conditions – such as microfinance opportunities, patient capital incentives and repatriation of funds – that are most conducive to their involvement.

New techniques for channeling large-scale finance to multiple small-scale projects are also being developed and implemented. Green bonds, such as those issued by the International Finance Corporation, offer a low-risk investment proposition to finance clean energy and low-carbon projects and thus bundle and securitize debt.[108]

Partial loan guarantees have also been used to support energy projects. For example, the African Development Bank provided a partial guarantee for a wind-power project in Kenya to protect against political risks of delay or default.[109] National governments looking to support energy entrepreneurship need to find similar programs that will de-risk investment in this sector. Canada, for example, is establishing a national Infrastructure Bank that will support a range of capital-intensive projects by attracting private investment to supplement direct federal funding.[110]

98. Luthra, S., Kumar, S., Garg, D., & Haleem, A. (2015). Barriers to renewable/sustainable energy technologies adoption: Indian perspective. Renewable and Sustainable Energy Reviews, 41, 762-776.
99. Bazilian, M., Nussbaumer, P., Eibs-Singer, C., Brew-Hammond, A., Modi, V., Sovacool, B. & Aqrawi, P. K. (2012). Improving access to modern energy services: Insights from case studies. The Electricity Journal, 25(1), 93-114.
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102. Soria, L., Farley, K., & Glinski, A. M. (2016). With Solar Sister, forward we go. Retrieved from: https://www.icrw.org/wp-content/uploads/2016/10/Solar-Sister-Qualitative-Assessment.pdf
103. SunFunder. (n.d.). About. Retrieved from: http://sunfunder.com/about/
104. SunnyMoney. (n.d.). How we work. Retrieved from: http://sunnymoney.org/index.php/about/model/
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107. International Institute for Environment and Development. (n.d.). How can business help boost access to energy for those who need it most? Retrieved from: http://www.iied.org/how-can-business-help-boost-access-energy-for-those-who-need-it-most
108. World Bank. (2015). Green Bonds Attract Private Sector Climate Finance. Retrieved from: http://www.worldbank.org/en/topic/climatechange/brief/green-bonds-climate-finance
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5. Call for collaboration

The United Nations' 17 Sustainable Development Goals are a powerful call to action on the multifaceted task of eradicating poverty, fighting inequality and tackling climate change. It will not be possible to complete this task without establishing universal energy access, which is vital to creating gender equality, providing educational opportunities, and stimulating economic development. Establishing energy access itself will require wide collaboration as laid out in SDG 17. This goal calls for principled, value-driven partnerships between governments, the private sector and civil society at the global, regional, national, and local level.

WGSI is committed to establishing and nurturing such partnerships on the road to establishing energy access. 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 conclusions and recommendations are laid out in this Blueprint. We are now embarking on a prolonged period of deeper studies of relevant literature and current practice, strategic implementation, network creation, and other support activities.

Our remit is not limited to energy access, however. In the coming years we will investigate the best way to make progress in related fields, such as agriculture, food security, water access and healthcare.

This will require wide and varied collaboration. We are aware that in any grand challenge scenario, many efforts can be unknowingly duplicated and valuable ideas can become isolated in the silos of disciplines. That is why we welcome further input to our current and future phases. We are already working with Discourse Media to support journalistic investigations of energy access and related issues.[65] We are also collaborating with Affordable Energy For Humanity (AE4H) to further research implementable pathways towards global energy access.[111] The Solutions Spotlights laid out in the pages that follow are provided as a catalyst to further innovation and networking.

This is only the beginning of our efforts to facilitate creative and effective partnerships. We are actively seeking new organizations and individuals with whom we can collaborate to identify and implement the political, legal, technological, educational and other changes necessary for achievement of the SDGs. We look forward to hearing from you.

111. Affordable Energy for Humanity. (n.d.). Our vision. Retrieved from: https://ae4h.org/vision

ENERGY ACCESS – THE CANADIAN CONTEXT

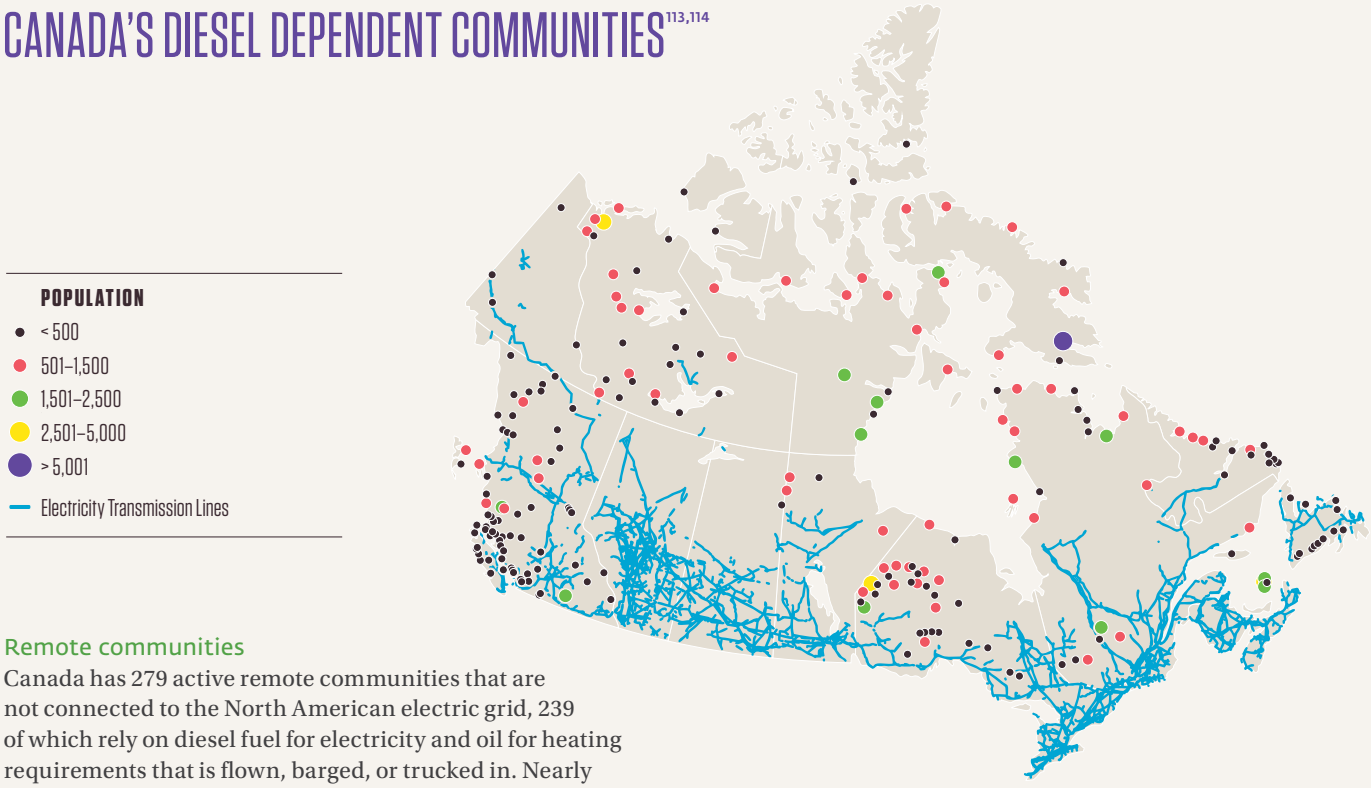
Planning for plenty – a strategic national priority

We must acknowledge the role of energy as the backbone of a better quality of life for remote communities facing a variety of disadvantages. We can no longer ignore our responsibility to provide the supportive resources these communities need to not only meet their current minimum energy needs but to **plan for plenty**.

Four steps are required to establish this as an area of national priority:

1. Commit to a step change in investment
   Canada's federal government should increase its overall funding commitments for energy in remote communities from the tens of millions to the billions in the immediate future. This funding should be seen as a priority area for ongoing green infrastructure spending programs.
2. Recognize Indigenous leadership and support capacity building
   In order to ensure long-term economic and social benefits, Indigenous clean energy leadership must be recognized and supported through capacity building programs.
3. Create a single, intergovernmental point of contact
   A single point of contact within government – whose responsibility is to ensure those initiating and managing energy projects can navigate regulations, funding and reporting at the federal and provincial/territorial level and across relevant departments – is essential.
4. Connect people, technologies and information
   Knowledge sharing between communities and innovative institutions is critical to success. Private and public sectors should be encouraged to utilize up-to-date information and innovative technologies to seek new arrangements for energy projects in remote communities that are financially sustainable over the long term.

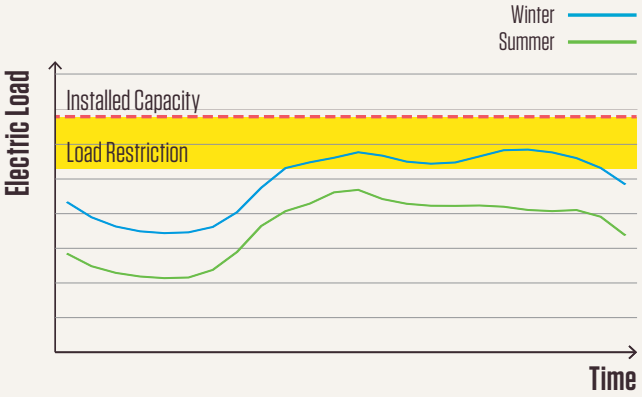
CANADA'S DIESEL DEPENDENT COMMUNITIES[113,114]



Remote communities

Canada has 279 active remote communities that are not connected to the North American electric grid, 239 of which rely on diesel fuel for electricity and oil for heating requirements that is flown, barged, or trucked in. Nearly two thirds of these remote communities are Indigenous.[112]

OUTAGES, LOAD RESTRICTION AND AGING EQUIPMENT[116]



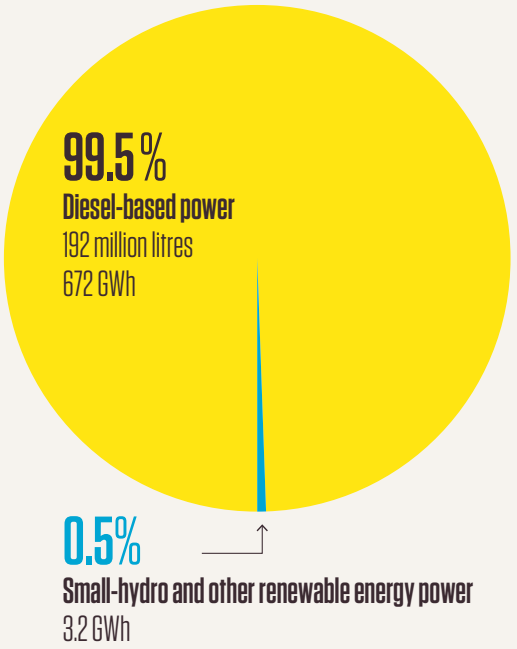
Inadequate energy services

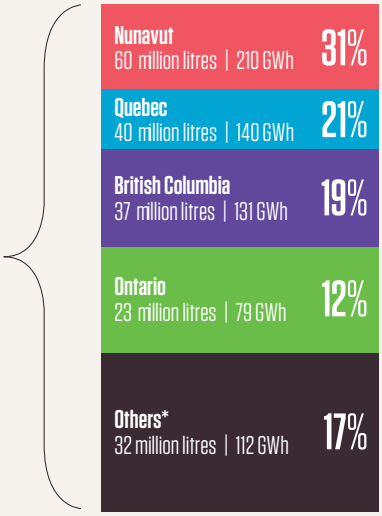
Nunavut, Ontario, and British Columbia are regions where an estimated 25 to 50 percent of communities have a load restriction status, meaning that peak electricity demand is near the maximum operating capacity of the diesel-generator plant.[115] Load restriction status has a number of negatively compounding 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 impact on quality of life.

ELECTRIC ENERGY SOURCE AND DIESEL CONSUMPTION ESTIMATE IN FUEL DEPENDENT COMMUNITIES[117, 118, 119, 120, 121, 122, 123, 124]

Fossil fuel dependency

Diesel fuel is used to generate 99.5 percent of all electricity in remote communities. 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 (INAC), there are over 2,000 contaminated sites on First Nations reserves across Canada, 70% of those sites are contaminated with diesel.[112]

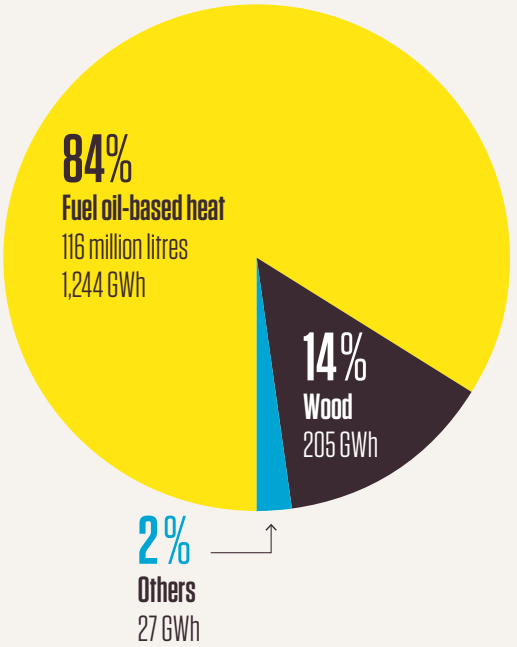


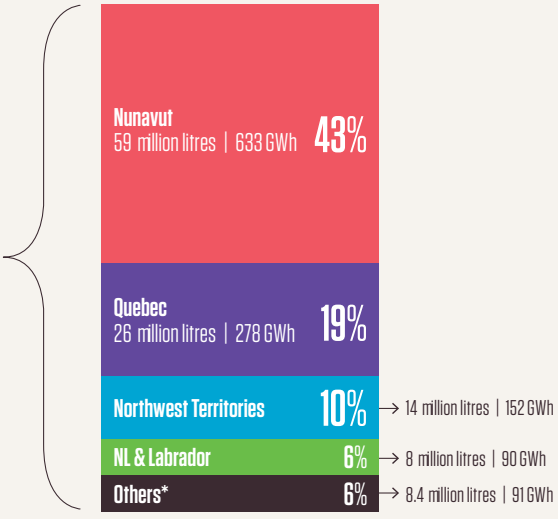


* Manitoba (4.0 million litres, 14 GWh, 2.1%)
Northwest Territories (12.8 million litres, 44 GWh, 6.7%)
Newfoundland and Labrador (13.3 million litres, 46.5 GWh, 6.9%)
Saskatchewan (0.05 million litres, 0.2 GWh, 0.03%)
Yukon (1.7 million litres, 5.9 GWh, 0.9%)

HEATING ENERGY SOURCE AND DIESEL CONSUMPTION ESTIMATE IN FUEL DEPENDENT COMMUNITIES[114, 129, 130, 131, 132, 133]

For heating, wood and fuel-oil are the most common sources of energy. In forested areas, wood is the preferred source for residential use due to its perceived lower cost.[125, 126] However, there are regions that fully depend on fuel-oil since no other resource is available. In energy terms, fuel-oil accounts for approximately 84 percent of the total energy use for heating across remote communities.[127, 128]





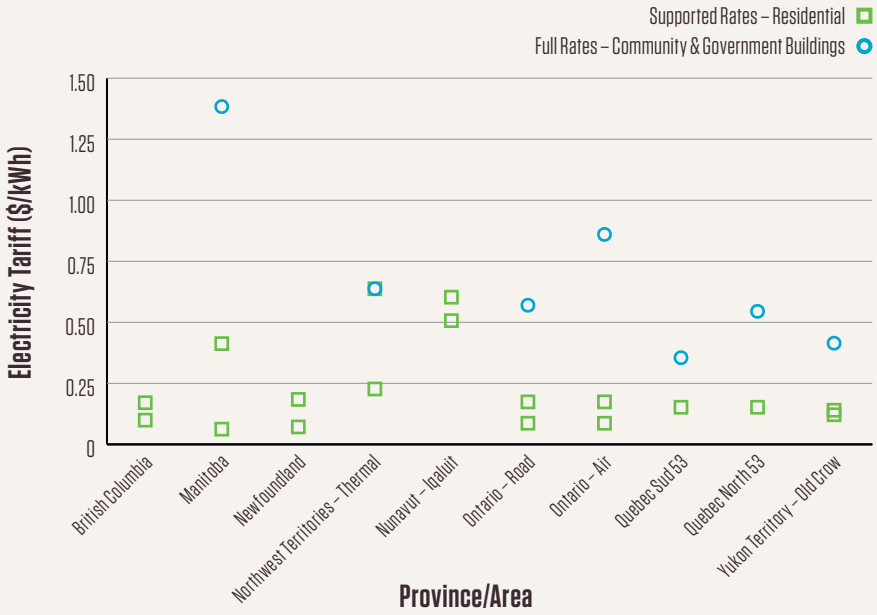
* British Columbia (3.4 million litres, 37 GWh, 3.0%)
Manitoba (0.5 million litres, 5.4 GWh, 0.4%)
Ontario (3.9 million litres, 41.5 GWh, 3.3%)
Saskatchewan (0.09 million litres, 0.9 GWh, 0.1%)
Yukon (0.6 million litres, 6.2 GWh, 0.5%)
** Norman Wells (NT) not considered.

