

Reducing emissions from diesel generators in remote communities

How smart policy decisions can drive the transition to renewables

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Most remote communities in Canada get their electrical power from diesel generators. According to the Pembina Institute's Diesel Reduction Progress Report, as much as 79% of the electricity used in remote communities originates from diesel generation.¹ Given the heavy dependence on diesel, a transition to clean energy won't happen quickly. However, avenues for reducing emissions from existing generators can be pursued in conjunction with broader efforts to support the clean energy transition.

Many of the diesel generators operating in Canada's remote communities are decades old and require continual maintenance, retrofitting, or replacement to ensure that they can reliably and efficiently supply power. This is both costly and time-consuming. For example, approximately two-thirds of the diesel generators in Nunavut are at (or have long surpassed) their end of life.² A host of opportunities and benefits become available when the replacement or upgrade of aging diesel infrastructure becomes necessary, such as:

- Greater system reliability, which contributes to improved energy security and fewer costly emergency repairs.
- More efficient equipment, which decreases the amount of fuel used and brings cost efficiencies while lowering emissions.
- Streamlined and cost-effective systems for operating and maintaining generators through advanced electronic controls and remote access for monitoring and troubleshooting.
- Convenient purchasing of replacement parts (as opposed to decades old generators, where parts for discontinued models can be hard to source) allowing for quick repairs and shorter system downtimes.

¹ Dave Lovekin et al, *Diesel Reduction Progress in Remote Communities* (Pembina Institute, 2020).
<https://www.pembina.org/pub/diesel-reduction-progress-remote-communities>

² Jim Bell, "Senate Study: Nunavut's Power Generation System "Unsustainable"," *Nunatsiaq News*, June 18, 2015.
https://nunatsiaq.com/stories/article/65674senate_study_nunavuts_power_generation_system_unsustainable/

Perhaps most importantly, new diesel generators can be downsized if they are complemented by renewable energy systems to meet overall electricity demand, presenting opportunities to implement hybrid power systems. Integrating renewables into a community's energy system was explored in "How to boost renewable energy integration in remote communities," the Pembina Institute's first policy piece in the Indigenous Off-diesel Initiative (IODI) series.^{3,4} Explored below are ways to decarbonize current diesel systems either through improving diesel generator performance or by replacing diesel fuel with lower-emission alternatives.

Improving diesel generator performance

Diesel generation systems are generally comprised of several individual generators. When these systems are upgraded, each generator is upgraded individually. Consequently, performance-enhancing improvements can be made with each generator replacement. Besides total replacement, diesel generation systems can also be supplemented with new technologies to improve the overall efficiency of the system. One way of doing this is to install combined heat and power systems that can recover the thermal energy generated during power production and use it to heat buildings in the community.⁵

Another efficiency-improvement technology is the variable speed generator (VSG) or variable speed drive (VSD). The first is a whole system replacement and the second (VSD) is a retrofit solution. These systems allow generators to run at varying and optimal speeds depending on the load, thus increasing fuel efficiency which results in reduced operating and maintenance requirements and extends the operational life of the generator. Variable speed generators and drives also allow for easier system integration with renewables and reduced energy storage requirements because shortfalls in renewable generation can be met by the variable diesel system. These integration challenges can also be addressed in part through well-designed microgrid controllers, a key facet of any hybrid power project.⁶

³ Marvin Quitaras, "How to Boost Renewable Energy Integration in Remote Communities," *Pembina Institute*, January 21, 2021. <https://www.pembina.org/blog/how-boost-renewable-energy-integration-remote-communities>

⁴ Marvin Quitaras, "Rethinking Energy Policy in Canada's Remote Communities," *Pembina Institute*, November 18, 2020. <https://www.pembina.org/blog/rethinking-energy-policy-canadas-remote-communities>

⁵ University of Victoria. "Combined heat and power based district energy systems increase energy efficiency in remote communities," *West Coast Wave Initiative*. <https://www.uvic.ca/research/projects/wcwi/home/news/archive/current/news-story-13.php>

⁶ Natural Resources Canada, "Development of a Utility Grade Controller for Remote Microgrids with High Penetration Renewable Generation," *Government of Canada*, February 15, 2018. <https://www.nrcan.gc.ca/science-and-data/funding-partnerships/funding-opportunities/current-investments/development-utility-grade-controller-for-remote-microgrids-high-penetration-renewable/16095>

