Discussion Paper

Low-Carbon Fuels Opportunities for Newfoundland and Labrador's Electricity Sector

July 2026

econext
Advancing Newfoundland & Labrador's
Green Economy

Contents

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1. Executive Summary

The objective of this paper is to generate discussion and encourage further exploration of the adoption of low-carbon fuels in Newfoundland and Labrador (NL)'s electricity sector.

The electricity sector is responsible for 9% of NL's GHGs[1]. The system has an estimated capacity to generate 8,428 MW of electricity[2], with 89% coming from hydroelectric plants, 1% from other renewables, and 10% from fossil fuel sources. Thermal generation is important for the system for load matching, peak matching, covering intermittency, and grid reliability purposes – and are thus not likely to be replaced with renewables for the foreseeable future. This presents opportunity for the adoption of low-carbon fuels.

There are important benefits to be realized from the adoption of low-carbon fuels in NL's electricity sector: (1) decreased greenhouse gas (GHG) emissions from both the electricity and waste sectors; (2) reduced air pollutants in the atmosphere; (3) increased energy security; (4) the opportunity to store a new form of dispatchable energy; (5) the valorization of under-utilized waste resources; and (6) economic development for communities.

NL's current and future electricity generation assets are compatible with low-carbon fuels. The province's fleet of generators have the potential to utilize fuels which blend biodiesel and renewable diesel. Meanwhile, its combustion turbines have the potential to run on these fuels in addition to natural gas, renewable natural gas, hydrogen blends, and/or exclusively hydrogen with additional modifications.

There are challenges to overcome, including utility mandates (around cost and reliability), guaranteed fuel supplies, logistics and storage, safety, and the need for testing, demonstration, and optimization. Electricity utilities are (rightfully) highly risk averse on economic and performance metrics. Yet if these barriers can be addressed, the sector has the potential to be a catalyst for local low-carbon fuels production.

NL can advance the adoption of low-carbon fuels in its electricity sector by: (1) identifying capacity for current generation infrastructure for low-carbon fuels adoption; (2) defining best use cases for available biomass in NL and techno-economic feasibility of low-carbon fuels production; (3) implementing required policy and regulatory adjustments; (4) aligning provincial climate and energy strategy with domestic production capabilities; and (5) investing in fuel blending and testing infrastructure.

[1] https://www.gov.nl.ca/eccc/files/Historical-GHG-Emissions-Summary-NL-1990-2024-April-2026.pdf

[2] With information from https://nlhydro.com/wp-content/uploads/2025/06/Newfoundland-and-Labrador-Hydro-2024-TAA-FINAL-For-Web.pdf and https://energy.kruger.com/services/hydro/

2. Background and Context

2.1 Introduction

In 2025 econext completed a study with KPMG titled "*Opportunities for Domestic Clean Fuels Use in Newfoundland and Labrador*". This study explored potential low-carbon fuel use according to various economic sectors within the province.

The outlook for the future adoption of low-carbon fuels is based on many different variables and is difficult to predict – particularly within a localized geography. However, the research did help to advance discussions and outline some of the opportunities and challenges for low-carbon fuels adoption within specific sectors in Newfoundland and Labrador (NL).

The estimates in this study were made based on high-level assumptions using available greenhouse gas (GHG) data, International Energy Agency (IEA) projections, and practical observations. One sector which required further analysis following this study was the province's electricity sector – a space that has been dynamic in NL in recent years with more information available today than at the time of the original study.

Discussion Paper Objective

The objective of this paper is to generate discussion and encourage further exploration of the adoption of low-carbon fuels in NL's electricity sector.

While every effort has been made to provide sources for information provided, this discussion paper is not an academic publication and is not intended to be. This is a document produced internally by econext staff informed by secondary research and information known to be available in the public domain.

econext welcomes all feedback that can help improve the quality and usefulness of this discussion paper. Feedback can be sent to info@econext.ca.

2.2 About econext

econext is a not-for-profit industry association dedicated to advancing environmentally sustainable economic growth in NL. With a network of approximately 200 member businesses, research institutions, governments, and organizations, econext serves as a leading voice for the province's green economy.

econext has four key areas of focus:

Member Opportunities
We connect our members with opportunities to grow their businesses in the green economy.

Public Policy & Advocacy
We identify, analyze, and champion policy frameworks that support sustainable economic growth in NL.

Capacity Building
We equip NL's businesses, communities, and workforce with skills, experience, and knowledge needed to contribute to green economic growth.

Innovation
We identify emerging trends and provide insights that inform policy, investment, and innovation that advance clean growth in NL.

Together, we strengthen NL's green economy by supporting our members and help drive sustainable growth and innovation across the province. Learn more at econext.ca.

3. Newfoundland and Labrador's Electricity System

To consider the adoption of low-carbon fuels within NL's electricity sector, it is important to have an understanding of the electricity grid as it exists today and as it is expected to be.

The electricity system in NL has an estimated capacity to generate 8,428 MW of electricity[3]. Approximately 89% of this generation is attributed to hydroelectric plants across the province. This includes the Churchill Falls facility which, at 5,428 MW, is the second largest hydro facility in Canada. This also includes Muskrat Falls (824 MW), the Bay d'Espoir system (729 MW), and many other smaller facilities throughout the province[4].

The system is supplemented by two 27MW wind farms (in Fermeuse and St. Lawrence), a biomass cogeneration plant (17.6 MW), and a small amount of biogas from anaerobic digester (0.4 MW). These additional renewable sources account for 1% of NL's generation.

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[3] With information from https://nlhydro.com/wp-content/uploads/2025/06/Newfoundland-and-Labrador-Hydro-2024-TAA-FINAL-For-Web.pdf and https://energy.kruger.com/services/hydro/
[4] https://nlhydro.com/about-us/our-electricity-system/our-generation-assets/

Ten percent of capacity is attributed to fossil fuel sources – i.e., thermal generation, combustion turbines, and diesel generators.

From a generation perspective, the vast majority of the electricity produced in NL is renewable. In 2023, NL generated 44.3 terawatt-hours (TWh) of electricity, with 43.1 TWh (97.4%) coming from renewable sources[5].

High-voltage transmission at the Churchill Falls hydroelectric power plan (Newfoundland and Labrador Hydro)

3.1 Electricity Systems Structure

Approximately 96% of electricity in NL is produced and managed by Newfoundland and Labrador Hydro (NLH), a provincially owned crown corporation. Newfoundland Power (NP) is a privately owned utility owned by Fortis Inc. which has generation capacity of 141 MW (~2% of the province's total) and is also the primary distributor of electricity to customers throughout Newfoundland. Through power purchase agreements (PPAs), NLH sources 202 MW (just over 2%) of electricity generated in the province from other sources (i.e., wind, biomass cogeneration, biogas, etc.)

[5] https://www.cer-rec.gc.ca/en/data-analysis/energy-markets/renewable-energy-canada/provinces/renewable-power-canada-newfoundland-labrador.html

3.2 Domestic Use vs. Export

Much of the electricity from Churchill Falls is exported. Approximately 90% of the power generated at Churchill Falls flows to Quebec and neighbouring markets in Canada and the U.S. through long-term power purchase agreements[6]. This means that the energy mix – when considering NL's domestic electricity use only – is slightly different. In 2025, NLH reported total energy supply for the Island Interconnected System (ISS) as being 7,153.5 GW/h[7] with an estimated 89% produced from renewables and 11% from fossil fuel sources.

3.3 Interconnected Systems vs. Off-Grid System

As a result of history and geography, NL's electricity grid is composed of three systems.

First, the Labrador Interconnected System includes the communities and customers who are connected through the electrical transmission system in Labrador.

Second, the Island Interconnected System includes communities and customers on the island of Newfoundland who are connected through the electrical transmission system on the island.

Third, Isolated Diesel Systems are independent from the interconnected systems (i.e., 'off-grid'). These systems use electricity generated by diesel generators to bring power to communities that are not connected to our larger transmission systems. These systems are described in greater detail in the following section.

3.4 Greenhouse Gas Emissions

The electricity sector is responsible for 9% of NL's GHGs[8]. Most GHG emissions from electricity originate from the Holyrood Generating Station which includes thermal generation and combustion turbines (see Section 4.2). This facility operates in the colder months and as a backup to the electricity. There are other diesel generators throughout the province which are used when needed but account for less than 1% of provincial GHGs. Off-grid diesel generation (i.e., for remote communities) accounts for 0.5% of provincial GHGs.

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[6] https://www.cer-rec.gc.ca/en/data-analysis/energy-markets/province-territory-energy-profiles/newfoundland-labrador.html

[7] http://www.pub.nl.ca/indexreports/20152019energysupply/From%20NLH%20-%20Energy%20Supply%20Monthly%20Report%20-%20December%202025%20-%202026-01-19.PDF

[8] https://www.gov.nl.ca/eccc/files/Historical-GHG-Emissions-Summary-NL-1990-2024-April-2026.pdf