ONGOING ISSUES: HIGH COST OF ELECTRICITY IN REMOTE COMMUNITIES[134, 135, 136, 137, 138, 139, 140, 141, 142]

High cost of energy

Although the cost of energy in remote communities is partially covered by the budgets of federal and provincial governments, economic difficulties mean electricity and heating remains a significant expense. The cost of diesel is much higher than simply the fuel – transportation, storage, and ultimately generation and storage site clean-up and remediation must also be accounted for.

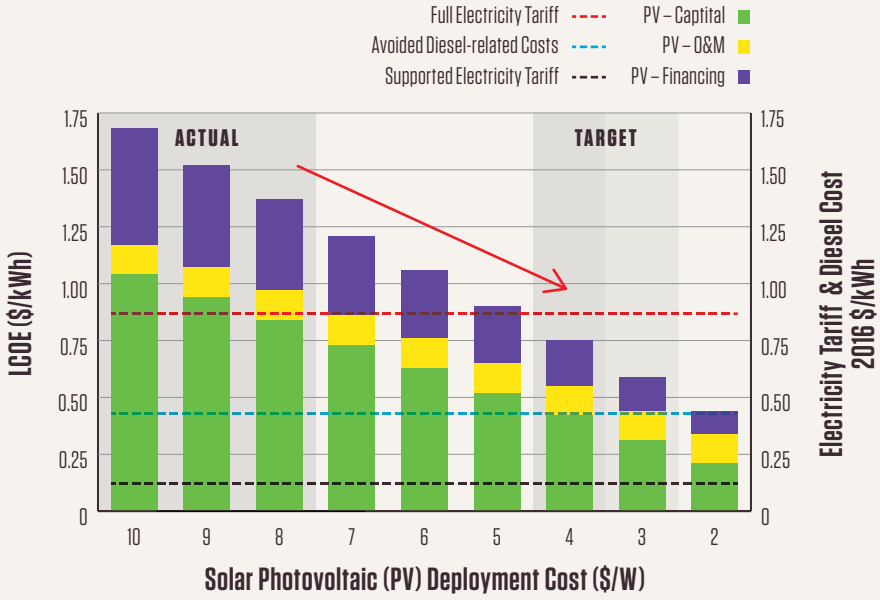
Many communities only have ground transportation access via winter ice roads and warming trends in recent years have seen some communities' road access diminish to the point where they have to fly in their fuel. Air transportation can double the cost of electricity.[114]



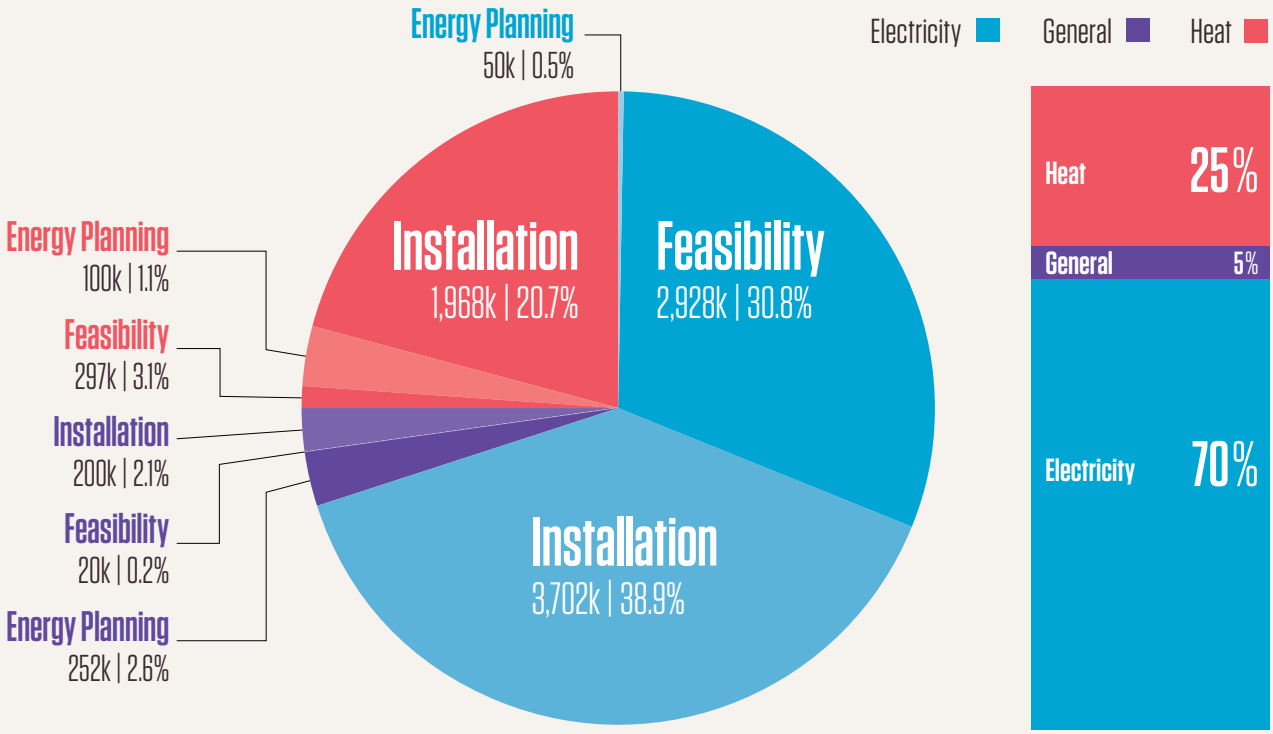
HIGH COST OF RENEWABLE ENERGY DEPLOYMENTS IN REMOTE COMMUNITIES[145, 146]

Installation costs of renewable energy technologies in remote communities are significant. Nonetheless, the savings in carbon emissions and the rising cost of diesel transportation means that, over the long term, projects should be considered worth the investment.[143]

Solar photovoltaics (PV) have been successfully deployed in remote locations across Canada. If 20 MW of solar capacity was installed across Canada's remote communities it could displace 5.8 million litres of diesel fuel annually, an estimated savings of CA$29 million on fuel costs.[144] To make this displacement a reality – assuming solar deployments reach a reasonable target of CA$4 per watt – it would require an estimated investment of CA$81 million.



INAC'S ecoENERGY PROGRAM ALLOCATED FUNDING FOR ENERGY STUDIES AND PROJECTS IN DIESEL-DEPENDENT COMMUNITIES[114, 150]



Funding

To date, federal program funding for energy services in remote communities has been inadequate. Compare Alaska's Renewable Energy Fund – which has been allocating US$50M annually since 2008[147] for renewable energy projects that reduce diesel dependency – to INAC's ecoENERGY for Aboriginal and Northern Communities Program which allocated CA$9.5 million to diesel-dependent communities for energy related projects over the 10 year course of the program.[148]

ecoENERGY is one of the few programs where enough public information exists to specifically determine funding targeted to diesel-dependent remote communities. There are several other federal, provincial, and territorial sources of funding that support energy projects and some of the funding recipients have been diesel-dependent communities.[149] Nevertheless, with the public information available, it is impossible to quantify and/or classify the amount of funding allocated specifically to diesel-dependent remote communities. So, while not a perfect comparison, we believe it provides a clear example of the type of dedicated, flagship program and increased level of financial commitment required to plan for plenty.

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139. Northwest Territories Power Corporation. (2016). Residential Electrical Rates. Retrieved from: https://www.ntpc.com/customer-service/residential-service/what-is-my-power-rate.
140. Yukon Energy. (2016). Rate Schedule. Retrieved from: https://www.yukonenergy.ca/media/site_documents/1042_1180%20Residential%20Service%20Hydro,%20Government.pdf. Accessed 10 Aug 2016.
141. Hydro One. (2013). Hydro One Remote Communities Inc. 4GIRM 2015 Distribution Rate Application. Retrieved from: http://www.hydroone.com/RegulatoryAffairs/Documents/EB-2014-0084/H1RC_APPL_20140924.pdf
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143. Arriaga, M., Caizares,C.A. & Kazerani, M. (2016). Long-term renewable energy planning model for remote communities. IEEE Transactions on Sustainable Energy. 7(1):221
144. Considering an average 10.7% solar PV capacity factor, an average of 3.3 kWh/litre energy conversion factor, and a cost of fuel of CA$1.5/litre. This latter cost is equivalent to $0.45/kWh, which as described in the Inukjuak case study, it is a low estimate of the value of clean energy in remote communities.
145. Arriaga, M. et al. (2016). Long-Term Renewable Energy Planning Model for Remote Communities. IEEE Transactions on Sustainable Energy. 7(1):221-231. Retrieved from: http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=7308080&isnumber=7355262
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147. Renewable Energy Alaska Project. (2016). Renewable Energy Fund. Retrieved from: http://alaskarenewableenergy.org/index.php/clean-energy-in-alaska/clean-energy-programs/
148. Indigenous and Northern Affairs Canada (2016). ecoENERGY for Aboriginal and Northern Communities Program. Retrieved from: http://www.aadnc-aandc.gc.ca/eng/1100100034258/1100100034259
149. Federal: ecoENERGY Innovation Initiative (NRCan); Provincial: IESO Aboriginal Renewable Energy Fund (ON), Microgrid Testing Facility in Rivière-au-Renard (TechnoCentre éolien), First Nations Clean Energy Business Fund (BC); Territorial: Alternative Energy Technologies Program (Arctic Energy Alliance), Micro-Generation Program (YK).
150. Indigenous and Northern Affairs Canada (2016). ecoENERGY for Aboriginal and Northern Communities Program. Retrieved from: http://www.aadnc-aandc.gc.ca/eng/1100100034258/1100100034259

6. Energy access – the Canadian context

Photo credit: Christopher Pollon

The trouble with diesel

For the people of Inukjuak, Quebec, a community of about 1,800, to have energy access, each year a single oil tanker makes a slow, plodding voyage across the Gulf of Saint Lawrence and north into the Labrador Sea. It rounds the horn of Quebec's Ungava Peninsula, which has a land area larger than Western Europe, tracing the southern coastline of Baffin Island before descending into Hudson Bay toward the 14 coastal communities of Nunavik. This annual 'sea-lift' of diesel is limited to a narrow, increasingly unpredictable ice-free shipping season that begins around late June and ends before Hudson Bay freezes solid – historically by late fall.

"It's something we take for granted – that nothing is going to happen to those tankers coming to Inukjuak to supply the fuel that everyone needs," says Pituvik's general manager Mike Carroll. "But if those tankers don't come, this town's in big trouble."

Arctic remoteness can be a blessing and a curse. While distance acts as a buffer protecting culture (virtually everyone here speaks Inuktitut), it also makes everything from the outside prohibitively expensive. A return flight to Inukjuak from Montreal costs about CA$2,700; a small package of bologna in the town's co-op store costs nearly CA$10, after taxes. If you live up here, at least half of your food must come from the land. That food must then be preserved in a freezer powered by the diesel generators – that hum and spew particulates – on the town's northwest corner, situated adjacent to a tank farm storing millions of litres of fossil fuel.

Dependence on diesel comes at a great cost, both financial and otherwise. In July 2015, human error during tank filling caused 13,000 litres of diesel to soak into the ground adjacent to the tank farm. Every particle of contaminated soil and rock had to be scooped up, loaded onto a tanker and shipped south for disposal. By October 2016, the final phase of a diesel spill cleanup was just wrapping up. Two other communities in the region have had to deal with similarly severe spills in recent years. "The risk [of spills] from diesel plants is always going to be there," says Eric Atagotaaluk, the president of Pituvik Landholding Corporation (PLC). "It's giving us a good reason to be more positive about renewable energy."

Stuck on the slow track

Finding a better way to generate energy is not a new idea in Inukjuak. A hydro project was introduced back in the early 1990s by the local municipality, but was rejected by residents. A decade later, Hydro-Quebec explored building a pilot wind project near town, but when that idea fizzled, PLC turned their attention to the Inukjuak River. Hydro was back on the table. Four sites on the river were identified as promising for a small 'run-of-river' hydro plant, considered greener than Quebec's system of large-scale hydro projects because it requires a much smaller reservoir, pipes water through turbines and then returns it downstream. Atagotaaluk says the waterfall Pituvik visited in October was by far the best of four scouted on the river: just 10 kilometres from town, it has the best gravitational drop and will impact fish less than other sites.

But progress on the project has been slow. It's been in the works since at least 2006, stalled after 2010 by an impasse with Hydro-Quebec while negotiating a power purchase agreement (which sets the price the utility will pay for PLC's hydro).

Among the biggest challenges of developing this hydro project is the astronomical cost of construction. It is among the biggest infrastructure projects ever planned in Nunavik, requiring the greatest single mobilization of resources, both human and material. A proposed 2.2-megawatt small hydro project on the remote northern coast of British Columbia was widely considered prohibitively expensive costing just over CA$25 million; Inukjuak's 7.5-megawatt hydro plant is projected to cost almost CA$100 million in all.

Barriers to overcome

Addressing this cost has necessitated sharing the project risk by taking on a Montreal-based private sector partner, Innergex Renewable Energy. Innergex is an established clean energy developer with experience navigating the complex web of federal and provincial agencies and outside funders. By 2012, PLC had secured federal funding for 25 percent of the project cost, contingent on matching funds from the province of Quebec. Atagotaaluk says this arrangement is no longer in place, but discussions continue with both Quebec and the federal government to secure funding. The next pivotal step for the project, he says, is to negotiate a power purchase agreement that will finalize the price Hydro-Quebec will pay PLC to generate the hydro power. The power will then be sold to Hydro-Quebec and delivered back to Inukjuak residents by the utility.

"That will be the determining factor if it's a go-ahead or not," says Atagotaaluk of the purchase agreement, which is currently being renegotiated.

In past negotiations, Hydro-Quebec has offered to pay just half (about 42 cents per kilowatt hour) of what it costs on average to generate Inukjuak's electricity, space heating and water heating with diesel. This price gap illustrates one of the biggest challenges for Canada's estimated 200 plus diesel-dependent remote communities, most of them Indigenous. Christopher

Henderson, a project advisor to PLC and author of *Aboriginal Power: Clean Energy & the Future of Canada's First Peoples*, says utilities will often lowball the amount they will pay a developer like PLC to produce clean energy. They'll only pay what it currently costs to supply diesel.