Examples of diesel system efficiency improvement projects in Canada include:

- Several combined heat and power systems in Nunavut, including one in Iqaluit.^{7,8}
- A VSG pilot project is currently underway in Aklavik, NWT.⁹

Alternatives to diesel fuel

The above solutions require technology upgrades, which require time, effort, and capital investments. Fuel switching, the practice of replacing conventional petrol-diesel with fuels that decrease greenhouse gas (GHG) and other emissions, is a simpler option. Fuel switching using renewable fuels is better still in the transition to clean energy. Some alternatives to diesel fuel are:

Renewable diesel

Made from natural fats or plant material, renewable diesel can reduce GHG emissions by 75%.¹⁰ Unlike biodiesel, renewable diesel's properties are almost identical to those of petrol-diesel and it can be used without retrofits or upgrades to existing generators (as a "drop-in" option). However, greater availability of renewable diesel that remains stable at temperatures below -40°C along with pilot projects ensuring performance are needed to scale up the use of renewable diesel in remote communities, particularly in northern remote communities throughout the territories.¹¹

Ultra-low sulphur diesel

This is another possible drop-in replacement that can reduce particulate matter emissions by approximately 20% in addition to significantly lowering the emission of sulphur oxides, a contributor to acid rain.

⁷ Qulliq Energy Corporation, "District Heating System." <https://www.qec.nu.ca/power-nunavut/alternative-energy/district-heating-system>

⁸ Qulliq Energy Corporation, "Qulliq Energy Corporation and City of Iqaluit Sign New District Heating Agreement," June 15, 2020. <https://www.qec.nu.ca/qulliq-energy-corporation-and-city-iqaluit-sign-new-district-heating-agreement>

⁹ Northwest Territories Power Corporation, "Variable Speed Generator in Aklavik Successfully Commissioned," February 16, 2018. <https://www.ntpc.com/about-ntpc/news-releases/2018/02/16/variable-speed-generator-in-aklavik-successfully-commissioned>

¹⁰ E. Emery, D. Sanscartier, R. Jansen, and Adam Bathe, *Assessing the Use of Liquid Biofuels in the Northwest Territories* (Saskatchewan Research Council, 2021), 43. https://www.inf.gov.nt.ca/sites/inf/files/resources/src_nwt_biofuels_final_report.pdf

¹¹ Covenant Energy, "Covenant Energy prepares to meet new demand for renewable diesel", *Cision*, March 18, 2021. <https://www.newswire.ca/news-releases/covenant-energy-prepares-to-meet-new-demand-for-renewable-diesel-816220734.html>

Ramping up policy solutions

Decarbonizing diesel generation will require either updating existing government policies and programs or implementing new ones.

Clean fuel regulation

In reference to fuel switching, the federal clean fuel regulation, scheduled for implementation in late 2022, will require liquid fuels (including diesel) to meet increasingly stringent carbon-intensity reduction requirements.¹² The clean fuel regulation is predicted to increase the national domestic supply of drop-in renewable diesel that is capable of performing at temperatures well below freezing. The likely market response to an increase in availability will be lower prices, which, in turn, would improve the business case for renewable diesel.

Carbon pricing

Carbon pricing is already regulated in every province and territory, but electricity production in remote communities is currently exempt from the federal carbon pricing system. The carbon pricing policy is divided into two streams: the carbon levy and the output-based pricing system (OBPS).^{13,14} If electricity generation in remote communities was covered (falling under the OBPS), diesel generation plants would be incentivized to reduce the emission intensity of the electricity generated through, for example, efficiency improvement technologies and fuel switching.

Applying carbon pricing to diesel use in remote communities should be considered. The possibility of cost increases being passed on to the consumer could be offset through energy efficiency programs so that consumers are protected from rate increases by consuming less electricity. Funding for these programs, and other clean-energy initiatives, could be sourced from carbon revenue redistribution programs and other financial mechanisms embedded in carbon pricing policies.

