Discourse Media

North America Access to Energy Brief

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Introduction

As the birthplace of the earliest electric power generator, North America may not be the first continent that comes to mind when thinking about the challenges of access to energy.[1] According to the World Bank, 100 per cent of the population in Canada and the United States have access to electricity, and 91 per cent of Mexico's population has access.[2] However, these statistics conceal the unique energy challenges faced by North American communities. Although the technology to supply both renewable and nonrenewable electricity is readily available everywhere in North America, issues of exorbitant cost, grid resilience, and poorly designed policy still affect many people's access to energy. This research brief will focus on three nuances of the North American energy landscape: far-Northern communities' over-reliance on diesel fuel for power generation, the resiliency of urban grids to major weather events or other shocks, and distortionary electricity-subsidies in Mexico.

Current Energy Profile

The North American Electric Reliability Corporation (NERC) is an international not-for-profit regulatory authority with the mission to ensure a stable power system in North America.[3] While the majority of Canadians and Americans fall under its authority, there are a number of island, Aboriginal, and far-North communities that remain disconnected from the continental grid because of economic and logistical reasons. The most recent Canadian data, from 2012, records 175 Aboriginal and northern off-grid communities spread across the country.[4] The energy profile of these isolated communities

1 Atkinson, Nancy. "Who Discovered Electricity?" Universe Today, March 3, 2014. http://www.universetoday.com/82402/who-discovered-electricity/.

2 World Bank. "Access to Electricity (% of Population)," 2015. http://data.worldbank.org/indicator/EG.ELC.ACCS.ZS.

3 NERC. "North American Electric Reliability Corporation." About NERC, 2015. http://www.nerc.com/AboutNERC/Pages/default.aspx.

4 Aboriginal Affairs and Northern Development Canada. "Off-Grid Communities." Reference material, May 1, 2012. https://www.aadnc-aandc.gc.ca/eng/1314295992771/1314296121126#comm.

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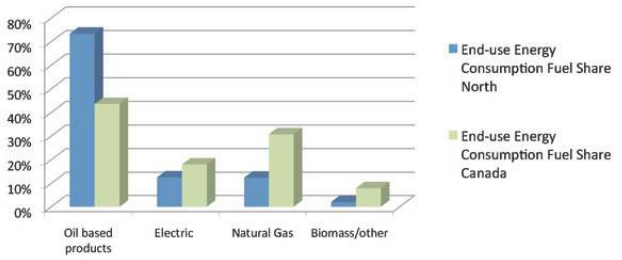

Figure 1: End-use Energy Consumption Fuel Share in the Northern Territories (Yukon, Northwest Territories, Nunavut) versus Canada. Source: NEB, 2014

is markedly different from the rest of Canada. To get a clearer picture of the challenges faced by Northern communities, it is useful to differentiate between power generation and power transmission. First, generation; as seen in Figure 1, almost three-quarters of energy consumption in the North comes from refined oil products, while in Canada as a whole that fraction is closer to 40 per cent.[5] There are also many isolated communities in Northern Ontario, Quebec, Newfoundland and Manitoba that rely on community diesel generators, in some cases as backup to small scale wind farms or hydroelectric plants. Transmission is also different in Northern communities than in the rest of North America. Although there are a few microgrids across the North (such as the one that connects a 15 MW hydroelectric facility 36 storeys beneath Aishihik lake to both Whitehorse and the Faro zinc mine), the power generated in most communities must be consumed by that same community.[6]

Northern Communities

On top of the challenges of generation and transmission, colder and longer winters mean that per-capita energy use in Northern communities is almost twice the Canadian average.[7] Finally, the logistical difficulty of transporting – ei-

5 NEB. "Energy Use in Canada's North: An Overview of Yukon, Northwest Territories, and Nunavut - Energy Facts." National Energy Board, October 2, 2014. https://www.neb-one.gc.ca/nrg/ntgrtd/mrkt/archive/2011nrgsncndnrthfct/nrgsncndnrthfct-eng.html.