"Why 42 cents? Because it's the cost of diesel fuel alone. They don't price in the costs for capital systems, [diesel site] management, things like that, so you end up with this really weird situation where the true value of alternatives is not being credited in the contracting context," Henderson says. "As a result, many of these projects cannot proceed because they don't have the revenue basis to proceed."

"You end up with this really weird situation where the true value of alternatives is not being credited."

The price gap combined with a general lack of capacity in many Indigenous communities to navigate complex capital projects, says Henderson, are the two main barriers to clean energy across the North. "It's why we have not yet made as big a dent in remote sustainable energy as we might."

The downside of clean energy leadership

Call it the downside to being a clean energy leader: not only will building the project potentially open the floodgates for clean energy across the diesel-dependent region, but the price for Inukjuak's hydro will set a precedent that the communities coming after will expect, at minimum, to receive.

Progress is similarly slow across the 25 diesel-dependent communities of neighbouring Nunavut, home to about 28,000 Inuit. Sheldon Nimchuk, who oversees clean energy projects for a subsidiary of the Nunavut-based Qikiqtaaluk Corporation, says the only other Arctic clean energy project approaching the size of Innavik is a hydro project designed to power Iqaluit, Nunavut's capital. He says this project was suspended about two years ago, largely because there were so many urgent competing priorities. "Do you build water treatment facilities and sewage lagoons, or do you invest in hydro?"

Nimchuk remains upbeat about clean energy prospects for the Arctic. Wind and solar technologies are plummeting in cost. In October 2016, Prime Minister Justin Trudeau announced that Canadian provinces and territories must impose a price on carbon, starting at CA$10 per tonne in 2018 and rising to CA$50 per tonne by 2022.

On February 10, 2017, CBC reported that the government is planning to commit CA$50 million dollars in their 2017 budget to help get remote communities off of diesel. This funding comes on the tail of Trudeau's signing of the Pan-Canadian Framework on Clean Growth and Climate Change in December 2016, a pact with eight provinces and three territories promising to ramp up clean energy and cut greenhouse gas emissions. No funds have been committed to this latter initiative yet, but even if more money is allocated it seems unlikely to be enough to have a significant impact.

The cost of the small hydro project in Inukjuak's is projected to cost almost CA$100 million, double what the federal government is promising to help remote communities. In Canada there are over 200 communities that depend on diesel. Nimchuk says many of the diesel generation stations across Northern Canada – in Nunavut, Yukon, the Northwest Territories and Nunavik – are now decades old, necessitating hundreds of millions of dollars in investment to keep the same plants humming. Nunavut alone has requested CA$250 million from Ottawa to replace and upgrade its diesel plants and infrastructure. The national project of ending northern diesel dependence remains underfunded and stuck on a slow track.

So what can be done? Perhaps the greatest immediate opportunity for change involves end-of-life diesel plants says Nimchuk. "Would it make sense for the government of Canada to provide hundreds of millions of dollars to upgrade [diesel] facilities, or is the time right to move that money to clean energy projects as a contribution from Canada toward addressing climate change in the Arctic?"

"Would it make sense for the government of Canada to provide hundreds of millions of dollars to upgrade [diesel] facilities, or is the time right to move that money to clean energy projects?"

Excerpt from What will it take to get Canada's Arctic off diesel? *Reported by Christopher Pollon for Discourse Media's Power Struggle project.*[151]

151. Pollon, C. (2017). What will it take to get Canada's Arctic off diesel? Discourse Media Power Struggle. Retrieved from: http://discoursemedia.org/power-struggle/what-will-take-get-canadas-arctic-off-diesel

6.1 Overview

As we can see clearly from the example of Inukjuak, Canada is linked to the global energy access challenge through its remote off-grid communities. Despite being what the UN considers an Annex 1 industrialized country, pockets of population that are distant from the grid do not have an adequate level of energy services. Across the country – particularly in the North – there are 279 active remote communities that are not connected to the North American electric grid, 239 of which rely on diesel fuel for electricity and oil for heating requirements that is flown, barged, or trucked in (see folio). Nearly two thirds of these remote communities are Indigenous.[152, 153]

Indigenous peoples constitute the fastest-growing segment of the Canadian population, with people under the age of 25 representing nearly half of the population of Indigenous communities.[154] These young adults are the most affected by the severe housing crisis in remote communities that has arisen in part because existing electricity infrastructure cannot power any new homes. Nunavut, Ontario, and British Columbia are regions where an estimated 25 to 50 percent of communities have a load restriction status, meaning that peak electricity demand is near the maximum operating capacity of the diesel-generator plant.[155] Load restriction status has a number of negatively compounding 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 impact on quality of life.

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 regularly destroy education infrastructure, such as WiFi routers, internet servers and laptop computers.[156] In the same community lack of electrical power for sewage and drinking water systems has exacerbated existing problems like the rates of gastrointestinal, skin and urinary tract infections which occur at a much higher rate than in grid-connected communities.[157]

We know that education, health, economic opportunity and social inclusion are all radically improved by reliable access to energy. It is unacceptable to ignore the inequity in our remote communities any longer. Today, there is an incredible opportunity to invest in Canada's fastest growing population and one of Canada's fastest growing industries – Indigenous-led renewable energy projects to both power and empower communities.

Watay Power Project

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 off-grid 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 CA$3.4 billion in fuel costs over 40 years.

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 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.[158]

152. Natural Resources Canada. (2012). Remote Communities Database. Retrieved from: https://www2.nrcan-rncan.gc.ca/eneene/sources/rcd-bce/index.cfm?fuseaction=admin.home1&new=true
153. Knowles, J. (2016) Power shift: Electricity for Canada's remote communities. Conference Board of Canada. Retrieved from: http://www.conferenceboard.ca/e-library/abstract.aspx?did=8249
154. Statistics Canada. (2016). Aboriginal peoples in Canada: First Nations people, Métis and Inuit. Retrieved from: https://www12.statcan.gc.ca/nhs-enm/2011/as-sa/99-011-x/99-011-x2011001-eng.cfm
155. Henderson, C., (2016). Personal interview with Mariano Arriaga.
156. Bombacino, E. (2016). How energy poverty devastates Pikangikum First Nation. TVO. Retrieved from: http://tvo.org/article/current-affairs/shared-values/how-energy-poverty-devastates-pikangikum-first-nation
157. Northwestern Health Unit (2006). Inspection Report on the Pikangikum Water and Sewage Systems. Retrieved from: http://www.turtleisland.org/healing/pikangikum06a.pdf

Although the cost of energy in remote communities is partially covered by the budgets of federal and provincial governments, economic difficulties mean electricity and heating remains a significant expense. The cost of diesel is much higher than simply the fuel – transportation, storage, and ultimately generation and storage site clean-up and remediation must also be accounted for. 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.[159] Many communities only have ground transportation access via winter ice roads and warming trends in recent years have seen some communities' road access diminish to the point where they have to fly in their fuel. Air transportation can double the cost of electricity.[160]

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 (INAC), there are over 2,000 contaminated sites on First Nations reserves across Canada, and 70 percent of those sites are contaminated with diesel. The Canadian federal government faces millions of dollars in liability associated with the ongoing need to remediate sites contaminated by hydrocarbon fuels. The estimated cost for only the sites below the 60th parallel is CA$458 million.[153]

For heating, wood and fuel-oil are the most common sources of energy. In forested areas, wood is the preferred source for residential use due to its perceived lower cost.[161, 162] However, there are regions that fully depend on fuel-oil since no other resource is available like the Ungava Peninsula of Nunavik in Quebec, the northern remote communities in Northwest Territories and Labrador and all communities in Nunavut.

In energy terms, fuel-oil accounts for approximately 84 percent of the total energy use for heating in remote communities.[163, 164]

Installation costs of renewable energy technologies in remote communities are significant. Nonetheless, the savings in carbon emissions and the rising cost of diesel transportation means that, over the long term, projects should be considered worth the investment.[165]

Solar: Solar photovoltaics (PV) have been successfully deployed in remote locations across Canada. If 20 MW of solar capacity was installed across Canada's remote communities it could displace 5.8 million litres of diesel fuel annually, an estimated savings of CA$29 million on fuel costs.[166] To make this displacement a reality – assuming solar deployments reach a reasonable target of CA$4 per watt – it would require an estimated investment of CA$81 million (see folio).

Wind: Several remote communities in Quebec, Newfoundland & Labrador and Nunavut have excellent wind resources.[167] The potential for wind to reduce diesel consumption in these locations is significant. For example, a prospective 6MW wind project in Îles de la Madeleine could conservatively reduce 10 percent – 4.2 million litres – of the island fuel-oil consumption for electricity where an equivalent on-grid equivalent project would cost approximately CA$17.5 million due to the additional logistical challenges.[168, 169, 170]

Hydro: Megawatt scale hydro power requires significant investment of financial resources and time to conduct appropriate environmental assessment. However, as highlighted by the Inukjuak hydro project, a CA$100 million investment will effectively displace diesel fuel use in the community.[151]

158. Wataynikaneyap Power. (2016). Our story. Retrieved from: http://wataypower.ca/
159. Stephenson, S.R., Smith, L.C> & Agnew, J.A. (2011). Divergent long-term trajectories of human access to the Arctic. Nature Climate Change. 1:156 – 160.
160. 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
161. Cherniak, D., et al. (2015). Report on the state of alternative energy in the Arctic. Carleton University. Retrieved from: http://www.bullfrogpower.com/wp-content/uploads/2015/09/State_of_Alternative_Energy_in_the_Arctic_POLAR_2015.pdf
162. Weis, T. & Cobb, P. (2008). Aboriginal energy alternatives. Pembina Institute. Retrieved from: http://www.pembina.org/reports/aboriginal-energy-alternatives.pdf
163. Government of Nunavut. (2016). Heating use in communities in Nunavut. Energy secretariat. Retrieved from: http://www.nunavutenergy.ca/communities
164. A Northern Vision (2016). Renewable energy inventory: Existing energy systems. Retrieved from: http://www.anorthernvision.ca/inventory/energysystems.html
165. Arriaga, M., Caizares,C.A. & Kazerani, M. (2016). Long-term renewable energy planning model for remote communities. IEEE Transactions on Sustainable Energy. 7(1):221.
166. Considering an average 10.7% solar PV capacity factor, an average of 3.3 kWh/litre energy conversion factor, and a cost of fuel of CA$1.5/litre. This latter cost is equivalent to $0.45/kWh, which as described in the Inukjuak case study, it is a low estimate of the value of clean energy in remote communities.
167. Arriaga, M. et al. (2014). Database of Electrical Grid Systems in Canada's Remote Communities. Technical report.
168. Considering an annual consumption of 190 GWh/year for the island, a 4.5 kWh/litre energy conversion factor, a conservative 36% wind capacity factor for a 9.1 m/s at 50m annual wind speed average, and a CA$3,000/kW deployment cost.
169. Hélimax Énergie Inc. (2009). Étude de la variabilité de la resource éolienne. Hydro Quebec. Retrieved from: http://www.hydroquebec.com/distribution/fr/marchequebecois/ap-201501/pdf/ap-2015-01-etude-variabilite-r1.pdf
170. Fournier, L. & Massé, M.O. (2016). Une stratégie énergétique territorial pour les Îles-de-la-Madeleine – Document de consultation. Municipalité des Îles-de-la-Madeleine. Retrieved from: http://www.muniles.ca/wp-content/uploads/2016-01-26_Document-de-consultation.pdf

Despite financial challenges, an increasing number of remote Indigenous communities are successfully collaborating with government, NGOs, and utilities to lead clean energy projects that are supplementing and, in some cases, replacing aging diesel generators. Adding renewables to the existing energy mix can help pull communities out of load restriction status and create a foundation for future social and economic development built on a supply of local, clean and high quality energy. As part of their energy planning, communities may have to consider upgrading aging diesel infrastructure and optimizing it with smart grid technology while promoting energy efficiency and conservation to meet their overall goals.

Deer Lake Hybrid Solar Project

Deer Lake First Nation is a small community of approximately 1,100 people. It has no access to the grid and pays close to CA$2.7 million 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 solar 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 CA$92,000, created part-time employment opportunities, reduced diesel fuel consumption by 31,000 liters per year and cut carbon emissions by 99 tonnes annually.[171]

6.2 Four actions needed to plan for plenty in Canada's remote communities

We must acknowledge the role of energy as the backbone of a better quality of life for communities facing a variety of disadvantages. We can no longer ignore our responsibility to provide the supportive resources remote communities need to not only meet their current minimum energy needs but to plan for plenty.

6.2.1 Commit to a step change in investment

To date federal program funding for energy services in remote communities has been inadequate. Compare Alaska's Renewable Energy Fund – which has been allocating US$50M annually since 2008[147] for renewable energy projects that reduce diesel dependency – to INAC's ecoENERGY for Aboriginal and Northern Communities Program which allocated CA$9.5 million to diesel-dependent communities for energy related projects over the ten year course of the program.[173]

ecoENERGY is one of the few programs where enough public information exists to specifically determine funding targeted to diesel-dependent remote communities. There are several other federal, provincial, and territorial sources of funding that support energy projects and some of the funding recipients have been diesel-dependent communities.[174] Nevertheless, with the public information available, it is impossible to quantify and/or classify the amount of funding allocated specifically to diesel-dependent remote communities. So, while not a perfect comparison, we believe it provides a clear example of the type of dedicated, flagship program and increased level of financial commitment required to plan for plenty.

We need an order of magnitude increase – on the order of billions – in investment by Canada's federal government in sustainable energy solutions for meeting the current and forecasted energy needs of remote Indigenous communities in Canada. Recall that, at the time of publication, only CA$50 million is earmarked in the 2017 federal budget

171. Canadian Solar, (2014). Deer Lake First Nation elementary school. Retrieved from: http://www.canadiansolar.com/solar-projects/deer-lake-first-nation-elementary-school.html
172. Renewable Energy Alaska Project. (2016). Renewable Energy Fund. Retrieved from: http://alaskarenewableenergy.org/index.php/clean-energy-in-alaska/clean-energy-programs/
173. Indigenous and Northern Affairs Canada (2016). ecoENERGY for Aboriginal and Northern Communities Program. Retrieved from: http://www.aadnc-aandc.gc.ca/eng/1100100034258/1100100034259
174. Federal: ecoENERGY Innovation Initiative (NRCan); Provincial: IESO Aboriginal Renewable Energy Fund (ON), Microgrid Testing Facility in Rivière-au-Renard (TechnoCentre éolien), First Nations Clean Energy Business Fund (BC); Territorial: Alternative Energy Technologies Program (Arctic Energy Alliance), Micro-Generation Program (YK).

for diesel reduction in remote communities[175] and that CA$100 million is the expected cost of Inukjuak's proposed hydroelectric project.[151] The significant quality of life and economic development improvements that are possible should make this Canada's top priority when it comes to green infrastructure development.

6.2.2 Recognize Indigenous leadership and support capacity building

People are the primary resource in energy access projects. Successful renewable energy and fuel saving projects in remote Indigenous communities in Canada to date have relied upon in-community leadership and support, motivated by Indigenous cultural values of environmental stewardship and self-determination. Community commitment and involvement leads to lobbying for investment, partnerships with external organizations that help guide the process, and empowered citizens ready to be a part of decision-making and promotion of the opportunities.