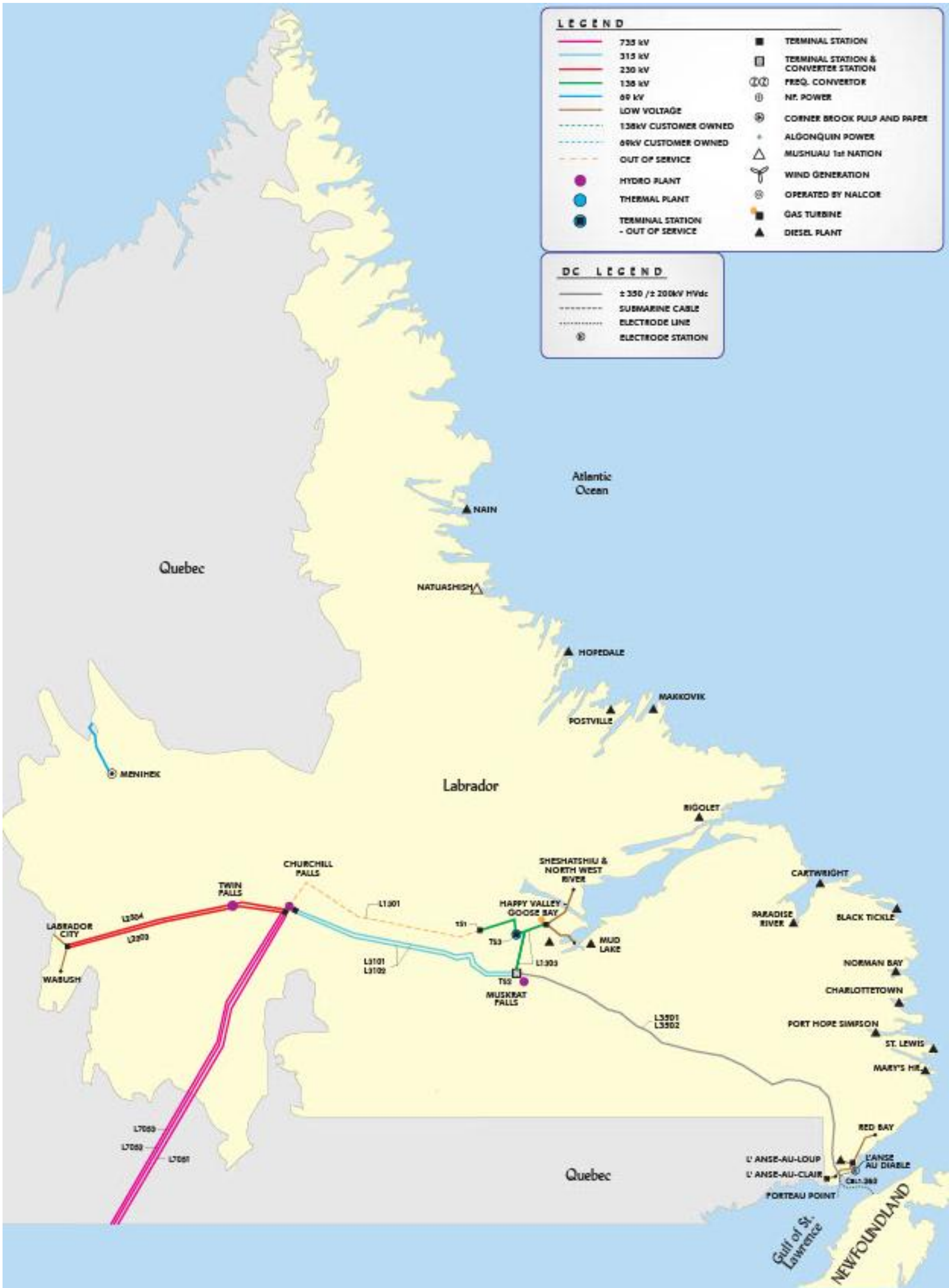

Figure 1: Labrador Generation and Transmission (Newfoundland and Labrador Hydro)

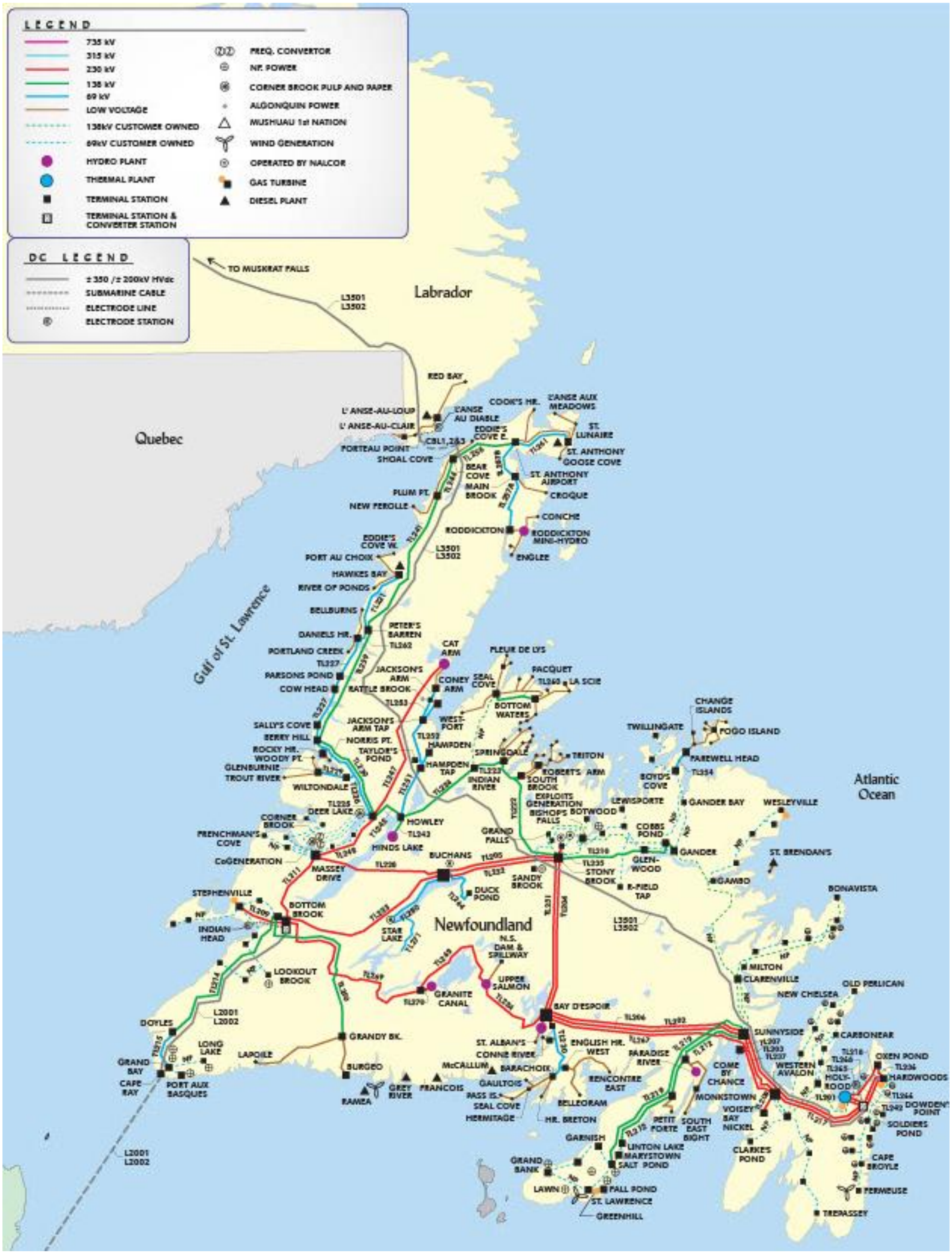

Figure 2: Generation and Transmission (Newfoundland and Labrador Hydro)

The Labrador interconnected system and Island interconnected systems are linked via the Labrador-Island Link (LIL). Completed in 2016, this 1,100km HVDC transmission link includes 35km of subsea cable through the Straight of Belle Isle with a maximum capacity of 900MW[9]. The island system is connected to the North American grid via the Maritime Link between Southwestern Newfoundland and Cape Breton, Nova Scotia. Extending over 170km underneath the Cabot Straight, the Maritime Link is the longest subsea electricity transmission cable in North America[10] with a capacity of 500 MW.

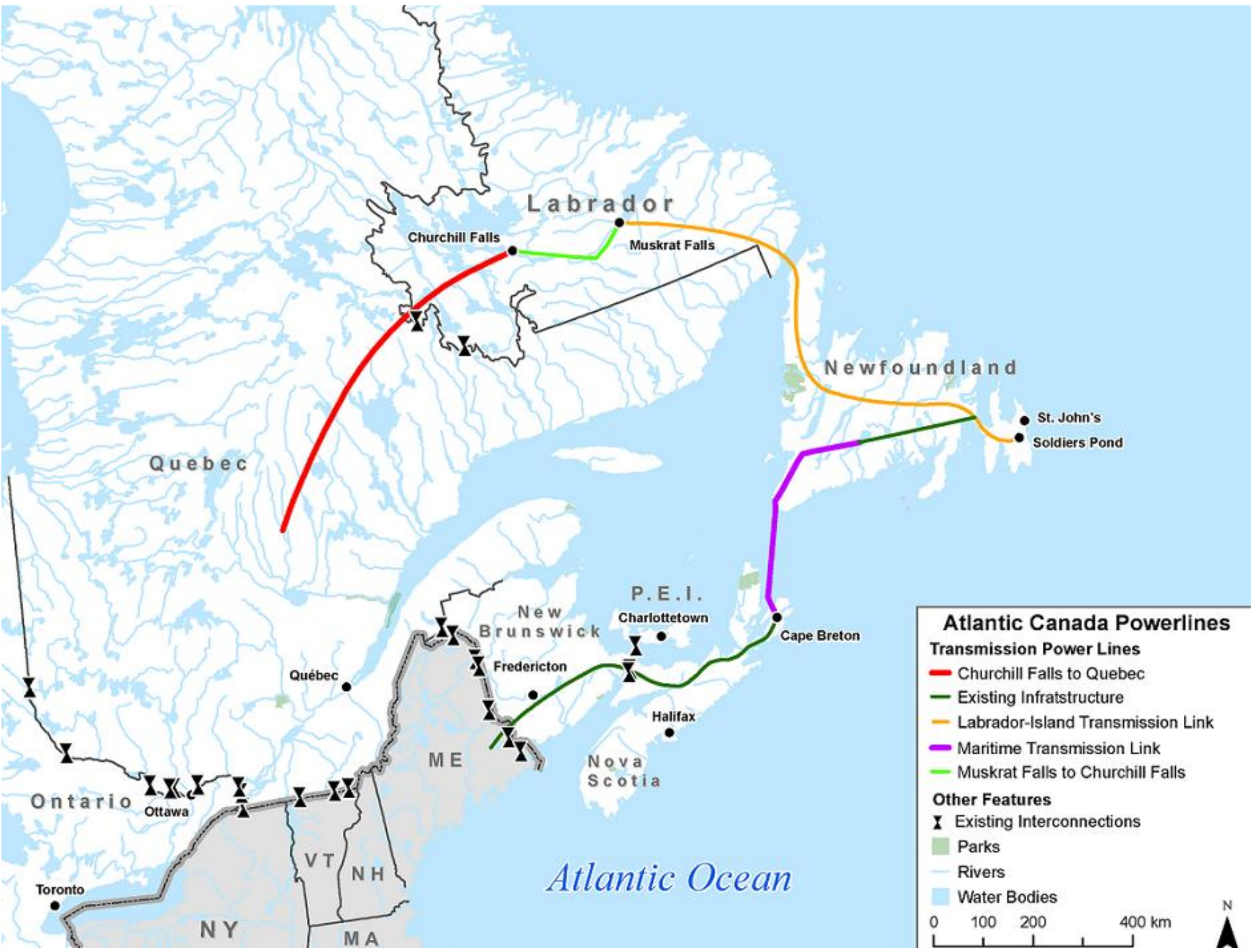

Figure 3: Major Electricity Transmission Lines in Atlantic Canada (Canada Energy Regulator)

[9] https://nlhydro.com/wp-content/uploads/2024/08/Hydro-Labrador-Island-Link.pdf
[10] https://www.emeranl.com/maritime-link/overview

4. Overview of Newfoundland and Labrador's Fossil Fuel Electricity Generation Assets

The potential for low-carbon fuel use within NL's electricity sector is tied directly to the ability to displace the use of conventional fuels within the system. Therefore, having an understanding of the fossil fuel generation assets currently deployed within NL's electricity system is a prerequisite.

4.1 Dispatchable Electricity

A 'dispatchable' source of electricity refers to a power source that can be turned on or off and power can be supplied to the electrical grid on-demand. Dispatchable sources are in contrast to electricity sources that are intermittent and/or non-dispatchable; wind power produces electricity only when the wind blows and solar panels only produce electricity when they can absorb the sun's light.