Under the carbon levy, 10% of revenues collected are to be distributed to schools, hospitals, small businesses, colleges, and Indigenous communities to offset costs incurred as a result of carbon pricing and increased energy efficiency. To date, little action has been taken to

¹² Pembina Institute, *Canada's Clean Fuel Standard* (2021). <https://www.pembina.org/pub/canadas-clean-fuel-standard-setting-the-record-straight>

¹³ Government of Canada, "How Carbon Pricing Works." <https://www.canada.ca/en/environment-climate-change/services/climate-change/pricing-pollution-how-it-will-work/putting-price-on-carbon-pollution.html>

¹⁴ Government of Canada, "Output-Based Pricing System." <https://www.canada.ca/en/environment-climate-change/services/climate-change/pricing-pollution-how-it-will-work/output-based-pricing-system.html>

redistribute these funds, and the federal government’s commitment to provide annual updates on federal carbon levy disbursements has yet to occur.¹⁵

With the exception of Quebec — which has committed to redistribute proceeds from its cap-and-trade market and has dedicated \$19.2 million toward climate action initiatives in Indigenous communities and \$11 million to support quality of life in Northern communities¹⁶ — greater transparency is needed with regards to revenue redistribution for federal, provincial, and territorial carbon pricing regimes. Furthermore, a significant portion of these revenues, and the revenue generated if exemptions around remote communities are lifted, should be committed to furthering renewable energy and energy efficiency initiatives in Indigenous communities.

Sulphur content of fuel

In addition to the carbon price exemption, remote communities are also exempt from Canada’s regulations on sulphur in diesel fuel; however, ultra-low sulphur diesel has been adopted in some jurisdictions in Canada where there are remote communities.^{17,18}

Emission regulations

Currently, no policies are in place to require that diesel generators be replaced at end-of-life or when they are not meeting emission regulations. The diesel generator regulations that do exist, such as the Off-Road Compression-Ignition Engine Emission Regulations (ORCIEER) under the Canadian Environmental Protection Act, are not enforced in remote communities.¹⁹

Under ORCIEER, engines are classified by the severity of their emissions, where Tier 1 is the highest emitting and Tier 4 is the lowest. To minimize the environmental impact of diesel generators, ORCIEER should be extended to remote communities; the enforcement of a minimum of Tier 3 engines would generally achieve a 50-80% decrease in emissions in the existing system.

¹⁵ Government of Canada, “Return of Pollution Pricing Fuel Charge Proceeds to Jurisdictions,” in *Greenhouse Gas Pollution Pricing Act: Annual report for 2019*. <https://www.canada.ca/en/environment-climate-change/services/climate-change/pricing-pollution-how-it-will-work/greenhouse-gas-annual-report-2019.html#toc10>

¹⁶ Canadian Institute for Climate Choices, “2020 Expert Assessment of Carbon Pricing Systems,” *Environment and Climate Change Canada* (2021), 82. https://publications.gc.ca/collections/collection_2021/eccc/En4-434-2021-eng.pdf

¹⁷ Environment and Climate Change Canada, “Guidance Document on the Sulphur in Diesel Fuel Regulations.” <https://ec.gc.ca/lcpe-cepa/default.asp?lang=En&n=0885D2DC-1&offset=5>

¹⁸ Department of Community and Government Services, “Petroleum Products Division,” *Government of Nunavut*. <https://www.gov.nu.ca/petroleum-products-division>

¹⁹ Environment and Climate Change Canada, “Guidance Document - Off-Road Compression-Ignition Engine Emission Regulations under the Canadian Environmental Protection Act, 1999.” <https://www.ec.gc.ca/lcpe-cepa/default.asp?lang=En&n=0CBF3BCC-1&offset=3>

Funding needed

The exemption of remote communities from these policies (namely the ORCIEER, Canada's sulphur in diesel fuel regulations, and carbon pricing) is severely restricting progress towards more efficient, lower GHG emitting, and more environmentally friendly diesel-generation systems. These policy exemptions promote the continued use of inefficient, emission-intensive generators and make it more challenging to transition to clean energy. Carbon pricing exemptions, among other subsidies, favour the economics of diesel-energy systems and do not push the boundaries of the larger systemic change needed in these communities.²⁰

In light of these regulatory exemptions, funding toward diesel decarbonization should either be significantly increased or the exemptions specified above should be reconsidered. In the U.S., the Environmental Protection Agency's Diesel Emission Reduction Act (DERA) provides funding specifically for diesel projects that use pollutant reduction technologies.²¹