From initial planning to maintenance, recognizing Indigenous leadership and building further capacity to lead and manage energy projects over the long term must be a priority. Existing education and training programs include 20/20 Catalysts,[176] and intensive summer program designed to provide 'Catalysts' from Indigenous communities across Canada with the skills and resources to maximize the social and economic benefits their communities can gain through participation in clean energy projects, and TREC Education's renewable energy options and opportunities programs for Indigenous communities that build skills, confidence and develop networks of practitioners, advocates and investment partners.[177]

Canadian governments, NGOs, utilities and investors must support existing and emerging programs that support Indigenous energy champions, skilled workers and entrepreneurs who can facilitate and realize energy access projects allowing communities to deploy their chosen technologies to their full potential.

Old Crow Solar Array

The Vuntut Gwitchin First Nation is leading the movement to decrease fossil fuel use in Old Crow - the Yukon's most northern community, and home to about 300 people – consumes approximately 500,000 litres of diesel a year.[178] The community had been looking for years to develop alternative sources of energy, because "We want some energy security," said William Josie, Director of Natural Resources for the First Nation to CBC News North.[179]

A 330 kW solar array, approved by the Yukon Environmental and Socio-economic Assessment Board (YESAB), set to begin construction in 2018, is expected to meet 17 percent of the community's annual electricity demand and reduce annual diesel consumption by over 90,000 litres. The project is a partnership with ATCO Electric Yukon, Yukon College's Research Centre, and the Yukon Government's Energy Branch and is estimated to cost CA$2.3 million. A working group made up of people and organizations that have developed similar projects has been set up to assist in the planning of the solar array.[180]

6.2.3 Create a single, intergovernmental point of contact

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.[181] These various programs often have different scopes, timelines and approval processes that are not complementary making coordination between agencies and programs a difficult prospect.

When provincial/territorial and federal contributions and regulations cannot be mutually agreed upon it is the communities that suffer. Uncertainty 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.

175. McDiamid, M. (2017). Federal budget money earmarked to help Indigenous communities get off diesel. CBC. Retrieved from: http://www.cbc.ca/news/politics/indigenous-remote-federal-budget-1.3975022
176. Lumos Energy. (n.d.) 20/20 Catayst program. Retrieved from: http://indigenouscleanenergy.com/2020-catalysts-program/
177. TREC Education. (n.d.) Indigenous communities. Retrieved from: https://treceducation.ca/programs/#indigenous-communities
178. Arctic Inspiration Prize. (2016). 2016 finalists. Retrieved from: http://www.arcticinspirationprize.ca/finalists/2016finalists.php
179. Tukker, P. (2016). Old Crow looks to solar power to cut diesel use. CBC News North. Retrieved from: http://www.cbc.ca/news/canada/north/old-crow-solar-power-proposal-yukon-1.3674277
180. Forrest, M. (2016). YESAB gives thumbs up to Old Crow solar project. Yukon NEWs. Retrieved from: http://www.yukon-news.com/news/yesab-gives-thumbs-up-to-old-crow-solar-project/
181. Arriaga, M. (2015). Sector profile for remote microgrids in Canada. Conference Board of Canada.

We recommend creating a single point of contact within government whose responsibility is to ensure those initiating and managing energy projects can navigate regulations, funding and reporting at the federal and provincial/territorial level and across relevant departments to minimize replicated work as well as wasted time and resources.

Hupacasath First Nation and the BC First Nations Energy Toolkit

When faced with the prospect of a natural gas-fueled power generation located on their traditional territory in the Alberni Valley of Vancouver Island, British Columbia, the Hupacasath First Nation not only stood in opposition but proposed a solution for a sustainable energy alternative that would have positive economic and community development benefits.[182] The China Creek run-of-river hydroelectric project supplies power to over 6,000 homes through an agreement with BC Hydro.[183]

Lessons learned throughout the development of this project are consolidated in BC First Nations Clean Energy Toolkit 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 on- and off-grid communities can begin the process of exploring 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.[184]

6.2.4 Connect people, technologies and information

To improve project outcomes knowledge sharing between communities and innovative institutions will be critical. Key steps are already being taken. A Northern Vision is a strategic plan for Northern development produced by the governments of the Northwest Territories, Yukon and Nunavut. Energy is a pillar of this plan as is a strategy for collaboration between government, NGOS and the private sector.[128] Lumos Energy's emerging Canada-wide Indigenous Clean Energy Network is a knowledge sharing platform that aims to unlock potential in Indigenous communities by providing a comprehensive set of collaboration tools.[63] The Ontario First Nations Technical Services corporation provides technical and advisory services to First Nations communities in Ontario, covering energy-linked areas like housing and infrastructure.[185]

There is also a need for reliable, up-to-date and publicly accessible data about each remote community's energy status, including load restrictions, and future electricity needs. Not only will this provide accountability, it will guide project planning and expose the market opportunities that will help governments leverage their investments in energy access for greater impact, and for new off-grid energy business models to be developed in the Canadian context. There is no need to start from scratch either. Natural Resources Canada (NRCan) has committed to updating and expanding its Remote Communities Energy Database [152] which, at the time of publication has fallen out of date, by fall of 2017.[186]

Canadian institutions from the private and public sectors should be encouraged to utilize up-to-date information and innovative technologies to seek new arrangements for energy projects in remote communities that are financially sustainable over the long term.

182. Aboriginal Business and Investment Council. (n.d.). Hupacasath First Nation. Retrieved from: http://www.bcabic.ca/success-stories/hupacasath-first-nation/
183. Indigenous and Northern Affairs Canada. (2005). Hydro-project partnership fuesl growth for island communities. Retrieved from: https://www.aadnc-aandc.gc.ca/eng/1100100021384/1100100021391
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186. Public Works and Government Services Canada. (2016). Request for proposal: NRCan-5000026971.

6.3 Call for a strategic national priority

As laid out here and in an ever-growing body of global evidence, the objective of energy access efforts is not simply to provide energy at reasonable cost and reliability. Rather, it is to provide levels of energy service of high enough quality and quantity to allow for greater economic and social development and self-determination in communities strangled by energy deficit.

A strong commitment from the Canadian government is required to break the historical logjam of jurisdictional disputes and delay that has so far proven woefully inadequate in addressing the energy needs of remote Indigenous communities. Canada needs an approach centered on clean energy provision that, at its heart, addresses a serious inequity issue within its own population.

Such a strategy would be a bold step towards enabling solutions to multiple crises in housing, water quality and sewage facilities, as well as adequately supporting community health and well-being in remote communities. It must be carried out with the leadership of and in partnership with the communities themselves and draw upon Canadian innovations and institutions to help forge sustainable energy service solutions for a plentiful future.

Solution Spotlights

Results-based financing with EnDev

Energising Development (EnDev) is a multi-donor energy access partnership currently funded by six donors – the Netherlands, Germany, Norway, the United Kingdom, Switzerland, and Sweden – and managed by Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) and the Netherlands Enterprise Agency (RVO).[187] The programme is piloting a set of 17 'results-based financing' (RBF) schemes across 14 developing world countries. The aim is to incentivize provision of energy access by paying private sector service providers based on performance. In so doing, financial risk is transferred from donors to the private sector.

EnDev aims to incentivize the development of energy access markets across a variety of contexts where private sector actors currently face market barriers. It also aims to learn (and share) important lessons about the potential effectiveness of RBF programs to support energy access.

Importantly, many of the RBF projects are being carried out in partnership with financial institutions. The primary aim of including financial institutions is to provide an opportunity for these institutions to gain experience in, and become better acquainted with, the energy access sector. This helps to address a crucial need in the development of the sector at large.

A number of lessons have already been drawn from the first three years of EnDev's RBF program. One is that, given the complexity of these markets, schemes must be developed in close collaboration with private and public sector stakeholders. Another is that significant market research of the specific context is essential in order to design a successful RBF scheme. Both the RBF approach and the energy access sector are novel for financial institutions, and they must inject significant resources if they are to understand how it operates. The inclusion of comprehensive research, consultations and bringing financial institutions on board caused delays in implementing some of the schemes. However, ensuring that all stakeholders understand the scope of such a new approach as well as the participation of the financial sector can be crucial to a successful outcome, and so such delays were worth the trouble.

The incentive structure itself also deserves careful consideration: who gets it, when, how much and based on which results. Incentivizing companies that deliver energy access products directly to consumers may seem like the most obvious way to achieve this. But barriers to energy access are often down to market failures across the supply chain. An incentive structure that targets one or more points in the supply chain may in the end contribute more to the set goal than directly delivering the product. In this regard, it is also critical to understand how the incentives fit within broader technical assistance frameworks and to ensure co-ordination between various donors and policy actors operating in the same markets. For example, by the time one EnDev RBF scheme – for pico-PV systems in Rwanda – was launched, a World Bank incentive program that provided up-front financing was already in place, making the RBF a redundant double incentive.

Another crucial lesson has to do with the verification process. Before payment is made to the service providers, independent verifiers provide third-party monitoring of RBF results. This can be another time and resource-intensive measure, largely because of the dispersed and remote nature of the markets being served and especially if it comes to portable technologies like solar lanterns. Verification generally involves contacting individual customers by phone to check if they received service as claimed by the provider. The process doesn't benefit from

187. EnDev. (n.d.). History. Retrieved from: http://endev.info/content/History

economies of scale, and puts an added burden on service providers: they must collect the required personal information from all of their customers. The efficiency of the verification process is crucial to the success of RBF schemes because service providers need to be confident that their claims will be processed quickly and payment for their services will be prompt. If that goes awry too often, the incentive becomes less attractive and can fail to bring in service providers.

Perhaps the most salient lesson learned thus far however is the importance of working in close collaboration with private sector actors when designing incentives. RBF puts the risk on the shoulders of service providers by only releasing funding for achieved results according to its stipulations. This results in high up-front costs, which are a challenge for energy access enterprises across the spectrum of energy access technologies. A major lesson is that in order to make RBF an attractive source of financing to companies, the rules and expectations of the schemes must be clear and simple, and their administration should take into account the financial cycles and constraints of service providers. Incentives must reflect what is seen as both achievable and attractive to these actors. Donors therefore need to adopt the perspective of service providers in order to develop effective RBF schemes at the outset.

Despite the challenges, the EnDev RBF program has proved successful across a variety of contexts. One winning strategy has been to build on a service provider's success by pushing it into underserved markets. In Tanzania for example, a number of solar companies had already found a comfortable position serving urban and peri-urban customers. The surrounding rural areas, particularly in Tanzania's Lake Zone were not being served by these actors, however. A custom-designed RBF scheme incentivized them to move into the surrounding rural region, resulting in significant shift into these markets from Mobisol, Off-Grid Electric and other major players already operating in Tanzania.

By providing service providers with a guarantee of payment (contingent on performance), RBFs can also de-risk outside investments in service providers. This is especially reassuring to investments in bottom of the pyramid markets where customer payment reliability is in question. In Benin, for example, an RBF program that guaranteed future results-based revenues enabled a triad of pico-PV companies to attract up-front financing from banks.

After three years of trial and error, the EnDev RBF program shows significant promise and has developed critical insights into the effectiveness of RBF as a means for spurring energy provision in underserved markets. Perhaps the most important lesson learned so far is that RBF schemes are only one of several tools to develop energy access markets.

In the majority of underserved energy markets in the developing world there are multiple barriers to entry. To unlock these requires that RBF schemes be implemented in concert with a larger set of technical assistance programs. These include reform of tariff and regulatory structures, local skills and supply chain development initiatives, consumer awareness campaigns, support for development of investment-worthy mini-grid business plans, certifications and product standard development, and others, depending on context.

Thanks to Elina Weber and EnDev for their help in developing this Solution Spotlight.

Innovative financing mechanisms and institutions

Social finance

These vehicles occupy a midpoint between conventional finance and charity with the objective to use financial products and services as a way to achieve a positive impact on society, the environment, or sustainable development. Social finance can be broadly categorized in three categories: 1) social banking 2) impact investment and 3) microfinance, each of which are currently and will continue to be important sources of finance, especially for smaller off-grid projects and energy service companies.

Debt

In December 2015, the first leasing platform for off-grid solar in Africa, with specialist company Off-Grid Electric[188] raised US$45 million in debt from the David and Lucile Packard Foundation and a number of other investors including USAID's Development Innovation Ventures program. This serves as a model which can be leveraged elsewhere, especially for fast-growing energy access enterprises.

Equity

Equity investment can come from a utility that is financing the whole cost of a project or from a developer that is contributing equity to cover a fraction (often 20 to 40 percent) of the investment cost. Equity can also come from outside investors such as infrastructure funds, private equity funds, insurance companies and pension funds. Cost of equity is higher for investors and very clear policies and visibility in returns backed by international guarantee such as the World Bank's Multilateral Investment Guarantee Agency (MIGA) may be required to attract equity in difficult financial environments such as sub-Saharan Africa.

Institutional investors

These large investment pools are a major source of equity financing however most are risk averse and currently focused on established markets in developed countries with mature policies. However, the OECD estimates that around US$2.80 trillion annually is potentially available from pension funds and insurance companies for new clean energy investment. Enticing these large investors to support the energy access sector could be hugely powerful.[189]

Third party leasing models

In these arrangements, developers enter into an agreement with building owners to lease their roof for installation of rooftop solar. The model has made strong inroads in North America, growing sixteen-fold since 2008. In the developing world context this model can be exploited in public buildings and other structures where feasible. This model is best suited to urban areas, and with urbanization exploding in the developing world it is poised for further growth. Alliances and partnerships between financiers and developers need to be established to leverage such a model.

Venture capital funds

The Silicon Valley-based Fenix International, for instance, was successful in raising US$12.6 million in Series B funding from a number of firms to help it supply mobile-enabled solar systems to off-grid communities in Africa.[190] Investors included Engie, operator of Europe's biggest natural-gas network, power management firm Schneider Electric and telecommunications giant Orange. Sector or region specific venture capital funds are needed to increase investments. National and international incentives for such funds – for example establishment of public-private funding partnerships – will stimulate venture capital investments in energy projects in developing countries.

188. Off-Grid Electric. (n.d). Our story. Retrieved from: http://offgrid-electric.com/#home

189. Kaminker, C. & Stewart, F. (2012). The role of institutional investors in financing clean energy. OECD. Retrieved from: https://www.oecd.org/sd-roundtable/papersandpublications/50363886.pdf

190. Lin, M. (2015). Fenix International raises $12.6 million in financing. Fenix International. Retrieved from: http://www.fenixintl.com/2015/01/26/fenix-international-raises-12-6-million-financing/

Advance market commitments or market-pull mechanisms

The UK's Department for International Development (DFID) is currently implementing an advance market commitments (AMCs) project in in Rwanda, which aims to demonstrate the wider potential of market-pull approaches to supporting low carbon development, and to catalyze private sector investment in renewable energy projects such as biogas and off-grid micro-hydro power. The model can be extended to other developing world nations.

Results-based finance (RBF) refers to a mechanism where financing bodies make payments only after the pre-agreed results or output has been achieved (See RBF solution spotlight on page 50).

Green bonds

The green bond market is plagued by illiquidity and lack of policy support which needs to be urgently resolved. January 2016 saw the first bond issue (of US$500,000) for residential solar in Africa. Oikocredit, BBOXX and Persistent Energy[191] bundled 2,500 active contracts for solar energy in Kenya, offering an interest rate of 21 percent and an average maturity of 2.5 years. Bond issues backed by international and national governments can attract investments in other underserved energy markets.

Structured finance

Standardized finance models can help increase investment volumes by reducing due diligence costs. Standardization of project documents and aggregation can be a vehicle that allows smaller projects to be pooled together in diversified investment portfolios. These mechanisms can also help securitize renewable energy assets for the purpose of trading in capital markets.