Dispatchable sources of electricity include turbines and generators which most often utilize fossil fuels such as diesel, natural gas, etc. These technologies are of high importance to electricity systems for a number of reasons:

1. **Load matching** – This refers to the changing need for electricity throughout the day since generally far less electricity is needed at night than during the day. Load matching plants can vary their output slowly over hours to meet needs.
2. **Peak matching** – Peak matching refers to meeting the highest electricity use during the day. Demand typically peaks for power grids at a relatively predictable time, depending on culture, weather and geographic location.
3. **Covering intermittent sources** – Intermittent electricity sources do not produce consistent electricity and therefore their power output cannot be controlled or guaranteed. Dispatchable sources are required when intermittent sources are not meeting their production demands[11] making them an important enabler of renewable energy penetration (i.e., solar, wind) into an electricity system.
4. **Grid Reliability** – Dispatchable sources of electricity play a crucial role in ensuring that the grid remains stable and reliable, even during times of exceptionally high demand or unforeseen events.

Hydropower is highly dispatchable and is also renewable, and therefore NL is in an enviable position with its vast hydroelectric resources. However, fossil fuel-based assets play an important role in helping to meet the energy demands of NL electricity customers, to ensure that the grid is reliable, and to deliver electricity during the coldest and windiest

[11] https://energyeducation.ca/encyclopedia/Dispatchable_source_of_electricity

times of the year when demand is greatest. Diesel generators play a vital role in the provision of reliable electricity in remote areas of the province which do not have access to the interconnected grid.

4.2 Holyrood Thermal Generating Station

In 1970 the Holyrood Thermal Generating Station was brought online, becoming just the second major source of electricity generation for the island[12]. Located in the Town of Holyrood, this thermal generating facility burns 0.7% sulphur No.6 fuel and consists of three turbines with a total generating capacity of 490 MW.

The plant has the capacity to generate up to 40 per cent of the island's annual energy needs if necessary[13] but, since the development of Muskrat Falls, it has predominantly operated during the cold weather months of the year and during emergencies. Plans are in place to retire the facility in the 2030s[14].

Holyrood Thermal Generating Station (Stantec)

[12] https://nlhydro.com/good-to-know/holyrood-thermal-generating-station-50-years-of-dedicated-service-to-the-island/
[13] https://nlhydro.com/about-us/our-electricity-system/our-generation-assets/
[14] https://www.cer-rec.gc.ca/en/data-analysis/energy-markets/renewable-energy-canada/provinces/renewable-power-canada-newfoundland-labrador.html

While the facility burns a significant amount of fossil fuels (up to 18,000 barrels of oil per day during the winter heating season[15]), this discussion paper does not consider the introduction of low-carbon fuels into the plant due to its age and imminent decommissioning.

4.3 Combustion Turbines

A combustion turbine is a type of internal combustion engine that converts the chemical energy of fuel into mechanical power. It consists of three main components: the compressor, the combustor, and the turbine[16]. Combustion turbines have been in use for stationary electric power generation since the late 1930s[17].

In a combustion turbine, compressed air passes through a combustor where fuel is injected and ignites. As heat is released during combustion, gases expand rapidly resulting in high velocity, hot exhaust gases exiting the combustor. The hot gases pass through a turbine, which causes it to rotate and generate electricity in the process[18].

NLH owns and operates four combustion turbines: one in Labrador (Happy Valley-Goose Bay – 25 MW); and three on the island (Stephenville – 50 MW, Holyrood – 123.5 MW, and Hardwoods in Paradise – 50 MW). These combustion turbines help to provide reserve capacity, if needed, during times of high customer demand and provide over 245 MW of backup generation in the event of a system outage[19]. These turbines are fueled with No.2 diesel. The estimated annual No. 2 diesel requirement for the Holyrood combustion turbine is 40,698,000 litres[20]. These units are dual fuel capable, meaning that they can conceivably run on natural gas – however there is presently no natural gas production, infrastructure, or import into NL. NP also owns and operates four small combustion turbines located in Wesleyville (8 MW), Greenhill (20 MW), a mobile unit stationed in Channel-Port aux Basques (6 MW), and another mobile unit (5 MW). These combustion turbines also use No. 2 diesel.

NLH's combustion turbines in both Stephenville and Paradise are slated for retirement post 2030[21] and, therefore, will not be considered for further analysis in this discussion

[15] https://www.muskratfallsinquiry.ca/files/P-00073.pdf
[16] https://savree.com/en/encyclopedia/gas-turbine-combustion-turbine
[17] https://www.epa.gov/sites/default/files/2015-07/documents/catalog_of_chp_technologies_section_3._technology_characterization_-_combustion_turbines.pdf
[18] https://savree.com/en/encyclopedia/gas-turbine-combustion-turbine
[19] https://nlhydro.com/about-us/our-electricity-system/our-generation-assets/
[20] http://www.pub.nl.ca/applications/NLH2018ReliabilityAdequacy/correspondence/From%20NLH%20-%202024%20Resource%20Adequacy%20Plan%20-%20REVISION%202%20-%20REDACTED%20-%202024-08-26.PDF
[21] http://www.pub.nl.ca/applications/NLH2018ReliabilityAdequacy/correspondence/From%20NLH%20-%202024%20Resource%20Adequacy%20Plan%20-%20REVISION%202%20-%20REDACTED%20-%202024-08-26.PDF

paper. The combustion turbine in Happy Valley-Goose Bay is used predominantly as source of backup energy[22]. Fuel consumption estimates are not available for this asset but are likely not significant.

However, NLH is planning the construction of a new combustion turbine which will be a significant addition to the system. While the retirement of the Hardwoods and Stephenville in 2030 amounts to a 100 MW capacity reduction, the new 'Avalon Combustion Turbine' – to be located in Holyrood – will be 150 MW and represents a net addition of 50 MW to the island system[23].

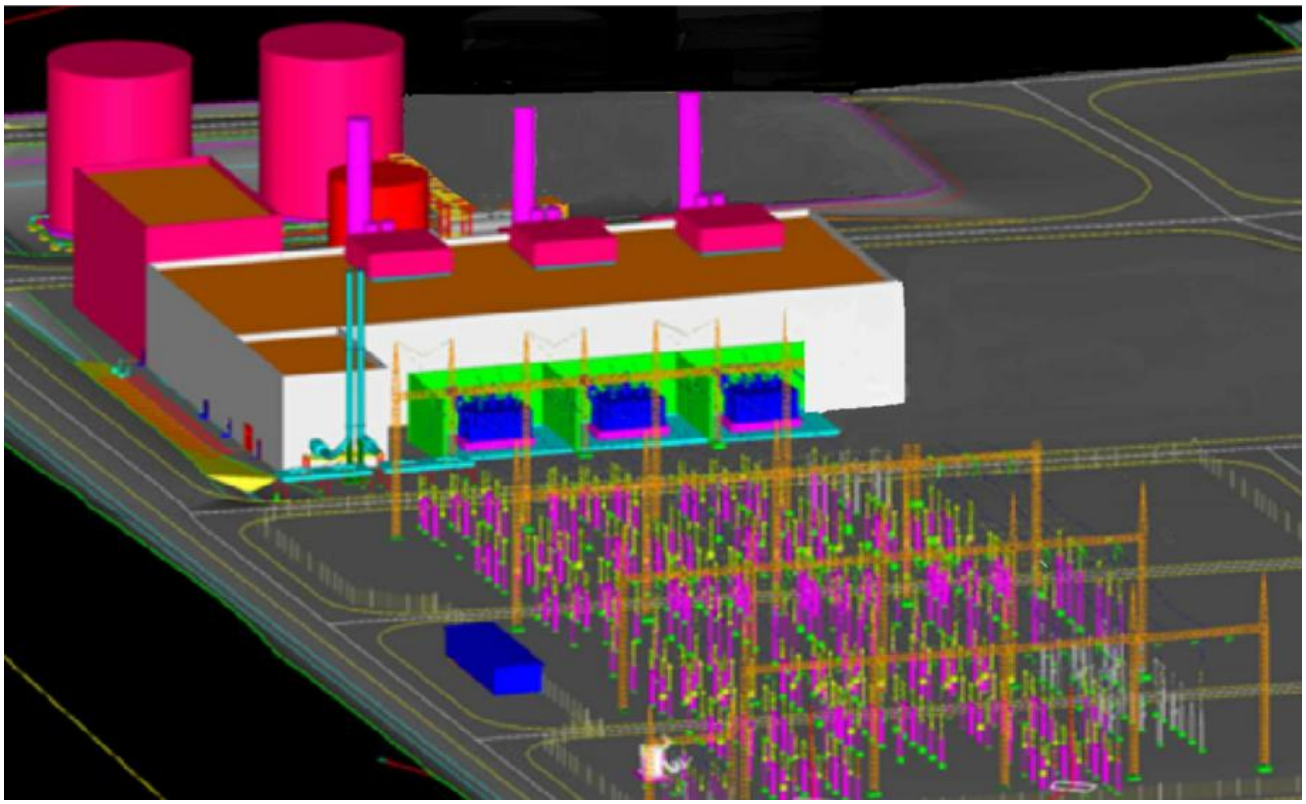

Figure 4: Conceptual Facility Rendering
(https://www.gov.nl.ca/eccc/files/env_assessment_y2025_2350-Registration-DOC.pdf)

The proposed Avalon Combustion Turbine will also be fueled with No.2 diesel. Front-end engineering and design (FEED) studies are underway, with NLH stating that the combustion turbine has the ability to use renewable fuels once they are reliably available in the region[24]. Preliminary fuel storage system design includes two tanks with a

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[22] http://www.pub.nl.ca/applications/NLH2025AvalonCombustionMarch/report/Bates%20White%20-%20Expert%20Report%20-%20Assessment%20of%20NLHs%20-%202024%20Resource%20Adequacy%20Plan%20-%202024-08-30.PDF
[23] https://www.gov.nl.ca/ecc/files/env_assessment_y2025_2350-Registration-DOC.pdf
[24] https://nlhydro.com/about-us/our-electricity-system/major-projects/avalon-combustion-turbine-holyrood/

combined storage capacity of approximately 9.5 million litres. The estimated annual No. 2 diesel requirement for the proposed turbine is 49,631,707 litres[25].

4.4 Diesel Generators

Generator sets ('gensets') burn fuel — typically diesel or gas — to produce mechanical energy that drives the alternator, converting the energy into electricity. They are normally used in locations where grid electricity is unavailable or unreliable, either as a temporary failover system or a constant off-grid energy source[26]. Diesel generators convert some of the chemical energy, contained in the diesel fuel, to mechanical energy through combustion. This mechanical energy then rotates a crank to produce electricity[27].

A diesel generator is an internal combustion engine, while a combustion turbine uses continuous combustion to drive high-speed rotary blades. Combustion turbines are better suited for large scale applications while diesel generators are more efficient for smaller-scale uses.

NL's electricity system features almost 30 diesel generators within both interconnected grids and in remote off-grid communities. All of these diesel generators run on No. 2 diesel.

Off-Grid (Remote Communities)

NLH operates 21 remote off-grid diesel plants throughout the province. Five diesel plants are on the island of Newfoundland, including: St. Brendan's, McCallum, Francois, Grey River and Ramea[28]. Fifteen of NLH's diesel plants are in Labrador, mostly stretched along the coastline: L'Anse-au-Loop, Mary's Harbour, St. Lewis, Port Hope Simpson, Charlottetown, Norman's Bay, Black Tickle, Cartwright, Paradise River, Mud Lake, Rigolet, Makkovik, Postville, Hopedale, and Nain[29]. NLH also operates a diesel plant in Natuashish on behalf of Mushuau Innu First Nation[30].