Furthermore, 30% of the funds go to individual government agencies to implement their clean diesel programs. While Canada has established several funding programs to support renewable energy projects in remote communities (such as the federal Clean Energy for Rural and Remote Communities program, the B.C. Renewables for Remote Communities program, and the Canada Infrastructure Bank's Indigenous Community Infrastructure Initiative program), none of them place a specific value on reducing the environmental impact of diesel infrastructure.^{22,23,24}

The legislation of policies such as DERA is one diesel decarbonization mechanism that can be used to increase the amount of federal investment in more efficient and environmentally friendly diesel infrastructure, such as the recent federal and territorial funding announcement for a new diesel generator in Sachs Harbour, NWT.²⁵

Through Canada's Clean Fuel Fund (CFF) \$1.5 billion has been allocated toward increasing clean fuel (including renewable diesel) production capacity; establishing biomass supply

²⁰ Dave Lovekin, *Diesel Subsidies – Simplified, Part I* (Pembina Institute, 2021). <https://www.pembina.org/pub/diesel-subsidies-simplified-part-i>

²¹ United States Environmental Protection Agency, "Diesel Emissions Reduction Act (DERA) Funding." <https://www.epa.gov/dera>

²² Government of Canada, "Clean Energy for Rural and Remote Communities: BioHeat, Demonstration & Deployment Program Streams," October 28, 2020. <https://www.nrcan.gc.ca/reducingdiesel>

²³ Government of British Columbia, "Renewable Energy for Remote Communities (RERC) Program." <https://www2.gov.bc.ca/gov/content/industry/electricity-alternative-energy/community-energy-solutions/renewable-energy-remote-communities>

²⁴ Canada Infrastructure Bank, "Indigenous Infrastructure." <https://cib-bic.ca/en/partner-with-us/growth-plan/indigenous-infrastructure/>

²⁵ Mackenzie Scott, "Sachs Harbour to Get New Diesel Power Plant," *CBC*, March 4, 2019. <https://www.cbc.ca/news/canada/north/sachs-harbour-power-plant-1.5042979>

chains; and developing codes, standards, and regulations.²⁶ While this represents a potential step toward decarbonizing diesel use, funds must be appropriately allocated to diesel systems in remote communities. Some funding has been designated specifically for projects where there is, at minimum, 50% Indigenous ownership, which will help ensure that the benefits of this standard are realized by Indigenous communities.

It is strongly recommended that a portion of funds be allocated to reducing diesel reliance in remote communities; however, it remains to be seen how the federal government will apportion the CFF between different regions, project proponents, and fuel technologies.

Moving forward

Until communities can fully transition to energy systems driven by efficiency and renewables, they will continue to, at least partially, rely on diesel. That means diesel will not go away for some time (even if not in active operation, many diesel generators will remain on reserve or standby mode). However, policies can still be put in place now to make diesel systems more compatible with environmental sustainability, energy security, energy affordability, and energy sovereignty.

Making diesel systems more efficient will provide more affordable energy over the long term as diesel prices increase. Newer diesel-based energy systems also help increase energy security by being more reliable and offering improved remote monitoring capabilities. Fuel switching and better emissions controls on newer generators have immense potential for lowering environmental impacts. Opportunities for increasing energy sovereignty for Indigenous people are presented with the integration of emerging technologies, as VSG/Ds could play an essential role in high-penetration renewable energy systems going forward.

None of these improvements will be possible without policy mechanisms driving change. Removing the exemptions from existing policies and implementing policies similar to DERA in the U.S. along with other innovative solutions will be key to maximizing diesel decarbonization. This should all be looked at in concert while the focus remains on renewable energy integration and energy efficiency improvements.

For each province and territory to meet its national and regional greenhouse gas reduction targets, all sectors must contribute to solutions. Diesel generation systems in remote areas must be subject to more stringent regulations to ensure the mitigation of harmful emissions as we transition to a climate-safe future where remote communities are afforded a more sustainable, resilient, and cost-effective energy system.

²⁶ Environment and Climate Change Canada, *A Healthy Environment and a Healthy Economy* (2020). https://www.canada.ca/content/dam/eccc/documents/pdf/climate-change/climate-plan/healthy_environment_healthy_economy_plan.pdf