191. ten Kroode, D. (2016). First securitization deal off-grid solar in Africa. Oiko Credit. Retrieved from: http://www.oikocredit.coop/k/n171/news/view/138533/462/first-securitization-deal-for-off-grid-solar-in-africa.html#.WA_K9_krLIU

Connecting Bangladesh's solar home systems with ME SOLshare

A solar success story is unfolding in Bangladesh – a low-lying developing country which is perhaps the world's most vulnerable to climate change. Founded in 2014 as a joint venture with Berlin's Microenergy International GmbH, ME SOLshare is a highly collaborative enterprise embedded in the international energy research community.[192] Headquartered in Dhaka, SOLshare has designed and piloted the world's first peer-to-peer DC smart village nano-grid, winning the prestigious 2016 InterSolar Award for Most Outstanding Solar Project along the way.

SOLshare allows anyone with a solar home system (SHS) or other electricity source to buy and sell power with their neighbors through the use of a bi-directional electricity meter, the SOLbox. Each household can be connected through cables to up to three other households linking the SOLboxes together, and even those without a power source can access the energy network and buy power from their neighbors by purchasing the SOLbox and a small battery.

To test their model SOLshare set up a nano-grid encompassing seven households in Shariatpur, 50km south of Dhaka, Bangladesh. Residents of the village include women primarily engaged in household work, and men working either as farmers or local drivers. The average income in the village varies between US$125–250 per month.

Six of the seven households that were connected through the nano-grid had existing SHS. SOLshare installed a buffer SHS to stimulate trading in the small pilot, maintaining majority (60 percent) community ownership of generation and storage assets. An additional household that could not afford a SHS also became part of the SOLshare network after receiving a battery and SOLbox. Each of the boxes were connected through a network of 12VDC cables to neighbouring households, linking them into the network.

The system initially allowed for the operation of multiple LED lights per household, phone chargers and communal street lights. However, since the project was initiated in September 2015, the increased flexibility of being able to use power that otherwise would have been wasted has allowed for the purchase of fans, televisions, and additional lights by some of the households. Usage data also shows that household income has increased due to the ability to sell surplus electricity to neighbors, and also that batteries have maintained a significantly higher state of charge which will very likely lead to an increase in the lifetime of the this critical and expensive component of their pervious SHS purchase.

SOLshare's technology helps solve a ubiquitous problem in Bangladesh. In the past decade, over 4 million SHS have been sold in the country. In large part that is thanks to a national solar home system program led by the state-sponsored Infrastructure Development Company Limited (IDCOL). This has allowed a large number of households facing energy poverty to afford these relatively high-tech solutions. However, over 45 million Bangladeshis still have no SHS or access to the national grid. Those that do own SHS are missing out on its full potential due to excess power wasted once the battery is full – an estimated 39 percent of the power generated by SHS in Bangladesh goes unused.[193] On the other hand, due to their small size, a single SHS does not have the nominal peak capacity to provide stable power for larger scale economic activities such as pumping water for irrigation.

SOLshare's network is highly scalable, allowing for increasing numbers of people to share their community's electricity resources as the number of households with SOLboxes grows. SOLshare and MicroEnergy International call it swarm electrification alluding to the efficiency gains of intelligently connecting power source and storage hardware together across multiple nodes/households. According to SOLshare, these interconnected nano-grids can even be connected with the national grid, allowing for SOLshare customers to purchase the extra power they need from the grid. In the future, it is also possible that this flow of electricity could be bi-directional, allowing them to sell their excess power to the grid as well.

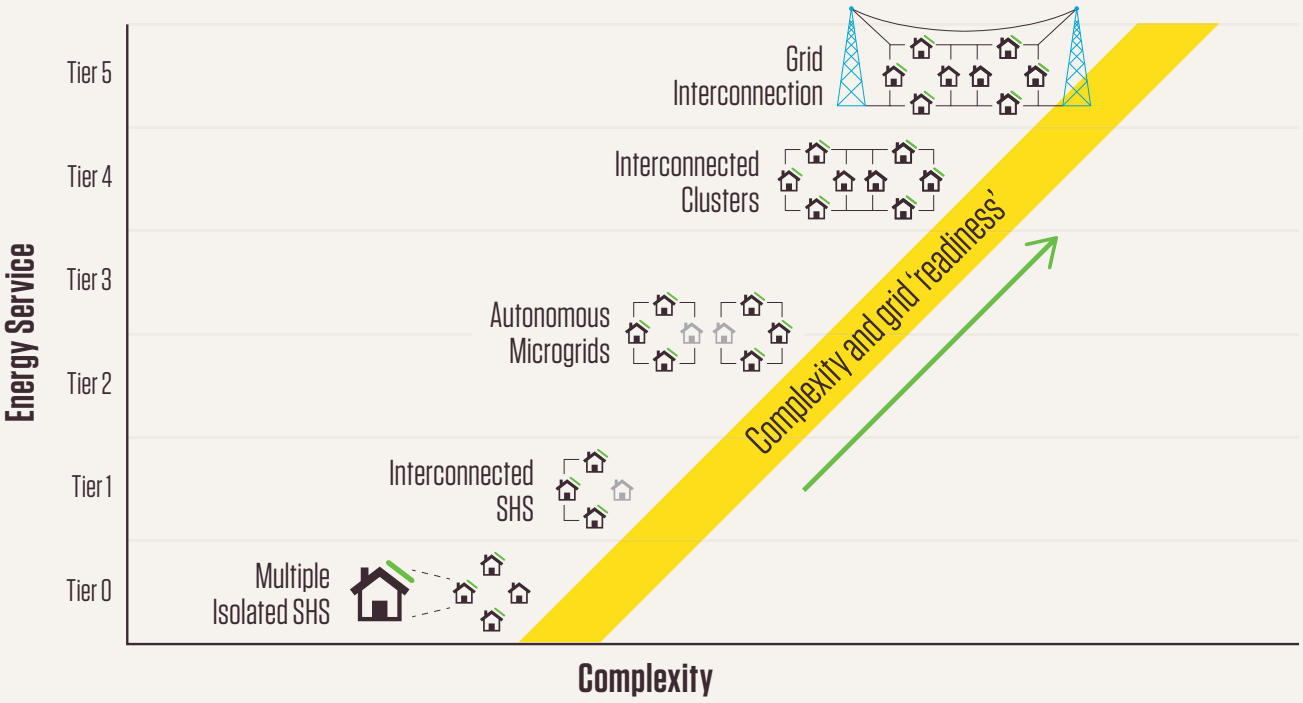
The flexibility of SOLshare's nano-grids allows truly demand-driven energy infrastructure expansion with very low capital cost. It also allows for the inclusion of those who cannot afford a SHS into the network, whereas those who can afford a SHS now have an added source of income derived from selling electricity to their neighbors that otherwise would have been wasted. Finally, as these systems increase in size, power capacity from multiple systems can be directed to productive

192. ME SOLshare. (n.d.). About us. Retrieved from: http://www.me-solshare.com/about-us/

193. Kirchhoff, H. (2015). Identifying hidden resources in solar home systems as the basis for bottom-up grids. In Kammen, D. (Ed) Decentralized Solutions for Developing Economies. Springer.

THE SWARM ELECTRIFICATION CONCEPT

COURTESY OF SOLshare



higher load uses such as post-harvest agricultural processing (for which a pilot project is already operating), which can benefit entire communities and spur local economies.

Within the nano-grid network SOLshare works with established local participating organizations (POs) entrusted with management of payment processes and maintenance of the grid. Payments are carried out through a flexible pre-payment system, similar to pay-as-you-go systems that have become commonplace in East African solar markets, and the POs enable pre-purchase of renewable electricity from the nano-grid in a similar fashion to mobile phone credit. A local trusted PO agent is also the contact person for SOLshare in the community, and by maintaining a good relationship with the PO, SOLshare ensures the continued operation and maintenance of their systems and learns about what is and isn't working for customers.

The flexible, bottom-up nano-grid approach employed by SOLshare holds huge promise. Its early success suggests that with innovative energy system management technologies, the lines between solar home systems, micro-grids, and grid access – often seen as very separate tiers of energy access – might become blurred, allowing for increased efficiency and utility for new and existing systems and flexible demand-driven growth of electricity service provision in Bangladesh and beyond.

Thanks to Setu Pelz at ME SOLshare for his help in developing this Solution Spotlight.

Growing bottom of the pyramid demand with Lighting Global

Lighting Global, an initiative of the World Bank Group, has pioneered a comprehensive promotional approach to grow demand for life-enhancing technologies.[194] Its Lighting Africa and Asia campaigns, for example, have driven demand for solar lighting technologies in rural markets by using a variety of media to reach rural customers.

A particularly successful format is the 'roadshow'. This involves representatives from Lighting Global and their partners – crucially the solar companies that operate in the targeted regions – travelling to rural villages to engage locals on the benefits and opportunities that these products can provide. They also offer information on how they can be purchased.

The roadshows allow people to touch and use a range of product offerings, speak to sales representatives, and learn about them through a variety of community events that feature music and live theatre – often at night, to showcase the lighting products. These campaigns have been developed in partnership with professional marketing firms that have experience marketing to bottom of the pyramid consumers and feature emotional messages and lifestyle appeals that employ well-tested advertising techniques.

The participation of companies that offer the products in question is of paramount importance. The ultimate aim is to sell high quality products that can improve lives, so while awareness is important, sales are the end goal. Consumers therefore have an avenue to follow-up with sales representatives at or after the event. To date, these events have been major catalysts for sales in remote markets where the 'last-mile' of rural sales is so often the biggest barrier facing distributors.

The success of Lighting Global's Africa (Kenya) and Asia (India) campaigns has inspired efforts in other markets as well. The Netherlands Development Organization (SNV) in Cambodia is one example. With the target of catalyzing sales of 25,000 SHS and solar lighting products, the campaign is projected to engage with over 100,000 Cambodians by 2018. In addition to holding road shows and employing other marketing best practices in close collaboration with Cambodia's nascent solar industry, SNV has also aided the market through providing business development and financial services.

A business development services hub was created to provide access to training and business support for solar companies, with many companies using these services to improve their operational efficiency and build relationships with other institutions that they can learn from and work with.

One critical partner for such firms are financial institutions. SNV developed their program in collaboration with a number of micro-finance institutions (MFIs) who provided small low-interest loans to help customers pay for the systems and also directed cash into a results-based financing program that rewarded firms for their sales. This extra cash is most critical for new firms that need capital for developing their distribution networks and operations, and therefore the incentives are reduced at higher sales volume, favoring financing to smaller companies that are most in need of capital.

Thanks to Leo Blyth (Lighting Global), Praveen Kumar & Anjali Garg (Lighting Asia), Arthur Itotia Njagi & Nana Nuamoah Asamoah-Manu (Lighting Africa), Sarina Bolla (International Finance Corporation) and Dennis Barbian (SNV) for their help in developing this Solution Spotlight.

194. Lighting Global. (n.d.) About us. Retrieved from: https://www.lightingglobal.org/about/

Improving resilience with SOLTRAIN

Solar thermal systems, which can provide heating, cooling and hot water, have become mature, useful technologies. They are modular and simple to operate and can take advantage of the large solar energy resources available in Africa. Mindful of this, Austria's AEE INTEC initiated a solar thermal project, SOLTRAIN, in five southern African countries in 2009.[195] The project is funded by the Austrian Development Agency and OFID. SOLTRAIN's aim is to enhance the resilience of the region's thermal energy system, and lessen thermal energy demands on existing electricity grids, thereby reducing blackouts.

The SOLTRAIN approach values training and capacity building as critical enablers for the diffusion of solar thermal technology. Rather than being a one-off development aid project, it aims to create the conditions where participating countries are provided with the know-how to sustainably implement a nationwide roll-out of solar thermal systems.

The first step was the creation of training hubs – mostly at universities – within each target country including outfitting them with solar thermal equipment for use in the training. These hubs ran over 80 training courses, reaching over 2,000 individuals in the first phases of the project. A focus on 'train the trainer' courses provided hundreds of individuals with the skills to not only design, install, operate and maintain systems but also to train others in these areas. There were additional courses on policy, administration and financing, along with 25 stakeholder engagement workshops focused on the collaborative development of solar thermal technology visions and roadmaps for each country. The hubs also co-ordinated public awareness campaigns through various media including TV, newspapers and radio. Finally, the universities involved were given support to develop courses on renewable energy.

These comprehensive capacity building initiatives provided a foundation of knowledge and resources to support the development of solar thermal demonstration projects – 187 of them have been completed so far. SOLTRAIN selected its demonstration project sites to benefit marginalized groups and social institutions including hospitals, retirement homes, orphanages, social housing projects, and community buildings. These demonstration projects benefit approximately 5,000 people annually and have shown considerable CO2 and cost saving outcomes (522 tonnes of carbon and US$250,000 per year).

As with the market-building approach utilized to grow demand for solar lighting products, SOLTRAIN owes its success to this comprehensive approach. However, there is a difference: SOLTRAIN's approach is focused more on support for the public than private sector. To cement this aspect, SOLTRAIN has given more than 150 policymakers tours of the demonstration projects, educating them on the benefits of the systems. A final phase of the project is now focused on further engagement with policy and energy system planners to develop the solar thermal technology roadmaps for each country.

Having achieved remarkable success, SOLTRAIN has expanded its reach to West Africa and is beginning a similar initiative in collaboration with ECOWAS.

Thanks to Werner Weiss of AEE – Institute for Sustainable Technologies for his help in developing this Solution Spotlight.

195. SOLTRAIN. (n.d.) About SOLTRAIN. Retrieved from: http://www.soltrain.co.za/about-soltrain

Incubating entrepreneurs at the World Bank's Climate Innovation Centers

Aspiring energy entrepreneurs in the developing world need the support of thriving ecosystems of people and business development services around them, all accessible at low transaction costs. Energy entrepreneurs also need to partner with other institutions and individuals in order to unlock the knowledge and resources that their companies need for success in a competitive and complex global marketplace.

The World Bank has initiated the creation of eight Climate Innovation Centers (CICs) in Kenya, Ethiopia, India, South Africa, Vietnam, Morocco, the Caribbean, and Ghana.[196] These centers offer early stage start-up support and allow new businesses that provide locally appropriate solutions to find success, and create jobs.

The aim of the CICs is to create a set of thriving entrepreneurial ecosystems in the developing world, each one focused on an open innovation approach to clean energy enterprise. To that end, the CICs provide the following services:

Proof of Concept funding to test the commercial viability of the entrepreneurs' ideas;

Access to technical facilities and technology information in order to support the iterative testing and prototyping of solutions;

Access to early-stage capital through the provision of targeted pre-investment advisory services and investment facilitation and syndication;

Technology-enabled business development services, networking, mentoring and training programs to support entrepreneurship skill-building within the networks;

Provision of needed sectoral and market information in order to assist entrepreneurs in scoping the local, regional and international market opportunities that are available to their new businesses;

Influencing and advocating for policy coordination and change through creating dialogues and linkages between the public and private sectors;

Promoting internationalization opportunities through creating and managing a network of regional and international partners, raising awareness and facilitating trade and export opportunities;

Holding Energy Entrepreneurship Bootcamp events to attract new talent and ideas to the centers.

Such services help energy entrepreneurs navigate complex market landscapes and develop strategies for success, innovative products, and partnerships that can fill gaps in knowledge and resources to get them to the last mile. This model emphasises an open-innovation approach that sees entrepreneurs as technology brokers – focused on adapting existing technologies and business models to local contexts – rather than inventors seeking to create entirely new products.

Thanks to Fred McBagonluri of Ashesi University for his help in developing this Solution Spotlight.