In 2019 a fire at the Charlottetown Diesel Generating Station left the unit inoperable, and the town has been relying on mobile gensets since that time. In 2021, NLH proposed a consolidation of generation for the neighbouring communities of Charlottetown, Pinsent's

[25] http://www.pub.nl.ca/applications/NLH2018ReliabilityAdequacy/correspondence/From%20NLH%20-%202024%20Resource%20Adequacy%20Plan%20-%20REVISION%202%20-%20REDACTED%20-%202024-08-26.PDF
[26] https://spectra.mhi.com/energy-transition/this-is-how-hydrogen-generator-sets-can-decarbonize-power
[27] https://energyeducation.ca/encyclopedia/Diesel_generator
[28] https://nlhydro.com/about-us/our-electricity-system/our-generation-assets/
[29] https://nlhydro.com/about-us/our-electricity-system/our-generation-assets/
[30] https://nlhydro.com/about-us/our-electricity-system/our-generation-assets/

Arm, Mary's Harbour, Port Hope Simpson, and St. Lewis[31]. A single 5.8 MW diesel plant would replace the four separate and smaller plants currently operating. This proposal was rejected by the regulator in 2025[32], and thus the implications of the project are not included in this analysis. However, the status of isolated diesel systems in this region is being highlighted as it is expected that the situation will be addressed in the coming years.

Interconnected Grid

NLH owns and operates two diesel generators which are not in remote, off-grid areas but work to provide backup power for some communities on the Island Interconnected System, if needed[33]. This includes operations in Hawke's Bay and St. Anthony.

NP owns and operates two diesel generators including one in Channel-Port aux Basques and one mobile unit.

Between 2015-2021, it was estimated that (on average) these diesel generators consumed 17,754,661 litres of fuel annually[34].

5. About Low-Carbon Fuels

Clean fuels, or 'low-carbon' fuels are fuels that produce much lower GHGs than traditional fuels on a life-cycle basis[35]. As, by definition, low-carbon fuels have a lower carbon intensity than conventional fuels. Their increased production and use is viewed as being vital in the world's fight against climate change and the pursuit of net zero.

Before exploring the opportunities for low-carbon fuels within NL's electricity sector, it is important to have general understanding of the relevant types of fuels and how they are generally produced and used.

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[31] http://www.pub.nl.ca/applications/2021/NLH2021Capital/NLH2021Capital_SUPP_Phase1SouthernLabrador/app/From%20NLH%20-%202021%20-%20Approval%20of%20the%20Construction%20of%20Phase%201%20of%20Hydros%20Long-term%20Supply%20Plan%20for%20Southern%20Labrador%20-%202021-07-16.PDF
[32] https://www.cbc.ca/news/canada/newfoundland-labrador/pub-decision-southern-labrador-plant-1.7498271
[33] https://nlhydro.com/about-us/our-electricity-system/our-generation-assets/
[34] https://opendata.gov.nl.ca/public/opendata/page/?page-id=datasetdetails&id=681 and addition sources
[35] https://natural-resources.canada.ca/energy-sources/clean-fuels/clean-fuels-fueling-future

5.1 Categorizing Low-Carbon Fuels

There are many types of low-carbon fuels.

Low-carbon fuels can be produced from a variety of feedstocks, such as agricultural and forest biomass, waste materials, electricity, and fossil fuels with carbon capture and storage[36].

Some low-carbon fuels can be used to supplement conventional fuels; some can be used as a direct replacement for conventional fuels within existing equipment and infrastructure; while others are replacements that require new equipment and infrastructure.

It is helpful to categorize low-carbon fuels into three categories that acknowledge these important differences: (1) biofuels; (2) renewable biofuels; and (3) e-fuels.

Biofuels

Biofuels are fuels made from recently living organic matter (biomass) like plants, agricultural waste, or animal fats, offering alternatives to fossil fuels. There are a wide variety of biofuels depending on the type of biomass used and the processes used in their creation. Biomass can be converted to fuels through different processes including direct combustion, thermochemical and chemical conversion, and biological conversion. A biofuel can be produced with much lower GHGs than their fossil fuel-based counterparts, and when 'burned' can also be less harmful. However, as they are not chemically identical to their conventional fuel counterpart (i.e., biodiesel vs. diesel), most often biofuels cannot directly replace fuels at a 1:1 ratio without causing harm to equipment. To achieve environmental benefits, biofuels are most often blended with petroleum-based products to reduce the GHG intensity of their use. 'First generation' biofuels are those made from sugar, starch, or vegetable oil. Their feedstocks are those that might have an impact on food supply if used in large quantities. 'Second generation' biofuels are those made from sustainable feedstocks as defined by the feedstock's availability, its impact from a GHG perspective, and land use[37].

[36] https://natural-resources.canada.ca/energy-sources/clean-fuels/clean-fuels-fueling-future
[37] https://econext.ca/wp-content/uploads/2025/06/Biomass-Energy-Potential-NL-Version-1.0-2025-06-11.pdf

Renewable Biofuels

Produced through a different method ('catalytic pyrolysis'), 'renewable' biofuels are chemically identical to their petroleum-based counterparts (i.e., diesel and renewable diesel).

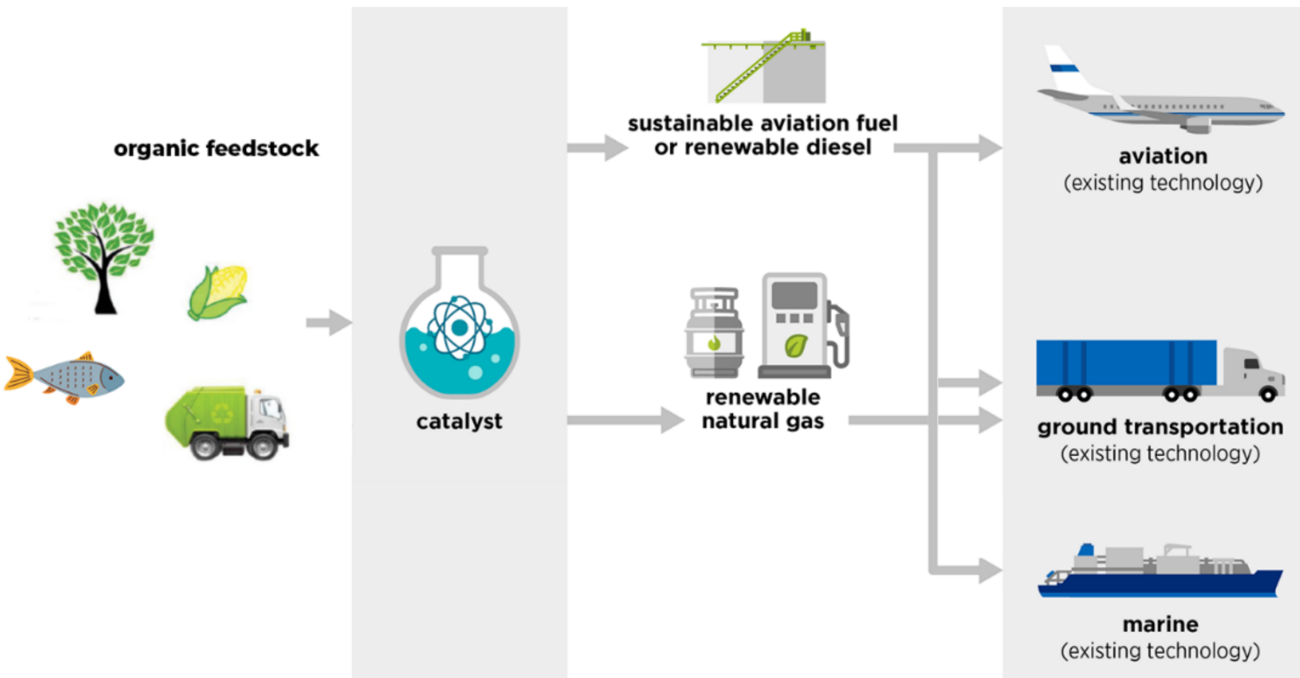

Figure 5: Examples of renewable biofuel pathways

This means that renewable biofuels can potentially be used as a direct replacement (i.e., as a 'drop-in') for conventional fuels in existing technology (i.e., combustion turbines, car/truck/ship engines, other heavy equipment) if not a heavy additive in blending. The concept of blending is defined explored in detail further in the report. This also means that existing transportation, storage, and refueling infrastructure can be used – simplifying the logistics of decarbonization.

E-Fuels

E-fuels (electro-fuels) are synthetic fuels produced through electrolysis, which splits water molecules into hydrogen and oxygen using renewable electricity[38]. The most commonly discussed e-fuel is hydrogen, but the category includes fuels that have hydrogen as one of the key components. E-fuels are viewed as being instrumental in the fight against climate change and the global pursuit of net zero as they generally emit significantly less GHGs

[38] https://spectra.mhi.com/energy-transition/what-are-e-fuels-and-can-they-help-decarbonization

than fossil fuel alternatives, and their main component – hydrogen – can be produced using clean energy sources.