6 Burpee, Jim R. "Powering Canada's North: Opportunities and Challenges." Power for the Future, March 15, 2013. http://powerforthefuture.ca/2013/03/powering-canadas-north-opportunities-and-challenges/.

7 NEB, 2014

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ther by ship, truck or plane – large quantities of diesel fuel, mean that electricity prices in some Northern communities have reached 10 times the Canadian average on a per-kilowatt basis.[8] The unique energy profile of isolated Northern communities creates a number of specific problems that could be considered symptoms of inadequate access to clean energy. Environmental concerns include greenhouse gas emissions from burning diesel, increased risk of spills as the fuel is transported over long distances, and local air quality concerns. From a social perspective, generators are noisy and disruptive, especially in small and quiet communities. There may be health problems associated with exposure to diesel fumes, and blackouts can occur if generators are not regularly maintained. Finally, from an economic perspective, reliance on diesel is also less than ideal. Its high and often unstable price deters small business and inflates the cost of living in Northern communities.[9]

Clearly there is much work to be done before Northern communities have access to a clean, resilient, and affordable energy system. Governments, not-for-profits, and private interests all realize this, and have been working to improve the situation for a number of years. In July 2015 at the Energy and Mines Ministers' Conference in Halifax, the provinces and territories with isolated Northern communities agreed to the formation of a task force to generate a report on efforts to reduce diesel use in Northern communities.[10] One of these efforts is the federal ecoEnergy program that received 83 applications for the 2015-16 cycle to fund small-scale renewable energy projects in Aboriginal and Northern communities.[11] Northern Canadian communities could also learn much from

8 NEB, 2014.

9 Aboriginal Affairs, 2012.

10 Canadian Press. "Agreement Signed to Reduce Diesel Fuel Use in Remote Canadian Communities." CBC, July 21, 2015. http://www.cbc.ca/news/canada/nova-scotia/agreement-signed-to-reduce-diesel-fuel-use-in-remote-canadian-communities-1.3161725.

11 Aboriginal Affairs and Northern Development Canada. "ecoENERGY for Aboriginal and Northern Communities Program," June 3, 2015. https://www.aadnc-aandc.gc.ca/eng/1100100034258/1100100034259#sect1.

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their neighbours in Alaska. For example, Kodiak Island, Alaska – the United States' second largest island, with a population of 15,000 – recently transitioned from 20 per cent reliance on expensive imported diesel fuel for electricity generation to 100 per cent renewable power accompanied by flywheel and battery energy storage.[12] Non-profit and academic organizations also play a role in improving Northern access to energy. The Arctic Energy Alliance provides funding and advice for communities seeking to transition to a greater share of renewables, and the Alaska Center for Energy and Power at the University of Alaska Fairbanks produces research about microgrids in Northern communities.[13][14] In other parts of Canada, there are many social enterprises that aim to directly address the issue of access to energy. They may provide valuable models for remote Northern communities. Some examples, for further reading, are: BUILD, a social enterprise in Manitoba focusing on job training and energy efficiency retrofits; MGR, which also focuses on green energy retrofits; Aki Energy, a non-profit Aboriginal social enterprise that has installed more than 400 geothermal systems on reserves – with more to come; Choices for Youth, a program in St John's, Newfoundland, modelled off of BUILD; and BuildingUp, another similar social enterprise in Toronto, Ontario.

What is clear in all of these initiatives is that the transition to a more renewable, stable and affordable energy system will require billions of dollars in research, infrastructure investment, and personnel training. One reason the conversation about access to energy in Northern communities may be accelerating today is that the region is likely on the cusp of a resource extraction-driven economic boom. The Confer-

12 Guevara-Stone, Laurie. "An Alaskan Island Goes 100% Renewable." RMI Outlet, May 19, 2015. http://blog.rmi.org/blog_2015_05_19_an_alaskan_island_goes_one_hundred_percent_renewable.