196. InfoDev. (n.d.) Climate innovation centres.World Bank Group. Retreived from: http://www.infodev.org/climate

Harnessing data from remote energy markets with SteamaCo and Vulcan Impact Investing

SteamaCo began life as a small, private off-grid utility company operating in rural Africa. It now serves other such firms by providing a smart metering platform to improve their operations.[197] The SteamaCo hardware is installed in off-grid energy systems or devices, connecting them to the cloud and allowing for remote monitoring and control. A mobile payment platform allows customers to make payments from their phones. All of this – the processing of payments, remote control of assets, and crunching of usage data – happens continuously, thousands of times per day, in areas where you can't even make a phone call.

Rural Africa is probably not the first place that comes to mind when anyone thinks of the burgeoning internet of things. However, it seems that this emerging set of platforms for collecting, analyzing and sending data between devices via the cloud has found an unlikely yet promising application in the continent's emerging off-grid energy sector.

Operators of off-grid systems, including solar home systems and micro-grids, face a number of challenges in rural Africa. A lack of roads and other infrastructure make travelling between assets to inspect them, collecting usage data and carrying out maintenance a major hurdle – even impossible at certain times of the year. Very little is known about current and prospective customers too – their ability and willingness to pay, the services they demand and how they will use the systems offered. Most do not have bank accounts or credit histories.

This is, despite its low-tech appearance, a situation in which the use of advanced data-driven technologies might become critical to greasing the wheels for rapid diffusion of advanced energy technologies.

The data infrastructure that SteamaCo provides allows operators to identify and troubleshoot problems before they become serious and require on-site maintenance. It gives the opportunity to direct spare capacity to other uses, and monitor the energy use of customers against their remaining balance. The platform essentially provides a simple and easy to use means of monetizing energy service assets anywhere customers can be found.

Vulcan Impact Investing has struck up a partnership with SteamaCo in the name of data sharing to build market intelligence for the off-grid sector. Having set up ten mini-grids in rural Kenya, Vulcan collaborated with SteamaCo to publish a white paper that presents and explores the data harvested through the use of SteamaCo's hardware. This level of data and market intelligence sharing may seem unlikely coming from private sector firms operating in a competitive marketplace. However, in the off-grid energy sector, where the untapped markets are so huge, sharing reliable data about consumer behaviour can be profitable for everyone. That's because it can drive the creation of forecasts and construction of service delivery strategies that enable the entire sector to grow.

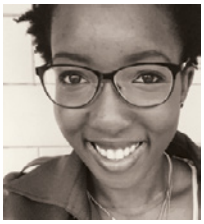
Continuing the effort to generate new insights will hopefully provide a shot in the arm for the whole off-grid sector. Continued growth in accessible market intelligence will diminish the 'Wild West' perception that currently limits investment in this sector. Increasing financiers' confidence in the promise and profitability of off-grid assets will open up opportunities to get new energy systems online and boost economic opportunities across the board.

Thanks to Emily Moder (SteamaCo) for her assistance in developing this Solution Spotlight.

197. SteamaCo. (n.d.). About. Retrieved from: http://steama.co/about/

Appendix: Contributors & Facilitators

Contributors



Adepeju Adeosun

Research and Operations Associate, Virgin Management Limited

Adepeju (Peju) Adeosun is a Research and Operations Associate, Virgin Management Limited. Peju specializes in policy and governance of renewables, land-use, clean tech and environmentally driven processes. "My current focus is developing more effective, values-driven communication between stakeholders to enable climate change solutions," she says.

Peju spent her formative years in Lagos, Nigeria and was educated in the UK. This early exposure to energy access and lifestyle disparity across the world sparked her interest in energy access issues. She is working to gain better understanding of how actions and mandates from international governance, funding agencies and nonprofits translate into the implementation of energy and environmental projects in developing nations, specifically Nigeria.

"Accidents of birth should not be the limiting feature of any individual's life. All people deserve to have equal rights when it comes to healthcare, education, security and, more recently some might argue, internet access," says Peju. "What links all of these things is access to energy."

Reja Amatya

Research Scientist, Tata Center for Technology + Design, Massachusetts Institute of Technology

Reja Amatya is a Research Scientist at MIT's Tata Center for Technology + Design where she leads two projects that focus on rural electrification in India. She knows that technology won't be useful if it is developed in a vacuum. "Understanding context has become far more important, so the engineering solutions that are coming up now will be far more useable than some developed in the past," says Reja.

Much of Reja's current work involves determining the right balance between grid extension and off-grid electricity supply. "In my view there has to be parallel growth between grid and off grid," she says. The big issue for those on the ground, though, is time. "If you ask me how it should look 50 years from now, I'd say grid extension with lots of distributed renewable generation assets. But when we're talking about energy access right now, purely grid extension is not going to do it in developing countries," Reja says.

Nkiruka Avila

PhD Student, Energy and Resources Group, UC Berkeley

Nkiruka (Nikky) Avila is a PhD Student in the Energy and Resources Group at UC Berkeley. Her research focuses on renewable energy integration, electricity access and sustainable energy development.

Nikky uses interdisciplinary research methods to evaluate centralized and distributed energy systems and to understand the role energy sovereignty plays in regional energy transitions. "I want to expand the energy access discourse to include bottom-up research approaches that glean strategies and solutions from the perspectives of people living in affected regions."

She returned to academia because "issues of inequality kept me up at night." Her personal experience with energy access led her to her current field. "I have experienced both the scarcity and the abundance of energy; weeks without grid electricity supply in Nigeria, and years without electricity interruptions in the United States," she says.

Nikky hopes to inform policymakers and investors on energy decisions. "Despite Nigeria's abundant energy wealth, the people are left in darkness due to grid and fuel infrastructure failures," she says. "Willingness and ability to pay for electricity do not overcome transformer failures, gas pipeline vandalism and limited generation capacity. Proper governance and policies are crucial to developing and managing the appropriate energy infrastructure that will ensure electricity access to all."

Theodore Blackbird-John

Workshop Facilitator, TREC Education

Theodore (Theo) Blackbird-John is a community activist and facilitator at TREC Education. He has been involved in grassroots organizing since 2012. "That was the year Idle No more was born, I haven't stopped since." Through TREC, he facilitates workshops engaging community members, elected leadership and youth in renewable energy.

"I have dedicated my mind, body and heart to raising awareness of social and environmental injustices that that will greatly affect the next seven generations and my home, Bkejwanong Unceded Territory, Walpole Island First Nation," he says.

Theo was drawn to work in energy access out of a desire to see his community grow and attain true sovereignty. "Here within Bkejwanong Territory, I see my friends and family struggle to pay their electrical bills in cold winter months or hot summer months. People have to choose whether they will pay for food or electricity." He sees an opportunity for First Nations communities to become leaders in community energy planning.

"I hope to achieve an everlasting future for the next seven generations. I hope to build bridges and partnerships that will help nurture the future of creation."

Ilan Chabay

Senior Advisor for Global Sustainability Research, Institute for Advanced Sustainability Studies

Ilan Chabay is the Senior Advisor for Global Sustainability Research at Institute for Advanced Sustainability Studies (IASS). From designing scenarios for sustainable development of the Eurasian and Greenland Arctic, to establishing a new global research alliance on knowledge, learning and societal change, his work is driven by the development of mutual understanding to create sustainable solutions.

Ilan has always been passionate about cultivating communication and understanding of science outside of the ivory tower. After a stint as Associate Director of the Exploratorium Science Museum in San Francisco, he founded the New Curiosity Shop in Silicon Valley where he led the design and production of interactive exhibitions and learning experiences for more than 230 museums, science centres and corporations across the globe, including NASA and Disney.

He continues to combine creativity, artistry, and scientific integrity by bringing stakeholders from diverse domains and walks of life together to confront the complex and difficult societal problems that they face.

On a recent trip to a pair of remote Indigenous communities in Alaska, Ilan saw firsthand the reality of northern communities facing energy isolation. "It was exciting to see how each community responded collectively and individually to the many challenges of a tough environment, including meeting their energy needs," he says.

Anna Clements

DPhil Student, Engineering Science, University of Oxford

Anna Clements is a DPhil Student in Engineering Science at the University of Oxford. Her research focuses on the development of sustainable energy systems for rural, off-grid communities in Kenya and Bangladesh.

"I trained to be an engineer so I could have an impact on global challenges," says Anna. "We have a responsibility to work towards responsible stewardship of the world and its resources." Right now Anna is working on implementing a sustainable energy service that will provide electricity to 50 households in two rural off-grid communities in Kenya.

"To design lasting and sustainable energy systems that truly enable the customer we have to move beyond the traditional, linear, approach to engineering design and begin putting the needs and aspirations of the customers first," says Anna. Challenging preconceived notions about the problems faced by those in rural off-grid communities is essential to creating appropriate solutions.

The opportunity for both immediate and lasting impact is what drew Anna to working in energy access. She finds the work "skills-stretching and challenging," and hopes to "understand or at least appreciate more greatly the complex interaction of social, political, economic and technical factors when it comes to the success of electrification projects."

George Colgate

Independent Energy Consultant

George Colgate provides consulting on energy access issues to several isolated First Nation communities in British Columbia.

After a career as a mechanical engineer, George spent a number of years as manager of Xeni Gwet'in Enterprise, a subsidiary of the Xeni Gwet'in First Nations Government. He founded the Enterprise in 1994 as a body that would help manage the First Nations' infrastructure assets, construct new assets, provide economic development opportunities and develop renewable energy resources. "People would like to get away from diesel and be as energy self-sufficient as possible," he says.

Unfortunately, he adds, there is no shortage of roadblocks. George has lived off-grid since 1970, and currently maintains his own off-grid residence with electrical energy produced

from photovoltaic panels. Much of the Xeni Gwet'in community is in a similar position, but providing everyone with access to electricity has been a 15 year process – and it's not quite finished yet. "People are very excited, and more so as we seem to be getting fairly close to this, but it shouldn't take this long in this day and age."

The delays are not about a lack of will on anyone's part, George reckons. They are down to a succession of "benign hurdles," such as over-complicated funding application procedures. Many agencies that are ready and eager to provide funds issue forms that could be simplified, he suggests – and shared between agencies so that communities don't have to fill out multiple different applications. "I suspect British Columbia is not the only place where this kind of thing happens," he says.

Hang Dao

PhD Candidate, SELECT PhD Erasmus Mundus Joint Doctorate Program, University of Lisbon

Hang Dao is a PhD Student at the University of Lisbon and specializes in sustainable energy solutions for the building sector, specifically modelling and optimizing energy systems for a net zero energy houses. Her research interest areas extend to energy security and sustainable energy development for developing countries.

"I care deeply about people and the environment," says Hang. "Energy use and energy access play a vital role to both." She believes we must act collectively to address the inequality of global economic system which, along with environmental degradation and political conflicts, create an energy access crisis for the world's poor.

Her passion for sustainability education led her to co-found POTATO Education & Communication, an organization that provides farm-based outdoor education for kids in Vietnam. As the co-founder and editor of CVD, a virtual think tank, Hang promotes discussions of regional development issues in Vietnam.

Hang wants to see more robust public policy supporting sustainable energy access worldwide. "Policy makers need to be able to take into account all sectors when working on energy access and sustainability," she says. "The high price of renewable energy technologies compared to fossil fuels creates a barrier to low-income populations and hinders mass implementation."

Mitchell Diabo

Projects Manager, Kasabonika Lake Development Corporation

Mitchell Diabo is the Projects Manager at the Kasabonika Lake Community Development Corporation. He describes himself as "running point on energy" with an active involvement in the community's attempts to reduce their dependence on diesel. "We get no petroleum products by road in the winter, which means we have to fly them in at much higher cost," Mitchell says.

The solution has involved developing a portfolio of energy solutions: solar PV and wind turbines in addition to diesel. "I see energy not as necessary infrastructure but as an economic foundation. It opened up a lot of opportunity for growth: we built buildings that created business opportunities, jobs and hope – right down to a planned youth centre that will give our young people something to do," he says. "Energy is always an economic foundation."

The highest priority for the Kasabonika Lake community is protecting its environment. "There is a strong culture of trapping, hunting and fishing here, and they don't want that impaired," Mitchell says. That's why their energy programs have to fully involve members of the community. "We are owners, and planners, developers and designers. Full participation is mandatory, as is ownership."

Sorin Grama

Co-Founder & Director, Promethean Power Systems Entrepreneur in Residence, Massachusetts Institute of Technology

Sorin Grama is the Co-Founder and CTO of Promethean Power Systems, which provides people in the developing world with technology for preserving perishable foods. Promethean's main focus is chillers that allow cows' milk to find a market beyond the immediate vicinity of rural dairy farmers. He also serves as entrepreneur-in-residence at the Martin Trust Center for MIT Entrepreneurship and the Legatum Center for Development & Entrepreneurship where he shares his experience of starting and scaling a business in a developing economy.

Promethean works with dairy processors to install milk chillers in India, Sri Lanka and Bangladesh. Each installation makes a huge difference to its community, something that Sorin didn't really see coming. "When I first set out to do this

I just set out to solve a technical problem," he says. "Now I see the bigger impact." The milk collection centre becomes a hive of activity, with people coming in twice a day to deposit their milk. "They're making good money, and that leads to development in the villages."

Immersion is the key to success in implementing energy and technology access, Sorin suggests. "If we're really serious, we have to be out there in the villages, living the life, seeing what the obstacles are," he says. While working out the best way to implement the "thermal battery" that underlies Promethean's technology, he spent a lot of time working in rural areas of the developing world. "It was the best part of my job: I was having to try to solve whatever problems came up."

Sameer Hajee

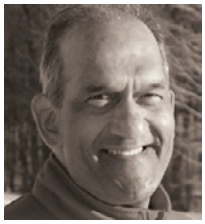
CEO, NURU Energy

Sameer Hajee is the Founder and CEO of Nuru Energy which launched in 2008 as a lighting and phone charging solution for the world's poorest consumers. Nuru provides extremely low cost or free-to-consumer LED lamps, which can be charged at stations operated by a micro-entrepreneur within the community.

Sameer trained as an electrical engineer, and worked for the UN, Freeplay Energy and a number of other development-focused organisations before setting up Nuru. The company's business model is a response to a misconception in energy access thinking, Sameer says.Though some households in the "base of pyramid" population can afford to invest in technology such as home solar systems, most can't. "There's market segmentation within the base of the pyramid that no one really appreciates," Sameer says.

It's important, he believes, to take official reports on income and spending in the base of pyramid consumer group with a pinch of salt. Nuru can track how often its lights are recharged, and has found that average energy use per household is much lower than World Bank estimates. "It's a quarter of what's in the development reports," Sameer says.

As a result he believes that many of the current energy access business models won't work for the poorest of the poor. Instead, Nuru provides hardware for a low "commitment fee" and charges on an "as you need it" basis. This has allowed previously unserved consumers to enter the energy services market.



Chris Henderson

President, Lumos Energy

Chris Henderson is the founder and president of Lumos Energy, an agency that provides trusted expert advice to First Nations, Métis and Inuit leaders and communities. The agency's aim is to finalize participation and partnerships in hydro, solar, wind, biomass, community energy planning, geothermal, and transmission projects.

Chris advises Chiefs and Councils, Tribal Groups and Aboriginal Economic Development Corporations on how to effectively secure and leverage partnership positions in clean energy projects across Canada. In recognition of his efforts he has been made an honorary member of several Indigenous communities. "In Inuktitut I'm called 'Tall Chris'," he says, "but the most fitting name might be the one given to me by the Boreal Ojibwe which translates as 'On Indian Time'."

Having catalyzed clean energy projects in every Canadian province and territory, Chris now hopes to help bring out a new generation of community energy leadership in Indigenous communities. The Catalysts 20/20 Program, an initiative of Lumos Energy, aims to use intensive training courses, mentorship and knowledge sharing programs to foster capacity and readiness on clean energy projects in Indigenous territories.