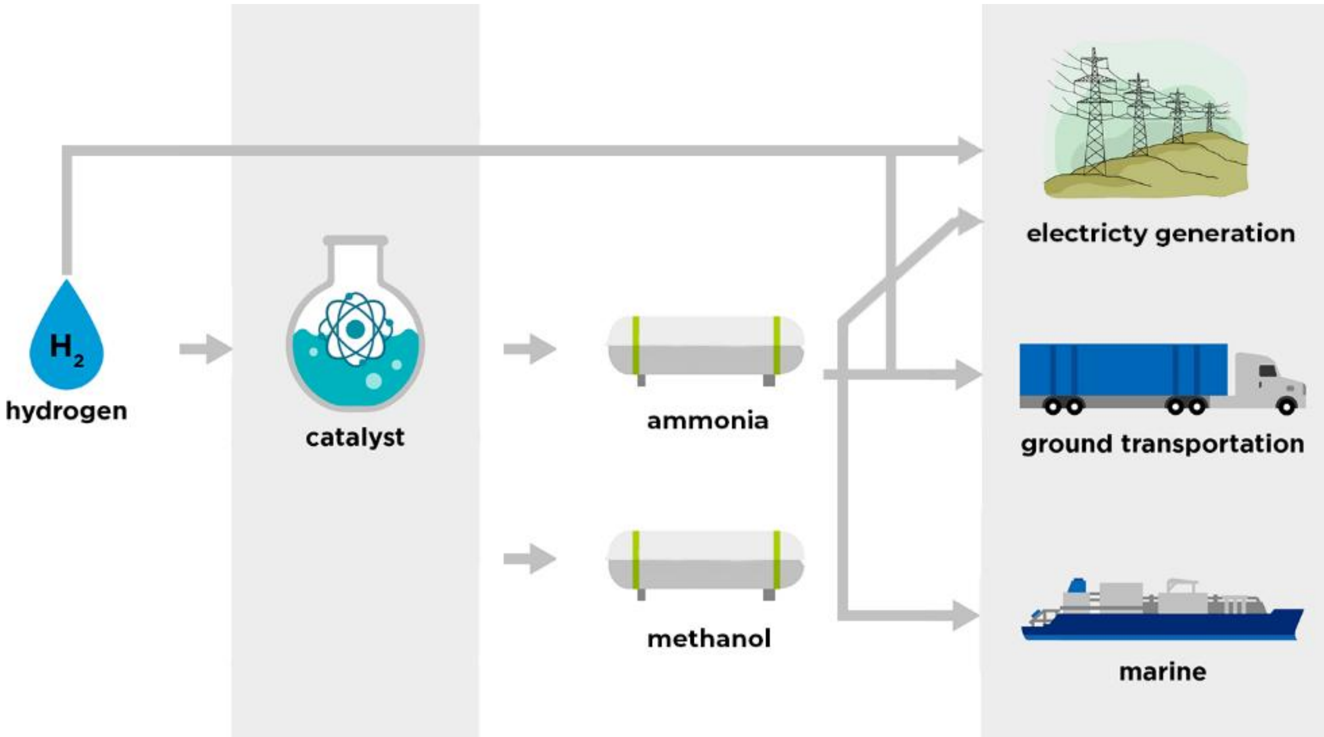

Figure 6: Examples of e-fuel pathways

There are a number of different terms that are being used to describe fuels with a lower carbon intensity that conventional fuels, often used interchangeably and sometimes incorrectly. However, in econext's experience, using these three terms (biofuels, renewable biofuels, and e-fuels) has proven to be the most effective approach to categorizing and communicating these fuels.

'Low-carbon fuels' is a catch-all term describing any fuel with a lower carbon intensity than the status quo fuel.

5.2 Low-Carbon Fuels Relevant to Electricity Generation

Below is a summary of low-carbon fuels that are relevant within the context of the electricity sector. This summary begins with conventional fossil fuels that are lower-carbon, moves into biomass derived fuels, and then e-fuels produced via electricity.

Natural Gas

Conventional natural gas is found in subsurface rock formations and is extracted through a well drilled into that formation. Once extracted, the gas is separated from free liquids, such as crude oil, hydrocarbon condensate, water, and entrained solids – and then processed[39]. While still a fossil fuel, the use of natural gas within combustion turbines and generators offers several benefits compared to heavy fuel oils (HFO) or diesel. Burning natural gas for energy results in fewer emissions of nearly all types of air pollutants and carbon dioxide (CO_2) emissions than burning coal or petroleum products to produce an equal amount of energy[40].

Biomethane / Renewable Natural Gas (RNG)

Biogas is a renewable source of methane gas produced when organic matter breaks down without oxygen[41]. Biogas can come from a variety of sources, including municipal solid waste landfills, anaerobic digester plants at water resource recovery facilities (wastewater treatment plants), livestock farms, food production facilities, and organic waste management operations[42] for use in place of (or in tandem with) fossil natural gas. The biological matter that's used to produce biogas will naturally decay anyway, so capturing the gases produced by this decay, and using them as an energy source, causes less harm to the environment than allowing them to escape into the atmosphere[43]. Biomethane – or 'Renewable Natural Gas (RNG)' – refers to biogas that has also been cleaned and conditioned to remove or reduce non-methane elements allowing it to be used as a replacement for (or supplement to) traditional natural gas or LNG[44].

Biohydrogen

Biohydrogen refers to hydrogen obtained from biogenic sources (for example, biogases and biomass) using a variety of technologies including biological, thermochemical, and bioelectrochemical processes[45]. For example, the vast majority of hydrogen used today is produced via natural gas through a process called 'steam methane reforming' (SMR). Consider that RNG is chemically identical to natural gas; a low-carbon hydrogen can be produced with biomass as the original feedstock via SMR using RNG. While biohydrogen

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[39] https://afdc.energy.gov/fuels/natural-gas-conventional
[40] https://www.eia.gov/energyexplained/natural-gas/natural-gas-and-the-environment.php
[41] https://biogasassociation.ca/biogas_101/
[42] https://afdc.energy.gov/fuels/natural-gas-renewable
[43] https://www.nationalgrid.com/stories/energy-explained/what-is-biogas
[44] https://afdc.energy.gov/fuels/natural-gas-renewable
[45] https://www.europeanbiogas.eu/wp-content/uploads/2025/06/Decarbonising-Europes-hydrogen-production-with-biohydrogen.pdf

itself is not expected to be used in large quantities in NL, it is mentioned here because of the potential uses of green hydrogen and the potential for biohydrogen as a supplement.

Bio-methanol

Biogas can also be refined to produce bio-methanol. Whereas RNG is gaseous, the compound can be further refined into a liquid alcohol (bio-methanol)[46]. Methanol is a light, versatile, colourless and flammable alcohol. Methanol is used as a solvent for lacquers, paints, varnishes, cements, inks, dyes, plastics and various industrial coatings. It is also used in the production of pharmaceuticals, formaldehyde and other chemical products. Methanol appears as an ingredient in many products, from industrial solvents to windshield-washer fluid and nail-polish remover. It can also be used as a fuel and is a viable option for various applications with increasing interest in its use in power generation and adoption within the marine transportation sector. In an internal combustion engine, methanol reacts with the oxygen in the air to create energy with carbon dioxide and water as the residuals.

Biodiesel

Biodiesel is a diesel fuel substitute made from renewable materials such as: plant oils (canola, soy, flax, etc.), waste cooking oil (yellow or tap grease), other oils (tall, fish, and algae), animal fats (beef or sheep tallow, pork lard, or poultry fat); and potentially from cellulosic feedstock consisting of agriculture and forest biomass. The process to create biodiesel is called 'transesterification.' Made from renewable resources biodiesel has the potential to reduce GHG emissions by over 80% on a lifecycle basis.[47] Biodiesel is most often used blended with conventional diesel (see 'Fuel Blends' below).

Renewable Diesel

Similar to biodiesel in terms of feedstock, renewable diesel is a fuel made from fats and oils, such as soybean oil or canola oil – however the process utilized in fuel production is different. Produced most often by hydrotreating, and also via gasification, pyrolysis, and other biochemical and thermochemical technologies, the resulting fuel is chemically identical to conventional diesel[48] but has a much lower lifecycle carbon footprint. This means that renewable diesel can be used as a direct replacement for conventional diesel (i.e., as a 'drop-in'), if not a heavy additive in blending. While renewable diesel has a similar chemical structure to diesel, it has been shown to produce equal or lower levels of NOx

[46] https://methanol.org/wp-content/uploads/2020/04/IRENA_Innovation_Renewable_Methanol_2021.pdf
[47] https://natural-resources.canada.ca/energy-efficiency/transportation-energy-efficiency/biodiesel
[48] https://afdc.energy.gov/fuels/renewable-diesel

and particle emissions when burned. In addition, traditional diesel contains aromatic compounds present in distillates that contribute to toxicity, whereas renewable diesel does not contain such compounds and as a result, has a decreased environmental toxicity and a higher degradation rate. As such, in the case of a spill, renewable diesel has less short and long-term environmental effects compared to conventional fossil fuels[49]. Renewable diesel is produced in NL; Braya Renewable Fuels has converted the Come by Chance refinery to produce up to 18,000 barrels per day of renewable diesel[50].

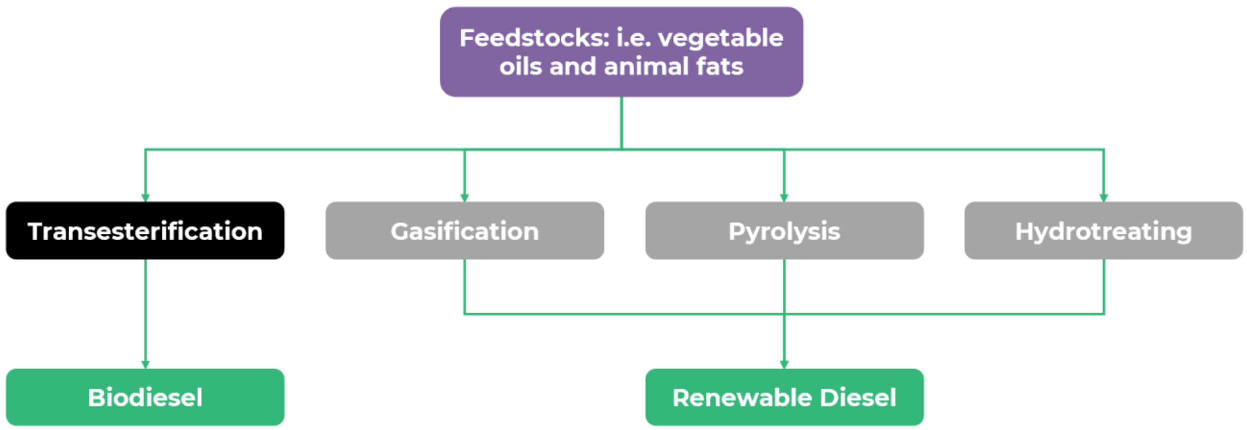

Figure 7: Example of Fuel Production Pathways for Biodiesel and Renewable Diesel (Forthcoming econext discussion paper)

Green Hydrogen

Hydrogen is the most abundant element in the universe. When burned, hydrogen produces only water vapour, resulting in zero GHG emissions which makes it an attractive fuel source. Hydrogen has been a widely used input in a variety of industry for many years and can be produced through a variety of methods[51]. The vast majority of hydrogen used today is produced via natural gas through a process called 'steam methane reforming' ('grey hydrogen'). This process can be paired with carbon capture and storage (CCS) to produce hydrogen with much fewer resulting GHGs ('blue hydrogen'). 'Green hydrogen' is when hydrogen is produced through a process called 'electrolysis' utilizing renewable energy. Green hydrogen can be produced with zero GHGs and be 'burned' resulting in zero GHGs – positioning it strongly as an important contributor in the fight against climate change. Green hydrogen is expected to be produced in NL in the early 2030s and will therefore be the primary focus of discussion for the purposes of this discussion paper.