13 Arctic Energy Alliance. "About Us." Accessed October 20, 2015. http://aea.nt.ca/about-us.

14 Alaska Center for Energy and Power. "About Us." Accessed October 20, 2015. http://acep.uaf.edu/about.

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ence Board of Canada estimates that Northern Canada's overall metallic and non-metallic mineral output will grow by 91 per cent between 2011 and 2020.[15] If communities are able to capture their share of this wealth, it could literally pave the way to a more secure energy future.

Resilience to Natural Disasters

Although populations in the highly urbanized and grid-connected portions of North America have access to uninterrupted and cheap energy, they are still susceptible to natural disasters. Power systems are vulnerable to many extreme weather events such as floods, windstorms, ice storms, snowstorms, hurricanes, heat waves, prolonged droughts that trigger wildfires, and so on. Economists estimate that storm-related power outages cost the U.S. economy between US$20 billion to $50 billion each year. Critically, the data also suggest that these extreme weather events are occurring more frequently as the climate changes.[16]

Hurricane Sandy in New York City, which caused an unprecedented US$65 billion in damages and 181 deaths in 2012, galvanized regulators and politicians to push forward research and investment into grid resilience.[17] Grid resilience first requires "hardening" the system infrastructure with traditional approaches like upgrading poles and trimming trees near lines. However, utility companies are recognizing it is impossible to make systems invulnerable to all storm damage; newer approaches are essential to give operators the ability to quickly reconfigure the system when portions of the grid go down.[18]

15 Rhéaume, Gilles, and Margaret Caron-Vuotari. "The Future of Mining in Canada's North." The Conference Board of Canada, 2013. http://www.miningnorth.com/wp-content/uploads/2013/01/Final-13-201_FutureofMining_CFN.pdf.

16 Abi-Samra, Nicholas C. "One Year Later: Superstorm Sandy Underscores Need for a Resilient Grid." IEEE Spectrum, November 4, 2013. http://spectrum.ieee.org/energy/the-smarter-grid/one-year-later-superstorm-sandy-underscores-need-for-a-resilient-grid.

17 The GridWise Alliance. "Improving Electric Grid Reliability and Resiliene: Lessons Learned from Superstorm Sandy and Other Extreme Events." GridWise Alliance, June 2013. http://www.gridwise.org/documents/ImprovingElectricGridReliabilityandResilience_6_6_13webFINAL.pdf.

18 Abi-Samra, 2013

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The core philosophy behind grid resilience is to return power to as many customers as possible as quickly as possible following a storm. To do this, it is necessary to split large networks into smaller circuits, to deploy smart grid technology that can automatically detect short circuits and reroute power around the problem to keep as many people energized as possible, and to incorporate more microgrids that can operate either autonomously or as part of the larger system. microgrids are particularly important in resilient systems to ensure critical sites such as hospitals, water treatment plants and telecommunications networks receive uninterrupted power in an emergency.[19]

Following the destruction caused by Hurricane Sandy, The President's Council of Economic Advisers prepared an extensive report that estimated the average yearly economic damage caused by extreme weather, and presented a number of smart grid and microgrid strategies to mitigate that damage.[20] In Canada, the NSERC Smart Microgrid Network (NSMG-net), a multi-disciplinary research program between government and industry, is pushing for the future of grid design. The research program emphasizes variable generation (a diversity of energy sources), islandability (the ability to connect and disconnect from the larger macro-grid without negative effects), and demand response (the use of forecasting, modern sensing and communication technology to manage demand and more closely match available generation).[21] It remains to be seen if these changes will be implemented locally.

Policy Design

Supplying clean, affordable power to Northern communities and building resilience into urban electrical grids are

19 Rajendra Singh & Krishna Shenai. "DC Microgrids and the Virtues of Local Electricity." IEEE Spectrum, February 6, 2014. http://spectrum.ieee.org/green-tech/buildings/dc-microgrids-and-the-virtues-of-local-electricity.

20 The President's Council of Economic Advisers and the U.S. Department of Energy's Office of Electricity Delivery and Energy Reliability. "Economic Benefits of Increasing Electric Grid Resilience to Weather Outages." Executive Office of the President, August 2013. http://energy.gov/sites/prod/files/2013/08/f2/Grid%20Resiliency%20Report_FINAL.pdf.