Supporting sustainable development in Indigenous communities has the potential to generate a diverse array of economic, social and environmental benefits for all involved, Chris says. "We need to focus on the prescription, not the diagnosis."

Søren Hermansen

Director, Samsø Energy Academy

Søren Hermanson is Director of the Energy Academy on Samsø, an island to the west of Copenhagen that is home to more than 4,000 people. In 1997 Søren initiated the transformation of Samso's energy sourcing, creating an island that not only meets its own needs with clean self-generated electricity, but also sells its surplus energy to the Danish national grid.

Though his experience and research, Søren identifies several key factors as an aid to creating create commitment to change. They include feed-in tariffs, good financing tools and long-term planning. Government commitment to renewables are also a huge help. Inflexible planning regimes are one of the biggest hurdles, he says.

Since Samso's energy transformation, Søren has become a much-sought advisor and consultant to energy projects around the world. He also hosts a stream of visitors keen to see how to create on-the-ground change in communities' attitudes to energy generation.

Søren's work is driven by commitment to the importance of local ownership. It is something that never fails to energise him. "I am an islander with a mission – I like to be in the middle of a good process with engaged people," he says. "I really like meetings where you feel engagement and courage leading to trust and decisions."

Matt Jordan

Director, Clean Energy Access, CLASP

Matt Jordan is the Director of Clean Energy Access at CLASP, an NGO focused on appliance energy efficiency. CLASP's Clean Energy Access program focuses on using energy efficiency to accelerate the affordability and benefits of access to clean energy throughout the developing world.

"Energy efficiency is a woefully underutilized and under-appreciated resource in energy access," Matt says. "How many coal plants are going to be built in the name of energy access? How many of those could be avoided through efficiency?"

CLASP's work in this sector is focused on off-grid product market development and transformation, such as their support of the Global LEAP initiative and the Alliance for Clean Cookstoves, as well as pushing the envelope on the overall role of energy efficiency in energy access. "In some ways, I see our work as highly technical program and policy development and implementation, "Matt says. "And in some ways, I see it as advocacy for this emerging issue that we think is really, really important."

Among other things, Matt hopes for simplified communication around energy project finance. "There's so much talk about finance, but if you're not a financier it's really opaque," he says.

Joachim Knebel

Head of Mechanical and Electrical Engineering, Karlsruhe Institute of Technology

Joachim Knebel is Head of Mechanical and Electrical Engineering at the Karlsruhe Institute of Technology. He is responsible for some 35 scientific institutions that work on solutions and scientific fundamentals for areas spanning energy, mobility and information.

His work on systems-level challenges includes planning the transformation of the German energy system ('Energiewende') "from research to prototype to industrial application." Operating at this vantage point gives Joachim a unique perspective on the strategy required to develop pathways for finding large-scale solutions for complex societal problems. "'Is it fair to all concerned?" Joachim asks, "That's the question that guides my work."

Through a partnership with the University of Waterloo, he now co-directs Affordable Energy For Humanity, a new initiative that aims to develop energy access solutions for the poorest of the poor by leveraging the expertise and resources within these institutions.

Joachim's vision for accelerating research on energy access begins with finding ways to motivate and support students and future leaders in this space. He is already working on a plan "to enhance the exchange of students between KIT and other institutions involved in the Summit," he says.

Jose Daniel Lara

PhD Student, Renewable & Appropriate Energy Laboratory, UC Berkeley

Jose Daniel Lara is a PhD Student in the Renewable and Appropriate Energy Laboratory at UC Berkeley. An electrical engineer who specializes in electric power systems, Jose's research projects include looking at the use of distributed gasifiers to generate electricity out of woody waste from forest fire management in California and characterizing barriers to climate change adaptation and solutions in California's power sector.

"My interest is in balancing electricity infrastructure development with climate change considerations," says Jose. "I like developing tools for analysis and sound decision making. The developing world needs access to electricity services and it is paramount that this energy is delivered in a clean, reliable and affordable way."

Jose sees issues of sustainability and scalability as a major barrier to energy access. "The International Energy Agency reports that in many cases energy projects in energy isolated communities don't last more than two years," he says. "Many failures are due to inappropriate or unclear organizational schemes."

He sees the possibilities that open source hardware and software might afford. "I hope we are able to deliver wellbeing for groups of people who need to make a huge jump ahead without repeating the same development path followed by developed countries."

Aaron Leopold

Deputy Director for Global Advocacy, Power For All
Global Energy Representative, Practical Action

Aaron Leopold is a globetrotting energy policy expert who serves as the Deputy Director for Global Advocacy at Power for All and as Global Energy Representative for Practical Action. He furthermore serves as an advisor to a number of key players in the energy access arena, including Sustainable Energy for All (SE4ALL), the International Renewable Energy Agency (IRENA), United Nations Framework Convention on Climate Change (UNFCCC), and the Climate Investment Funds (CIF). He is also a Deputy Director of the Power for All partnership, which brings together industry and civil society to spur enhanced effort to end energy poverty.

Aaron became invested in energy access as a result of his research on energy in developing countries. "When I learned that 80% of energy infrastructure investment in the 21st century will take place in developing countries where access is such a key issue," says Aaron, "I was hooked."

Aaron highlights two key areas that he feels can lead to the greatest unlocking of our collective potential to deliver energy to those without: financing and training. While the need for significantly more funding is more well-established, Aaron says that "there is an unnerving lack of attention to the need to develop business and vocational skills. Universalizing access will require the creation of thousands of companies, large and small."

Daria Malyutina

Global Investment and Innovation Incentives Professional, Deloitte

Daria Malyutina is a Global Investment and Innovation Incentives Professional at Deloitte. She works as a bridge between international research and development projects and funding opportunities.

Daria was born in Rostov-on-Don, a large industrial city in southern Russia where "neither ecology, nor renewable energy was ever an issue. The only thing that mattered was profit," she says. "I came to understand the role money plays in decision-making, so I studied both finance and ecology to help make the world a better place. I want to make green renewable energy projects as attractive for investors as possible."

Daria hopes to use her experience working in the European energy sector to support the energy projects in developing countries. "In many countries where the need for electricity is high, investors don't do business because of low returns on investment," says Daria, "and even more often because of high political risks." Daria sees a lack of knowledge and qualified energy professionals in these markets as a significant barrier. "We have to improve communication between technical experts, financial managers and business owners in order to develop robust, sustainable energy projects."

Chiedza Mazaiwana

Zimbabwe Campaign Manager, Power For All

Chiedza Mazaiwana is Power For All Campaign Manager at Practical Action Zimbabwe. This campaign promotes distributed renewable energy as the fastest, cheapest and most reliable solution to energy access. She is working on bringing together key stakeholders in the energy sector in Zimbabwe to provide information and tools to accelerate the distributed renewables market. "We are using best practices and cases borrowed from East Africa, facilitating the strengthening of the private sector voice in policy development and stakeholder engagement strategies that improve information flow, build trust and credibility, enhance transparency and create mutual accountability – all critical to market transformation and access acceleration."

"I started working on energy access soon after college," says Chiedza. "My main interest was in community development but I quickly realized that for any sustainable development to occur, energy access has to be addressed first."

She wants to see women and children in the rural areas of Africa being afforded the same opportunities and empowered as those that live with access to electricity. "Marginalized communities not only have limited health and educational services," Chiedza says, "energy poverty leaves them exposed to serious hazards."

She believes the right combination of policies, regulations, technologies and investment are necessary to make sustainable improvements to the lifestyles and wellbeing of many Africans. "I have seen the excitement of children from isolated communities when they see electric light, the improved incomes and productivity that come along with access to energy. Electricity changes lives."

Fred McBagonluri

Dean of Engineering, Ashesi University

Fred McBagonluri is Dean of Engineering at Ashesi University and was the inaugural Executive Director of the Ghana Climate Innovation Center, a new clean tech incubator backed by the World Bank.

Born and raised in Ghana, Fred attended secondary school there before heading overseas. He has been awarded 21 patents during his career as an inventor, engineer and executive at major universities and corporations in the United States, has written eight books and spends much of his time mentoring young adults about STEM and leadership. In 2009 he was a candidate finalist in NASA's astronaut recruitment program. Now, though, he has headed home.

"I returned to Ghana to help foster and refocus the next stages of economic development on an innovation footpath," Fred says. His interest in energy access and renewable energy in Africa comes from the recognition that it can have profound effects. "Persistent issues with power supply in Ghana have ravaged small businesses and slowed economic growth," he says. He is currently using his materials science, business and complex systems analysis expertise to craft strategies for the implementation and marketing of organic solar PVs in Africa.

Velma McColl

Principal, Earnscliffe Strategy Group

Velma McColl is a Principal at Earnscliffe, a strategic consulting company that works across a broad range of industries. Her current focus is on energy, environment and green technologies. She is proud of her 20-year record of work in the areas of climate change and energy, which has included co-founding the Canadian Clean Technology Coalition and advising Federal Cabinet Ministers on political strategy, policy and communications.

Velma believes that the difficult issues facing this generation are ripe for resolution. The key to achieving global energy access, she says, is collective action. "Individual countries can act on individual aspects of it, but to make a difference, at a global scale, on an accelerated timeline is going to require a joining of forces," she says. Though it's "one of the hardest things to do," she is currently optimistic that collective action is possible. "We are now all pointed in same direction," she says.

She acts as an "accelerator" for conversations between those who haven't always talked. It is also important to get government and private initiatives aligned and working together. "Working in isolation, we would only meet with limited success."

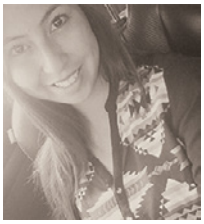
Eli Mitchell-Larson

Director of Operations, SunFarmer

Eli Mitchell-Larson is Director of Operations for SunFarmer, a social enterprise dedicated to bringing affordable renewable energy to those who need it most in the developing world. He supports the rollout of SunFarmer's solar-powered irrigation program in Nepal, and leads SunFarmer's efforts to expand to new markets beyond Nepal. His responsibilities run the gamut from strategy and product development to field operations and fundraising.

Eli is committed to combating climate change without leaving marginalized groups behind. "In rural South Asia, the ability to pay for electricity can be very low," says Eli. "Radically affordable and appropriate renewable energy technology, coupled with patient financing, is necessary." Poorly designed incentive schemes from government or development agencies, as well as political instability and currency risk are key systemic challenges Eli faces in his work that he hopes the summit will recognize and address.

SunFarmer recently completed its first financed solar-powered water pumping pilot projects in Nepal, and is pioneering a rent-to-own business model that could help millions of smallholder farmers in Nepal and beyond improve their livelihoods. Eli is thrilled to be involved in this project and has big ambitions for where it will go next. "I believe we have a moral imperative to try to reach universal energy access without relying on the carbon-intensive technologies of the past," he says. "We need to bring affordable renewables to as many people without energy access as possible, as quickly as possible."



Michelle Myers

Regional Representative, Indspire
BA & BSc Student, University of Alberta

Michelle Myers is completing her undergraduate studies at the University of Alberta studying a combined degree in Native Studies and Environmental Conservation and serves as a regional representative for Indspire. She has a specific interest in Indigenous land-based sovereignty that is rooted in traditional teachings and land expertise. Michelle has been part of several Indigenous/non-Indigenous organised initiatives focused around issues related to land and climate change including the Indigenous Climate Change Action Plan (Edmonton, AB), Tla-O-Qui-Aht Tribal Parks Summit (Tofino, BC), and Power Shift Alberta (Edmonton, AB).

Growing up in an isolated community Michelle see's the first hand consequences of limited energy options that stem from a lack of financial resources and community capacity. "My community, Xeni Gwet'in First Nations, is currently looking to provide renewable energy for our people," says Michelle. "I want to support my community in developing a sustainable economy using the bountiful resources we have been gifted with, and I look to support an energy based strategy that will bring jobs into my community and protect the livelihoods of our youth for seven generations to come. We need renewable sources of energy and economy in our community that is led by First Nations, for First Nations."

"I am responsible for providing my son with the best possible future," says Michelle "That includes ensuring he has a land base to learn his traditions and culture on. All of this work is necessary to protect and preserve the country I grew up on."

Kavita Myles

Program Director, Integrated Sustainable Energy and Ecological Development Association

Kavita Myles is Program Director at the Integrated Sustainable Energy and Ecological Development Association (INSEDA). She brings a unique mix of high-level expertise and on-the-ground experience to her work on energy access. Growing up in India, she was inspired by her father who spent over four decades advocating for affordable and clean energy in rural settings. After receiving degrees in economics and international relations and applying her knowledge as a climate change policy researcher, she has spent four years working with grassroots NGOs in India that develop and promote climate resilience strategies and low-cost, low-carbon energy access solutions for rural areas.

Kavita's ongoing work includes the development of a model for an 'eco-village' to demonstrate the community co-benefits of implementing renewable energy technologies, and a pilot sanitation project that uses biogas technology to generate power. "This ties in with three issues that I feel strongly about and have a lot of relevance in India, " she says," sanitation, women's rights and energy access."

Despite her experience and education, Kavita sees the energy access issue from a distinctly human and intimately local level. She wants to address the issue that there are not enough incentives given to private citizens to innovate in the field.

Djimingue Nanasta

Regional Coordinator for West Africa, International Network for Sustainable Energy

Djimingue Nanasta is the Regional Coordinator for West Africa for the International Network for Sustainable Energy (INFORSE). Djimingue says that he understood energy poverty when he saw a woman burning a plastic bucket to cook food for her family. "This was and is unacceptable," he says and he has been working as clean energy advocate ever since.

Djimingue is particularly interested in the crucial implications of increased clean energy access on human and community development. "Success," he says, "rests on addressing a number of major challenges." One of those challenges is creating energy policies that take into account the urgent energy needs of peri-urban and rural

areas. "In Africa we often fail to consider rural women and men as integral players to energy access and sustainable development," he says.

Djimingue has learned through 15 years of hands-on research activities, policy analysis studies and case study identifications that poverty is the overriding limiting factor to energy access in Senegal and other West African countries.

Jatin Nathwani

Professor, Ontario Research Chair and Executive Director, Waterloo Institute for Sustainable Energy, University of Waterloo

Jatin Nathwani is Executive Director of the Waterloo Institute for Sustainable Energy (WISE) and Ontario Research Chair in Sustainable Energy and Public Policy at the University of Waterloo. He also serves as Chief Scientific Advisor to the Waterloo Global Science Initiative.

Jatin began his academic career later in life after spending decades as a leader in the Canadian utilities sector. Now, a sense of duty towards the billions who do not have reliable access to electricity drives this work.

As co-founder of Affordable Energy for Humanity, his focus is forging collaborations between university researchers, energy companies and organizations active on the ground to accelerate the transition to a low-carbon global economy. "Energy poverty remains a barrier to economic well-being for such a large proportion of humanity," he says, "we have a moral imperative to ensure that the needs of the poor are not ignored anymore."

He believes scientific and technological innovations will remain at the core of the effort to address this complex global problem but he knows "significant advancement will only be possible if we can bring into play the insights and knowledge from many disciplines including the social sciences and the humanities. In the end, it is the quality of life of every global citizen that matters."

Crystal Okudo

Transaction Advisory Associate, GreenMax Capital Group

Crystal Okudo is a Transaction Advisory Associate at GreenMax Capital Group. She brings her experience as an energy economist and project finance specialist to both the 'buy' and 'sell' sides of grid-connected and off-grid projects. "I connect investors from all over the world with strong energy projects in Africa," says Crystal. "The region I work in now has many viable energy projects but it is still a struggle to attract affordable project development financing."