[49] https://econext.ca/discussion-paper-opportunities-for-domestic-clean-fuels-use-in-newfoundland-and-labrador/
[50] https://brayafuels.com/
[51] https://www.siemens-energy.com/global/en/home/products-services/solutions-usecase/sustainable-fuels.html#Hydrogen-tab-0

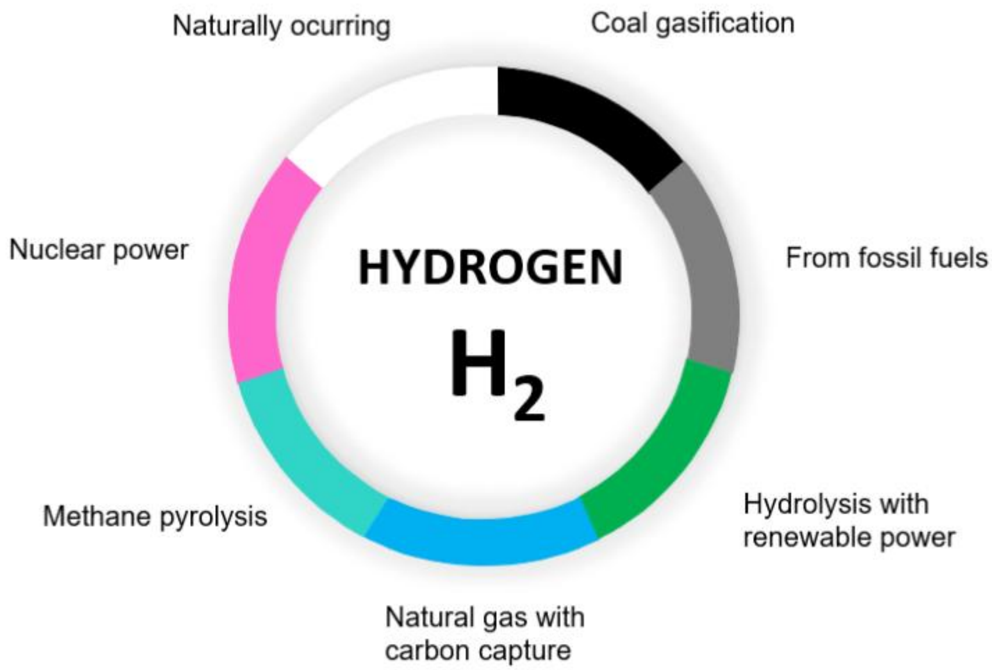

Figure 8: Hydrogen production pathways and colour associations[52]

Liquid Organic Hydrogen Carrier (LOHC)

Hydrogen is light gas with low energy density, making storage and transportation costly. For this reason, a number of different fuels which feature hydrogen as one of the primary elements are being considered as 'hydrogen carriers' as they have more favourable characteristics for transport and storage. LOHC is one of these 'hydrogen derivative' fuels and allows hydrogen to be chemically bonded to a liquid carrier making it safer and more efficient to handle. LOHCs can be transported easily using existing diesel infrastructure, with the organic compound removed near the point where hydrogen is to be used. These organic compounds are capable of reversible hydrogenation – binding and releasing hydrogen through chemical reactions[53]. Much of the organic compound can be 'recycled' and bonded with hydrogen again many times. Given the potential LOHC has as a hydrogen carrier and the fact it may be produced within NL by the early 2030s[54], it presents opportunities for hydrogen use within the province that are not practical if transporting and storing hydrogen in its pure state.

[52] https://jpt.spe.org/twa/the-color-palette-of-the-colorless-hydrogen
[53] https://www.deassociation.ca/newsfeed/what-is-lohc-liquid-organic-hydrogen-carrier
[54] https://www.greenenergyhub.ca/

Green Methane

Methane has been used as a fuel and, later, a chemical feedstock since it was discovered and isolated in the 18th century. It is four parts hydrogen and one part carbon. Methane is a key component of natural gas (90%) and historically has been taken either directly from natural gas fields or as a by-product of other fossil fuel extraction[55]. However, methane can be synthetically created through the combination of hydrogen and carbon dioxide. When green hydrogen is used in this process (along with sustainably sourced carbon dioxide), the resulting fuel is green methane (or 'e-methane'). Similar to biomethane, green methane is chemically identical to conventional methane and thus can be used as a heavy blend (or replacement for) natural gas. Green methane production has been commercialized at a relatively small scale, with most projects tied to existing biogas / biomethane plants; supplying green hydrogen in addition to anaerobic digestion can reportedly increase methane output by 60% compared to typical biogas upgrading[56].

Green Methanol

Methanol is one part carbon, three parts hydrogen, one part oxygen, and one part methyl group (CH_3OH). Methanol as a fuel has several potential benefits, including low emissions, low cost, and excellent energy density. Methanol is water-soluble and readily bio-degradable. With hydrogen being a primary component, the use of green hydrogen in methanol production results in 'green methanol' or 'e-methanol'. Liquid methanol has a higher energy density than gaseous hydrogen, making it practical for transport and storage. Low-carbon methanol (including bio-methanol and green methanol) is increasingly being viewed as a fuel of choice within the marine transportation sector.

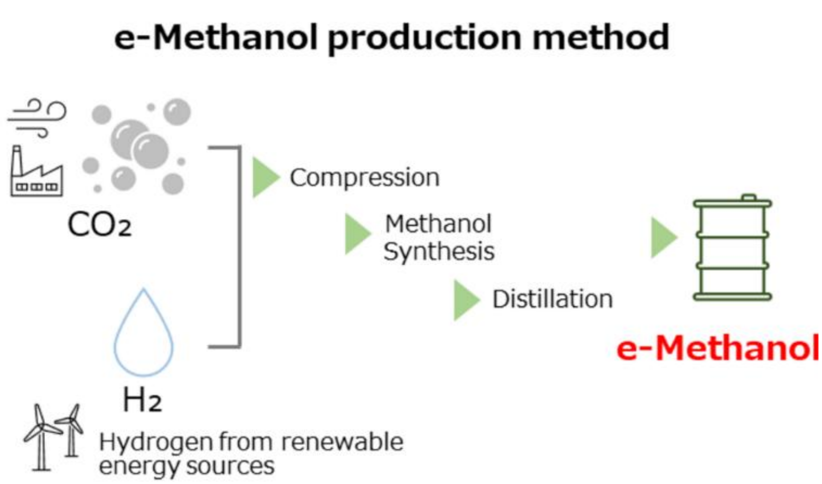

Figure 9: e-methanol production method[57]

[55] https://enapter.com/en/blog/the-promise-of-green-methane/
[56] https://www.idtechex.com/en/research-article/e-fuels-explained-methanol-methane-diesel-and-saf/34444
[57] https://www.idemitsu.com/en/business/oil/lowcarbon/e-methanol_future.html

Green Ammonia

Ammonia is a stable chemical compound composed of two common elements: nitrogen and hydrogen. Each ammonia molecule consists of one nitrogen atom bonded to three hydrogen atoms (NH_3), making it both carbon-free and hydrogen-rich[58]. Ammonia has a higher energy density than hydrogen, making it practical for storage and transport. Meanwhile, ammonia production and transport are well-established processes, with a proven safety record[59]. As hydrogen is a key component of ammonia, ammonia is often referred to as a 'hydrogen carrier' or 'hydrogen derivative'. Therefore, ammonia can have a high carbon intensity (if produced with grey hydrogen) or a very low carbon intensity (if produced with green hydrogen). 'Green' ammonia's potential as a carbon-free energy vector makes it a promising option for future energy systems[60].

Conventional Fuel	Biofuel	Renewable Biofuel	e-Fuel
Diesel	Biodiesel	Renewable Diesel	
Natural Gas	Biogas	Biomethane / RNG	Green Methane
Hydrogen		Biohydrogen	Green Hydrogen
Ammonia			Green Ammonia
Methanol			Green Methanol

Figure 10: Categorization of Fuels Relevant to Electricity Generation

Figure 10 presents these fuels in a chart. While an oversimplification, this chart does help to quickly classify the relevant fuels on the vertical columns. The horizontal rows articulate the direct relationships that exist between fuels for supplemental blending or direct replacement.

There are many additional relationships between these fuels that exist; the most relevant of these relationships from the perspective of NL and its electricity infrastructure are articulated in the section titled '*Low-Carbon Fuels Opportunities for Newfoundland and Labrador's Electricity Sector*' below. The interplay between these fuels can help de-risk decisions around future fuel production. While fuel X may decrease in demand over time, fuel X may have the ability to be further refined or blended with another fuel, or the feedstock for that fuel can be used in the production of other fuels.

Overall, increased low-carbon fuels adoption in the electricity sector is expected. Canada's Energy Regulator projects that total end-use bioenergy demand in Canada (like biofuels

[58]https://www.enbridge.com/~/media/Enb/Documents/Projects/Ingleside/FS_Intro_to_Ammonia_FINAL.pdf?rev=76814892c3134065bc111c56c2044d53&hash=B40952A0218BADAD6C2EB4FC332909DF

[59] https://www.siemens-energy.com/global/en/home/products-services/solutions-usecase/sustainable-fuels.html#Ammonia-tab-1

[60] https://www.siemens-energy.com/global/en/home/products-services/solutions-usecase/sustainable-fuels.html#Ammonia-tab-1

and renewable biofuels) will increase by 2050 by 10% in the low-end scenario, 32% in a scenario where current measures are maintained, 73% in the high-end scenario, and around 150% in a net-zero scenario. Increasing use of electricity produced with bioenergy becomes a large part of Canada's bioenergy use[61].

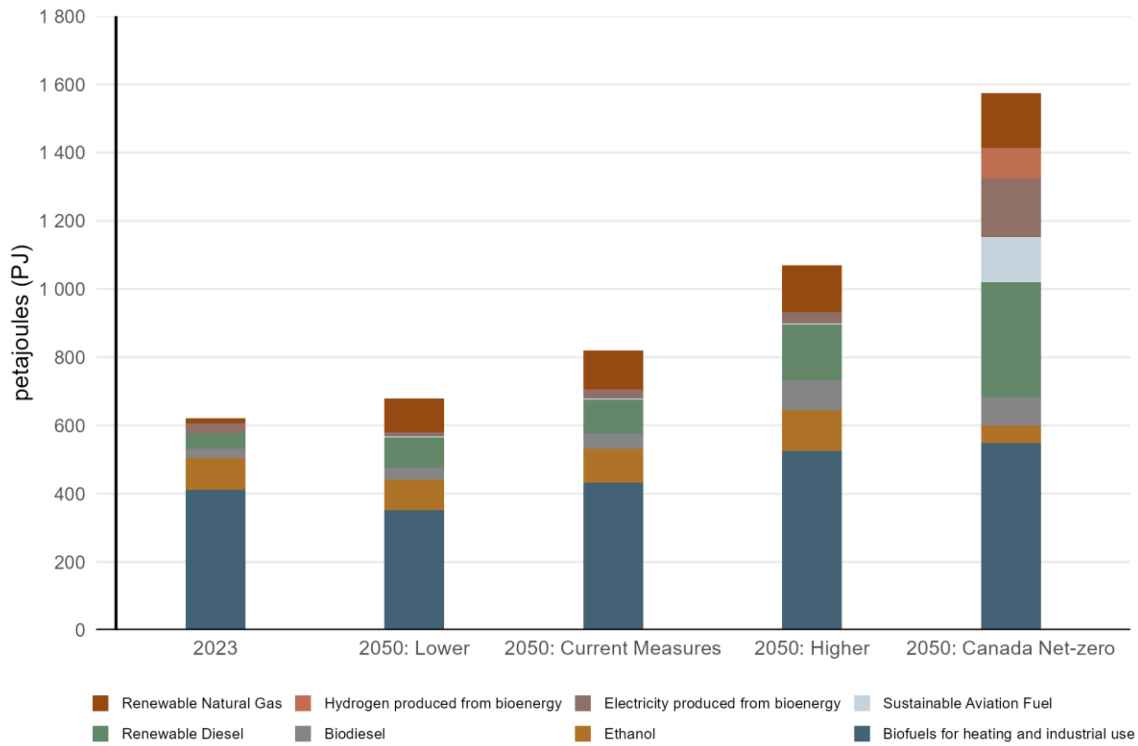

Figure 11: R.18 from Canada's Energy Future 2026 (Canada Energy Regulator): End-use bioenergy demand by type, 2023 and 2050 for all scenarios

5.3 Benefits of Low-Carbon Fuels

There are a number of benefits to the adoption of low-carbon fuels that should be considered in decision-making.