21 NSMG-net. "About." The NSERC Smart Microgrid Network, 2015. http://www.smart-microgrid.ca/about/.

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both matters of investing in the appropriate infrastructure and technologies. However, parts of North America also suffer from poorly designed and implemented policies that limit access to energy. In Mexico, access to energy has been seen as a component of social justice since the 1960s, when the government nationalized the electricity sector and amended the constitution to forbid private interests from participating in any part of the system. The state-run system was remarkably effective at connecting millions of people to the grid and achieving nearly universal coverage.[22] To assist this expansion, the government developed the idea of electricity as social justice, and provided extensive subsidies to residential and agricultural consumers. Although subsequent reforms have slowly allowed the private sector back into aspects of the energy system, Mexico's subsidies have remained some of the largest in the world. In 2006 they totalled US$9 billion, two thirds of which went to residential consumers.[23] At first glance, subsidies to consumers may seem like a good method to improve energy access; however, they play a major distortionary role in the market and effectively act as a regressive tax on the poor. As seen in Figure 2, electricity prices in Mexico for all customer classes are set below the cost of production, creating an unsustainable financial situation. The financial shortfall created by these subsidies must be made up by government, or if not directly by government, then by reduced spending on service quality upgrades and on operations and asset maintenance.[24] Additionally, although low-income individuals pay for subsidies through their taxes, studies have shown that they receive only one per cent of the benefits of electricity subsidies. In effect, the subsidies only induce demand in the richer classes who

22 "Guide to Electric Power in Mexico." Center for Energy Economics, August 2013. http://www.beg.utexas.edu/energyecon/2013%20E.pdf.

23 Guide to Electric Power in Mexico, 2013.

24 Komives, Kristin, Todd M. Johnson, Jonathan Halpern, Jose Luis Aburto, and John R. Scott. Residential Electricity Subsidies in Mexico: Exploring Options for Reform and for Enhancing the Impact on the Poor. World Bank Working Papers. The World Bank, 2009. http://elibrary.worldbank.org/doi/book/10.1596/978-0-8213-7884-7.

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can afford more products that use power.[25] Artificially elevated demand has the further negative effect of increasing environmental costs both locally through air pollution and globally through carbon dioxide emissions.[26]

Although redirecting energy subsidies could have significant positive effects in improving the power grid and alleviating poverty, the public is fearful of price shocks. Additionally, the problem of concentrated social benefits and diffuse social costs means that the beneficiaries will fight to keep the subsidies in place while the non-beneficiaries do not have much incentive to even take notice.[27]

At the request of the Mexican government, the World Bank has authored an extensive report that documents the ill effects of energy subsidies in the country and lays out a series of possible scenarios to redirect the benefit of subsidies to the poorest members of society. One promising scenario is to phase out energy subsidies in favour of a direct cash-transfer program that has proven successful in helping people help themselves out of poverty.[28] Political realities may require identifying the parties opposed to subsidy reform and providing them, as well as the poor, with short-term compensation while the government phases out the subsidies.[29] All that is missing now is the political will to make it happen.

Sector	Sales (GWh)	Subsidies (2006 MM Pesos)	Price/Cost Ratios
Residential	44.5	63,369	.41
Commercial	13.2	5,476	.92
Services	6.6	2,887	.77
Agriculture	8.0	9,211	.30
Medium Size Industries	65.3	12,478	.83
Large Industries	37.9	4,213	.97
TOTAL	175.4	97,633	.68

Figure 2: Distribution of Mexican Electricity Subsidies by Customer Class, 2006. Source: Komives et al., 2009.

25 Atlas Network. "Phasing out Destructive Energy Subsidies in Mexico." Atlas Network, March 16, 2015. https://www.atlasnetwork.org/news/article/phasing-out-destructive-energy-subsidies-in-mexico

26 Komives et al, 2009.

27 Atlas Network, 2015.

28 Komives et al, 2009.

29 Atlas Network, 2015