Crystal is no stranger to making a big impact in energy access. In 2010, after seeing her village community of Asembo Kanyigoro becoming increasingly poor due to lack of economic activity, Crystal proposed bringing grid electricity to the area. The local council adopted her plan and after 18 months of payments, the entire village was electrified.

She counts her role as a financial consultant in the development of a $42 million USD green mini-grid facility. "The design of this green mini-grid program is important because it has been a catalyst for increased involvement of Kenyan banks in green energy projects," says Crystal. "For years, developers in Kenya have struggled to attract project financing from local banks. And now, Chase Bank Kenya has announced an $11 million USD credit line to fund green energy projects."

Shonali Pachauri

Senior Research Scholar, Energy Program, Institute for Applied Systems Analysis

Shonali Pachauri is a Senior Research Scholar in the Energy (ENE) Program at the International Institute for Applied Systems Analysis (IIASA). Her research focusses on the socioeconomic, demographic and environmental dimensions of energy use and energy poverty at the household level.

Her broader research interests include fuel use and choice and how it is affected by lifestyle as well as the analyzing household consumption in developing countries.

"We know that access to adequate, reliable, affordable and quality energy services is a huge challenge," says Shonali. By taking a systems level approach, she is exploring the synergies and trade-offs of pursuing universal energy access (SDG 7) concurrently with the rest of the UN's Sustainable Development Goals.

Aline Pacheco Pelucio

Technical Advisor to the Secretary of the Environment, State of São Paulo, Brazil

Aline Pacheco Pelucio is Special Advisor of the State Secretary for the Environment of the State of São Paulo. She specializes in sustainable finance and environmental liability.

Brazil is facing a series of important policy decisions that will determine its energy future over the next several decades, with important implications for the country's economic competitiveness, the well-being of its citizens, and even the global climate. "Historically our power generation has dominated by hydroelectricity generated by huge plants," say Aline. "This dependence on big hydro has had devastating effects on the environment and communities, we need a transition plan." She also notes the disparity of electricity access in Brazil; communities in the developed south of the country tend to have reliable access, whereas remote communities in the north struggle.

Aline is currently working on the Climate Fund of the State of São Paulo, a collaborative effort that includes international development banks and private banks developing ways to incentivize the replacement of conventional energy infrastructure in public buildings like hospitals and schools. "I hope to provide financial engineering solutions applicable to Brazil in order to replace conventional energy sources in public buildings with more sustainable options," she says.

Aneri Pradhan

Founder and Executive Director, ENVenture

Aneri Pradhan is the Founder and Executive Director of ENVenture, a social enterprise that operates an incubator in Uganda for community based organizations that sell clean energy technologies. "I'm driven by the excitement our partner organizations experience as they become entrepreneurs," says Aneri. ENVenture provides mentorship and coaching to support local organizations in creating sustainable supply chains to bring clean energy technologies to their communities.

Seeing rows of homes equipped with solar water heaters on their roofs on a trip to visit family in India is what drew Aneri to working in energy. "I realized then that to prevent catastrophic climate change, we have to increase access to renewable energy in developing countries," she says.

"Too much energy access innovation is happening in the west," she says "and not enough is happening on the ground for locals to take control and profit off of their energy decisions." She is currently working on productivity tools designed to aid rural entrepreneurs in managing inventory and sales forecasting. Despite making strides in innovative business development, access to finance remains a barrier for local entrepreneurs. By supporting local organizations with robust business development, improving product adoption and creating compelling rural marketing, Aneri hopes to smooth the road to energy access.

Ortwin Renn

Scientific Director, Institute for Advanced Sustainability Studies

Ortwin Renn has spent his career engrossed in systems-level thinking at the intersection of technology, environment, culture and social change. He is the Director of multiple institutes and programs in Germany, including the Institute for Advanced Sustainability Studies, the Stuttgart Research Center for Interdisciplinary Risk and Innovation Studies and DIALOGIK, a nonprofit institute for research on communication and cooperation.

What connects his work is "a desire to understand processes of technological and cultural change, how they interact, and how they can be navigated in order to create a more sustainable and resilient future."

Ortwin views the primary culprits for the persistence of energy poverty through the lenses of risk governance, sustainable development, public participation and technology assessment. Among these culprits? "The unequal distribution of wealth, a belief in large-scale, centralized energy production and the view that are other more important topics to be concerned with."

Ortwin looks at systems-level issues in the hopes of opening up space for new ideas and consensus in an area often bogged down in the minutiae of financing, policy change, and technology.

Fredy Rios Silva

Scientific Assistant, FZI Forschungszentrum Informatik

Fredy Rios Silva is a Scientific Assistant at FZI Forschungszentrum Informatik (Research Center for Information Technology). His research investigates demand response programs for guiding the behaviour of customers, to increase the use of intermittent generation sources including wind and solar power.

Fredy brings insights regarding the energy challenges and perspectives of two different realities, from his native Chile and his current home in Germany. "In Chile, there are concerns regarding the environmental consequences of power generation and energy security," says Fredy. "In Germany, the challenge is preparing the power grid for intermittent generation." He sees considerations from both places as drivers of development, local growth and decentralization of the economy. He hopes to develop a better understanding of how policy enables the development of local economies through the diversification of energy portfolios.

Fredy considers financing to be one of the main barriers to energy access. "From a private investment perspective, energy access is justified if there is a market," he says. "So, from a state perspective, incentives should be focused on supporting local markets to ensure connectivity to remote areas."

Yuri Rugai Marinho

Director, Eccon Soluções Ambientais

Yuri Rugai Marinho is the Founder and CEO of Eccon Soluções Ambientais, a Brazilian environmental consultancy. He is also the Co-Founder of Vigiapp, a startup that developed a communication portal for registering environmental problems in Brazilian with a view to connecting with appropriate solutions.

As a trainee at a law firm during his legal studies, Yuri participated on due diligence processes of several national and international energy companies located in different regions of Brazil. His experiences analyzing the regulatory and environmental aspects of hydroelectric, solar, wind and thermoelectric power plants drew him to a career in energy.

"The most challenging aspect of increasing access to electricity globally are distribution costs," says Yuri. "It's a complicated mix of economic, logistic, environmental and social costs. And environmental concerns are a particularly complex hurdle in Brazil because of its many ecologically sensitive areas."

Judith Sayers

Strategic Advisor, Sayers Strategic Advice

Judith Sayers (traditional name Kekinusuqs) has been a lawyer, strategic advisor and a Chief of the Hupacasath First Nation on the west coast of Vancouver Island.

During her time as Chief, the Hupucasath First Nation built a 6.5-megawatt run-of-river hydro project that produces more than enough electricity for the 6,000 homes in the community. "We own 72.5% of this project. We get to set the standards," says Judith, "one of the great benefits is that we manage our territory, the land, the water. We get to make the decisions. We believe in the right of self-determination."

Of all of her accomplishments advocating and lobbying for clean energy opportunities for First Nations is her proudest achievement to date. In her capacity on the New Relationship Trust Economic Development Support Team she frequently visits First Nations communities in BC to provide support for a range of economic development activities including clean energy. For other communities looking to develop clean energy projects, she has compiled the BC First Nations Clean Energy Toolkit, an extensive resource.

Judith's gaze is fixed clearly on the future. "I am working for the next seven generations. We must inspire our youth to make changes in the world. To help bring more knowledge, skills and tools for them to address energy access issues."

Taha Selim Ustun

Assistant Professor, Electrical and Computer Engineering, Carnegie Mellon University

Taha Selim Ustun is an Assistant Professor of Electrical and Computer Engineering at Carnegie Mellon University in Pittsburgh, Pennsylvania. He is currently working at CMU's campus in Kigali, Rwanda where his roles include teaching and power systems research, with a focus on designing and implementing electrical power in a rural context.

One aspect of Taha Selim's research that particularly fascinates him involves the novel ways in which energy deployment can happen in the developing world. A "blank slate" offers opportunities that are unavailable in the developed world and because of legacy systems and resistance to change. "It's a really fertile area, we can export those findings back to engineers and policy makers in the developed world," he says.

Taha Selim does encounter a significant roadblock in his day to day experience: scalability. “Every microgrid solution you see in the developing world is a custom-made solution,” he says. “That means you can’t duplicate it somewhere else, you always have to go back to the drawing board.”

While a one-size-fits-all energy access solution is neither possible nor desirable, Taha Selim hopes the Summit participants can together uncover paths towards broadening the design process for energy access projects. For instance, with a general schema for research and development process in the developing world in hand, on-the-ground engineers might be able to work from a pre-existing set of design principles, guidelines and tools that speed the process.

Vagish Sharma

Strategic Projects, National Skill Development Corporation

Vagish Sharma is a Project Manager at National Skill Development Corporation, an armslength organization under India’s Ministry of Skill Development and Entrepreneurship. He specializes in energy education and sustainable project management. He played a vital role in development of the Joint Clean Energy R&D Centre, a partnership between the US Department of Energy and India’s Ministry of Science & Technology focused on ensuring mutual energy security building a clean energy in each partner nation. Beyond that he hopes to develop a more effective knowledge sharing infrastructure – a system where people working across disciplines in energy access can access supportive resources and community.

Capacity-building and standardization within the energy sector is important to Vagish. ”India has a very high number of young people who are unemployed or not enrolled in an education or training program,” he says,” this huge obstacle to progress but, at the same time, an opportunity.”

“Solar and wind energy provides a tremendous opportunity to provide light to Indian homes,” says Vagish,”we can create skilled, green jobs and improve access to electricity.” He sees private-public partnerships playing a critical role in skill-development ecosystems because “India is a big and lucrative marketplace.”

Karl Skare

Director of New Business Initiatives, d.light design

Karl Skare is the Director of New Business Initiatives at d.light design. His responsibilities include business and product development, fundraising, and strategic planning. “I believe that distributed solar in the developing world has the potential to leapfrog centralized generation powered by fossil fuels,” he says, “similar to how cell phones leapfrogged landlines in the same markets.”

Currently he works on technology-enabled financing solutions for small scale solar home systems. His customers do not have access to electricity and are living on less than $2 USD per day. “Our customers can now redirect the money that they were spending on kerosene, phone charging, and disposable batteries towards the ownership of a productive asset,” says Karl. “They can save hundreds of dollars once they have paid off the system.”

Karl was first drawn to energy access while doing a project for the solar lantern manufacturer Greenlight Planet in a design class at Stanford. Tasked with designing an innovative distribution model for solar lanterns in India, he conducted interviews with industry players, potential customers, and experts in off-grid energy access. “I realized just how challenging distribution can be in remote rural locations,” he says. “That experience made me realize that this was a challenge that I could wake up every day excited to tackle.”

Eryn Stewart

Program Manager, 20/20 Catalysts Program, Lumos Energy

Eryn Stewart the Program Manager of the Catalysts 20/20 Program, an interactive three-month program built on mentorship, collaboration and the sharing of information between communities to support Indigenous leaders embarking on clean energy projects. The program is guided by Indigenous leaders and clean energy practitioners from across Canada.

“There is simply no substitute for local knowledge and good relationships,” says Eryn, “Having community members involved in a project makes a world of difference. External experts can offer valuable advice, but achieving benefits and creating social change require community support, knowledge and leadership.”

Eryn believes modern energy access is a fundamental human right. "Electricity is essential to human well-being and economic development," she says," it is crucial for access to clean water, sanitation, healthcare and reliable lighting." She hopes to help more people, and specifically Indigenous peoples, gain access to clean and renewable energy.

"My father's motto is 'you can't treat the earth like there is a spare in the trunk'," says Eryn, "that really stuck with me growing up, and now, echos a lot of my values in my work and personal life.

Laura Sundblad

Program Advisor, Facilitating Access to Finance, Global Off-Grid Lighting Association

Laura Sundblad is a Program Advisor at the Global Off-Grid Lighting Assocaiton (GOGLA) focusing on facilitating access to finance.

After spending ten months living on a small atoll in the middle of the Pacific in a house powered by a small solar home system, Laura was keen to work in energy access. "I wanted to learn more about how rural and remote households could gain access to clean energy to meet household needs," she says, "going beyond lighting to food storage and preparation, laundry, and other tasks that are traditionally huge time sinks for women."

In her current role, Laura is working to help increase investments that allow for scaling and accelerated development of the off-grid market, leading to more people benefiting from clean, sustainable and economically viable off-grid lighting and electrification.

Billy Yarro

West Africa Energy Lead, Practical Action

Billy Yarro is the West Africa Energy Lead for Practical Action. He is a voice for those at the 'bottom of the pyramid' – those without access to energy and living on an income of less than $2.50 USD a day. "Enabling energy access is a key lever for realizing the potential of the world's poor," says Billy.

Billy contributes to Practical Action's Poor People's Energy Outlook, an annual publication that takes a multidimensional approach to energy access; 'access' meaning when the full range of energy supplies and services required to support human social and economic development are available to households, enterprises and community service providers.

His other projects include the Moving Energy Initiative in Burkina Faso and a market study for an an irrigation power system in Senegal. "One of the most significant roadblocks to energy access I've encountered is the engagement of key stakeholders," says Billy, "from people on the ground, to the private sector and government bodies."

Using his experience to motivate others is something Billy does through training sessions across West Africa. Billy's energy outlook is bright, "When I was working in Cameroon, we used to say 'believe that in 2020, we will be able to bring light to all Cameroonians.'"

Hisham Zerriffi

Associate Professor, Department of Forest Resources Management and Faculty Affiliate, Liu Institute for Global Issues, University of British Columbia

Hisham Zerriffi is an Associate Professor in the Department of Forest Resources Management and a Faculty Affiliate at the Liu Institute for Global Issues at the University of British Columbia He has spent over a decade conducting leading research on energy decision-making, regulations and markets for energy access in the developing world.

Hisham's research group uses interdisciplinary approaches to develop evidence-based policy recommendations for all stakeholders in the energy access space – governments to donors, private sector firms to individual households.

"There are strong built-in incentives and disincentives that make achieving energy access difficult," Hisham says. One of the problems is misleading assumptions about how decisions get made. "The decision-making environment, even at the household level, is much more complex than it is often assumed to be," he says.

He sees collaboration as essential for developing a roadmap for reducing barriers and creating support for accelerating energy access especially where policy is underdeveloped. Hisham has had "the great pleasure to mentor and collaborate with amazing graduate students," also hopes to continue to learn from practitioners"directly involved in trying to implement energy access solutions in the field."

Facilitators

Michael Brooks

OpenAccess Energy Summit Curator

Michael Brooks is an author, journalist and broadcaster with a PhD in quantum physics, He is a consultant at *New Scientist* and the author of *At The Edge of Uncertainty*, *The Secret Anarchy of Science* and the bestselling non-fiction title *13 Things That Don't Make Sense*.

Nigel Moore

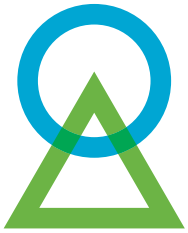
OpenAccess Energy Summit Rapporteur

Nigel Moore is the Manager of Global Programs and Initiatives at the Waterloo Institute for Sustainable Energy, University of Waterloo. He is responsible for the Affordable Energy for Humanity Global Change Initiative, an international research network addressing energy poverty through the development of low carbon energy systems that are responsive to the needs of the global populations that need them the most.

Dan Normandeau

OpenAccess Energy Summit Facilitator

Dan Normandeau is the President of ConversArt Consulting. A management consultant with over 30 years' experience in the private and public sectors he has been engaged by leaders in at all levels who are facing strategic, operational, policy, program and regulatory challenges. His objective for every group conversation is to create the right conditions for groups to create ideas that generate high impact results for any endeavour.



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