Decreased GHGs: The use of low-carbon fuels allows for lifecycle GHG reductions. These reductions will either be associated with the direct use of the fuel (e.g., a clean fuel will produce far fewer GHGs) and/or the displacement of conventional fossil fuels. The amount of GHGs replaced will depend on the low-carbon fuel used and what is displacing.

Reduced air pollutants: The use of low-carbon fuels is often associated with the reduction of other air pollutants such as particulates (tiny particles of solid matter that lodge in the lungs and deposit on buildings), carbon monoxide, sulfur dioxide, hydrocarbon, and other

[61] https://www.cer-rec.gc.ca/en/data-analysis/canada-energy-future/2026/results/index.html#a6

air toxins[62]. Each low-carbon fuel and the process used in their deployment will result in unique reductions. The amount of air pollutants reduced will depend on the low-carbon fuel used and what it is displacing.

Energy security: Many low-carbon fuels can be produced using local renewable resources (i.e., biomass, electricity, etc.) Even when locally produced fuels are blended with conventional fuels, this: (1) displaces the volume of fuel that must be imported; (2) protects against supply and supply chain disruptions caused by geopolitical events; (3) protects against price volatility of globally traded commodities; and (4) provides for domestic fuel production and supply capabilities that can be called on when needed in an emergency. For example, a diesel fuel blended with 30% locally produced biodiesel and renewable diesel displaces 30% of the required diesel to be imported and the geopolitical impacts on that import which are out of the user's control.

Storage of dispatchable energy: E-fuels can be viewed as a form of energy storage. Generally speaking, electricity grids have lower energy demands in the warmer Summer months and higher demands in the colder Winter months. This often results in excess energy in the Summer and peaks that are met through sources of electricity that are easily dispatchable in Winter. Excess electricity can be used to produce an e-fuel in the Summer; this fuel can be stored until needed in the Winter months (or during an emergency).

Valorization of wasted resources: Oftentimes organic waste material (e.g., household organic waste, forestry residues, fishing and aquaculture discards, agricultural waste) are sent to landfill. This 'waste' is actually a resource which has value and can be considered as feedstock for low-carbon fuels production. Morevoer, the diversion of these waste streams away from landfills reduces the harmful GHGs that are caused by the decomposition of biomass.

Economic development and growth: The production and distribution of low-carbon fuels (including the diversion of biomass from landfills) creates jobs, wealth, and improved environmental outcomes for communities. Many low-carbon fuels have value and opportunity domestically, while also are tradeable commodities on a regional, national, and global scale. As various biomass-derived fuels are interoperable with their e-fuel counterparts, there are opportunities for the scaling of production utilizing electricity as an additional feedstock.

[62] https://advancedbiofuels.ca/net-zero

5.4 Blending Fuels

Fuel types do not necessarily need to be homogeneous or used exclusively. As alluded to above, fuels can often be blended.

Purpose of Blending

Blending allows for the realization – even if in part – of the benefits to low-carbon fuel use as described above. While the blending of fuels does not provide the environmental benefits that the wholesale adoption of low-carbon fuels might, given the long lifespans of equipment and low turnover rate, blending presents an immediate opportunity to achieve GHG emissions reductions.

Blending can be done on an incremental basis, allowing for its users to become comfortable with the use of low-carbon fuels over time, ensure minimal disruption with existing equipment, and also to grow alongside with the available supply.

Fuel blending is likely to become more important over time as (a) pressures continue to mount worldwide to lower the carbon intensity of fuels produced and consumed, while (b) the availability of low-carbon fuels to meet this demand is likely to be in short supply.

Blending of Different Fuels

In some cases, the degree to which fuels can be blended is limited.

This is specifically the case for biodiesel. As biodiesel is not chemically identical to conventional diesel, it is most often an additive in a blend with conventional diesel. A blend classified as B2, for example, is 98% petroleum diesel and 2% biodiesel. B20 is a blend of 80% petroleum diesel and 20% biodiesel. Blending of biodiesel with diesel has become commonplace; the majority of North American engine manufacturers now endorse up to a B5 biodiesel blend[63]. Generally, B20 and lower-level blends can be used in current engines without modifications. In fact, many diesel engine original equipment manufacturers (OEMs) approve the use of B20[64]. Blending potential is specific to the equipment, its manufacturer, and warranty coverage.

[63] https://natural-resources.canada.ca/energy-efficiency/transportation-energy-efficiency/biodiesel
[64] https://afdc.energy.gov/fuels/biodiesel-blends

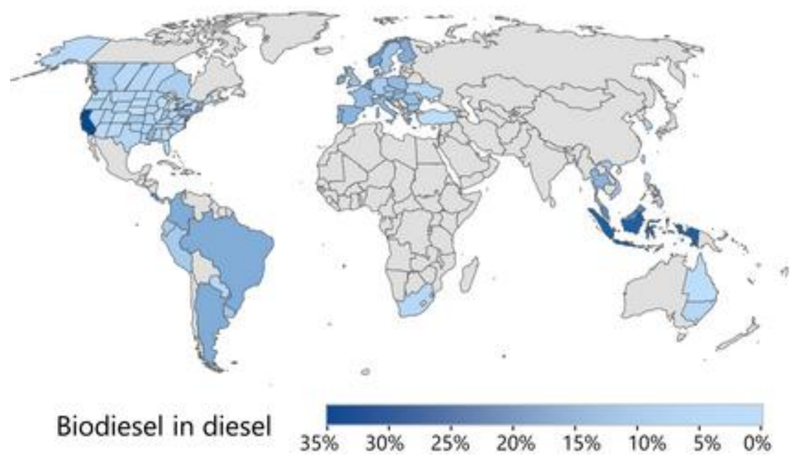

Figure 12: Global Biodiesel Blending Mandates ***Error! Bookmark not defined.***

Another similar case is the potential to blend low-carbon methane with natural gas. While a significant amount of low-carbon methane can be blended due to having the same chemical makeup as the methane component of natural gas, methane totals 90% of the makeup of natural gas so 100% replacement is not possible.

Similarly, there is the potential to blend low-carbon hydrogen with natural gas. Hydrogen can be blended with natural gas and delivered through its existing infrastructure for end-use appliances such as stoves, water heaters, generators, etc[65]. Existing natural gas equipment can typically handle a blend of up to 15% hydrogen without compromising performance or safety[66].

Blending of Same Fuels

In other cases, the low-carbon fuel is chemically identical to its fossil fuel counterpart and can be blended at any ratio at it will not change the composition or characteristics of the original or resulting fuel. This is the case with diesel and renewable diesel.

Multi-Fuel Blends

Blending does not necessarily need to be limited to two fuels. For example, the Canadian Coast Guard is testing fuel blends composed of 10% biodiesel, 40% renewable diesel, and 50% conventional diesel[67] in its ships[68].

[65] https://www.cga.ca/natural-gas-101/hydrogen-a-lower-emitting-and-versatile-fuel
[66] https://www.csagroup.org/article/research/appliance-and-equipment-performance-with-hydrogen-enriched-natural-gases
[67] https://www.ccg-gcc.gc.ca/corporation-information-organisation/greening-initiatives-ecologisation-eng.html
[68] https://www.canada.ca/en/canadian-coast-guard/corporate/about-us/greening-initiatives.html

6. Applications for Low-Carbon Fuels in Electricity Generation

Low-carbon fuels can be used to generate electricity in combustion turbines and generators. This can be achieved today with some fuels, depending on the equipment in operation. Meanwhile, other fuels are a focus of research and development with an aim to commercialize their adoption in the future.

6.1 Combustion Turbines

Modern gas turbines can operate on a wide variety of fuels, which helps power generation in industrial and utility-scale applications where natural gas or light distillate fuels are not available[69].

Biodiesel blends can be used within combustion turbines today, with the blend level (i.e., B5, B10, B20, etc.) dependant on the specific equipment and manufacturer's specifications.

Renewable diesel is a drop-in fuel for conventional diesel, and thus blends at every level (up to 100%) are feasible with minimal modifications. Siemens Energy has successfully tested 100% renewable diesel in their gas turbines[70].

Stephenville Combustion Turbine (NL Hydro)

[69] https://www.gevernova.com/gas-power/applications/flexible-fuel-offerings
[70] https://www.siemens-energy.com/global/en/home/products-services/solutions-usecase/sustainable-fuels.html#Hydrotreated-vegetable-oil-(HVO)-tab-2

Similarly, natural gas turbines can conceivably incorporate any level of RNG.

Of the clean fuels, hydrogen has been the fuel most researched, experimented with, and demonstrated with respect to combustion turbines. For example, GE Vernova has more than 100 gas turbines operating on hydrogen fuel blends that have accumulated more than 8 million hours of operation[71]. In fact, many existing units are capable of burning hydrogen. Each gas turbine model has specific capability for burning hydrogen (from 5% upwards), dictated primarily by the combustion system[72]. Siemens Energy has successfully demonstrated dry low emissions combustion of 100% green hydrogen using an SGT-400 gas turbine and is accelerating the development of gas turbine technology for hydrogen firing[73] targeting 100% hydrogen capability as soon as 2030[74]. Existing gas power plants can be retrofitted to burn higher volumes of hydrogen than originally configured for. These upgrades can be scheduled with planned outages to minimize plant downtime, and for new units these capabilities can be part of the initial plant configuration or phased in over time as hydrogen becomes available.

Combustion turbine technology for other clean fuels is less advanced at the present time.

Siemens Energy has successfully tested methanol-fired turbines with smaller sizes and validated with promising results[75]. A 2023 test showed CO_2 emissions could be reduced by up to 75% when compared to conventional fuels[76], with tests in 2024 showing 80% emissions reductions[77].

Siemens Energy is actively researching ammonia combustion in gas turbines[78]. Demonstration projects led by GE, Mitsubishi, and others have been announced or advanced in 2025[79]. IHI and GE Vernova are collaborating to create a new combustion turbine capable of burning up to 100% ammonia by the year 2030[80].

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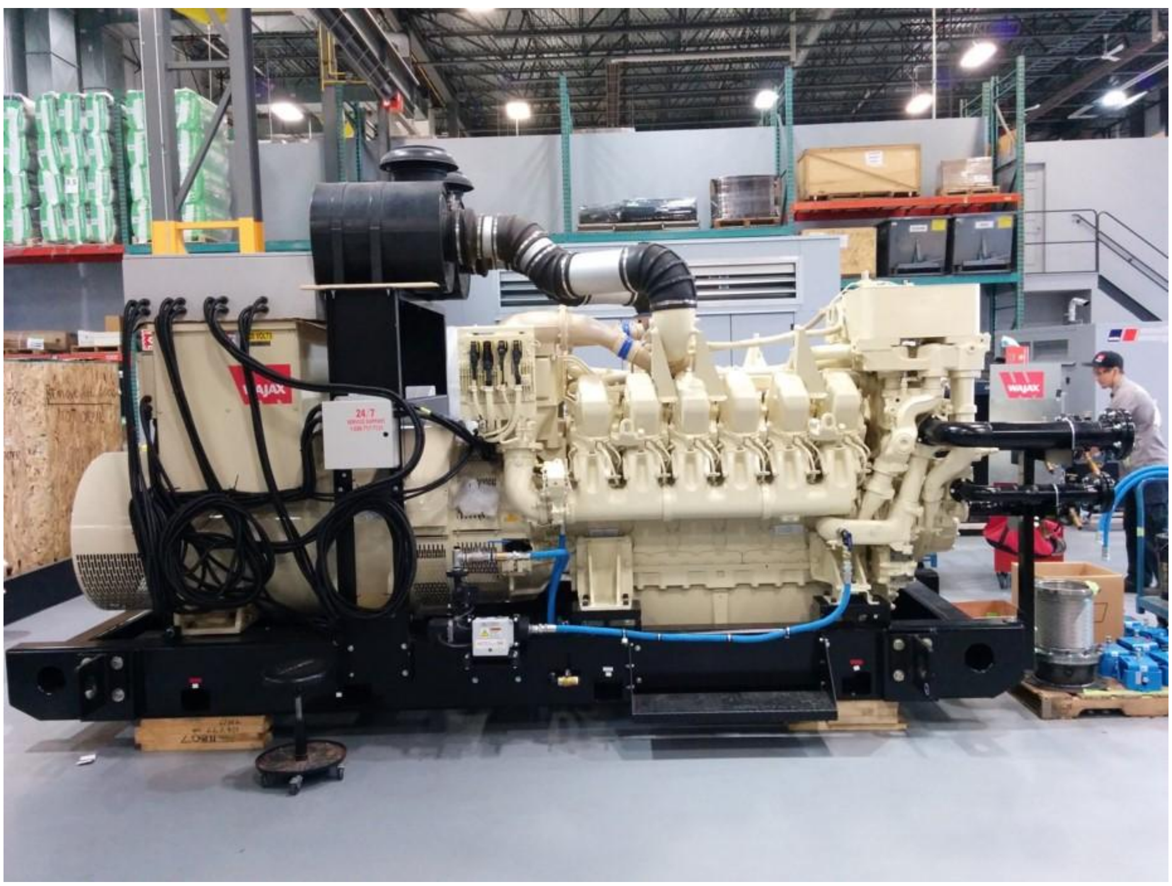
[71] https://www.gevernova.com/content/dam/gepower-new/global/en_US/downloads/gas-new-site/future-of-energy/GEA35685-GEV-Hydrogen-Overview_8.5x11_RGB_R4.pdf
[72] https://www.gevernova.com/gas-power/future-of-energy/hydrogen-fueled-gas-turbines
[73] https://www.siemens-energy.com/global/en/home/products-services/solutions-usecase/sustainable-fuels.html#Hydrogen-tab-0
[74] https://www.energymonitor.ai/sponsored/decarbonizing-gas-turbines-hydrogen-carbon-capture-and-beyond/
[75] https://www.siemens-energy.com/global/en/home/products-services/solutions-usecase/sustainable-fuels.html#Methanol-tab-3
[76] https://www.modernpowersystems.com/analysis/methanol-gas-turbine-fuel-of-the-future/?cf-view
[77] https://www.enlit.world/library/retrofitted-gas-turbine-runs-on-methanol-with-80-less-nox-emissions
[78] https://www.siemens-energy.com/global/en/home/products-services/solutions-usecase/sustainable-fuels.html#Ammonia-tab-1
[79] https://ammoniaenergy.org/articles/ammonia-fueled-gas-turbines-a-technology-and-deployment-update/
[80] https://www.gevernova.com/gas-power/future-of-energy/ammonia-powered-gas-turbines

6.2 Diesel Generators

Over the last decade, there have been significant advances in the ability for gensets to run on low-carbon fuels.

Similar to combustion turbines, biodiesel blends can be used within diesel generators today. Many modern diesel motor generators can run on biodiesel blends without modification. Blends like B5 (5% biodiesel, 95% diesel) and B20 (20% biodiesel) are commonly used today[81], with the blend level dependant on the specific equipment and manufacturer's specifications. Generators can also be modified or designed to run exclusively on biofuels.

Renewable diesel is a drop-in fuel for conventional diesel, and thus blends at every level (up to 100%) are feasible with minimal or no modifications. Rehlko (formerly Kohler) approved the use of renewable diesel in its entire line of generators in 2022[82]. Caterpillar approved the use of renewable diesel within its generator sets for over a decade[83].



MTU genset, similar to those used in Labrador (Wajax)

[81] https://bcdieselgenerators.com/the-future-of-biofuel-use-in-diesel-generators/
[82] https://biomassmagazine.com/articles/kohler-approves-use-of-renewable-diesel-in-its-diesel-generators-19120
[83] https://eneria.pl/en/blog/hvo-ekologiczne-paliwo-dla-silnikow-caterpillar-przyszlosc-napedow/

Hydrogen generators are a fully commercialized technology with many manufacturers worldwide including leading diesel genset manufacturers like Rehlko[84] and Caterpillar[85]. Many diesel genset manufacturers provide retrofit kits to allow for existing diesel generators to be modified to dual-fuel application to allow for some hydrogen use.

Ammonia and methanol generator technologies are earlier in their development, with commercialized units only recently coming online. However, there are blending opportunities; the National Research Council (NRC) has found that 70% of diesel used in a generator can be displaced by ammonia in a blend[86].

6.3 Challenges in Adopting Low-Carbon Fuels

Aside from the lack of technological maturation (in some cases), there are a number of challenges that utilities may face in adopting and integrating low-carbon fuels into their electricity grids.

No room for error: Reliability is a fundamental consideration for utilities. Customers expect and demand that they can rely on the electricity grid at all times, within reason. This is particularly true in Northern climates where access to electricity is vital. Utilities may not integrate low-carbon fuels into their systems until they are certain that they will perform as expected. Utilities are therefore less likely to be early adopters of technologies and may not be keen to experiment to the possible detriment of their customers. It has been observed that there are limited case studies to support the application and consistency of performance of renewable diesel in cold weather environments[87]. This testing is critical, as extreme cold weather can often be associated with peak electricity demands, which is when these facilities support the grid.

Least cost mandates: Utilities are often mandated to provide reliable and safe electricity at the least cost possible to the customer. They are required to prove that their decision-making is in the interest of least-cost to regulator(s). This is problematic for the adoption of low-carbon fuels as they are typically more expensive than conventional fuels and there are capital costs associated with the technologies that are able to utilize them. For reference, in 2025, diesel was estimated to cost approximately $29/GJ while renewable diesel cost 16% more[88]. The pricing gaps between conventional fuels and low-carbon fuels are expected to close over time.

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[84] https://www.powersystems.rehlko.com/hydrogen-fuel-cell-systems
[85] https://www.cat.com/en_US/by-industry/electric-power/electric-power-industries/hydrogen.html
[86] https://nrc.canada.ca/en/stories/ammonia-shows-promise-fuel-hard-decarbonize-sectors
[87] https://econext.ca/wp-content/uploads/2025/04/econext-Domestic-Clean-Fuels-Opportunities-Analysis-2025.04.07.pdf
[88] https://econext.ca/discussion-paper-opportunities-for-domestic-clean-fuels-use-in-newfoundland-and-labrador/

Access to supply: When making decisions about electricity systems, utilities need to achieve as much certainty as is possible in order to ensure reliable operations. Thus, utilities may be hesitant to make decisions on fuel without assurance on the availability of supply. The prospect of future access to a fuel may not be enough to allow utilities to make decisions on technologies that will have implications for many years.

Logistics and storage: The adoption of a new fuel may require changes in transportation and storage infrastructure and other logistics. Sometimes, these are capabilities that distributors or others in the supply chain must develop and are entirely beyond the utility's control. This can add another layer of uncertainty to fuel supply.

Safety and risk: Some low-carbon fuels have very different characteristics which impact their safe handling and use. Utilities avoid risk in their operations, and the introduction of new processes and protocols (sometimes in addition to and not in replacement of) existing ones introduces new risks to personnel and infrastructure.

Testing and optimization: The integration of any new technology requires a period of testing and optimization. In the context of low-carbon fuels, this may mean blending ratios to achieve optimal performance in certain weather conditions, for example. Utilities rarely have the luxury of having the resources – in terms of finances, time, or equipment – to engage in the testing and piloting necessary to prove and de-risk the adoption of a new technology.

7. Low-Carbon Fuels Opportunities for Newfoundland and Labrador's Electricity Sector

Opportunities for the adoption of low-carbon fuels in NL's electricity sector are divided into 'current state' opportunities – or those that apply to the electricity system as it exists today or as it will soon be, and 'future state' opportunities – or those that have longer-term potential and should factor into long-term decision making.

In both explorations, the assumption is made that dispatchable energy like that which is currently provided by fossil fuel consuming electricity generation assets will continue to be desired and required into the long-term.

7.1 Current State

The 'current state' of the electricity system in NL assumes:

- The Holyrood Thermal Generating Station will be decommissioned by 2030
- The Avalon Combustion Turbine will be constructed and operational by 2030
- The existing combustion turbine in Holyrood will continue to operate
- Combustion turbines in Stephenville and Paradise will be decommissioned by 2030
- While the exact makeup of the diesel generator fleet is subject to change, overall fuel consumption will remain constant.

It is expected that this current state of the electricity system will be in place for the foreseeable future in NL.

Decarbonizing Diesel Use

The table below summarizes the estimated total No. 2 diesel consumption by utility owned and/or operated combustion turbines and generators based on the assumptions outlined above.

Generation Source	No. 2 Diesel Consumption (Litres Annually)
Holyrood Combustion Turbine	40,698,000
Avalon Combustion Turbine	49,631,707
Diesel Generators (Total)	17,754,253
Other Gas Turbines	155,962
TOTAL ANNUAL CONSUMPTION	**108,240,330**

Figure 13: Total No. 2 Diesel Consumption by Utility-owned/operated CTs and Gensets

It is understood that diesel imported to NL is not blended with a lower-carbon fuel. Roughly estimated, over 108 million litres of diesel could be decarbonized on annual basis.

Biodiesel: There is an opportunity to decarbonize diesel use in NL's electricity sector through the blending of biodiesel with conventional diesel. At a conservative blend of B5 this would amount to almost 5.5 million litres annually of biodiesel that could be blended; at a more robust blend of B20 this would amount to over 21 million litres annually of biodiesel. Various biomass waste sources in NL would lend themselves well to biodiesel production – i.e., fisheries, aquaculture, agriculture. Compared to diesel, biodiesel has the potential to reduce GHG emissions by over 80% on a lifecycle basis[89]; reductions would be determined by the feedstock used in production, the production method, and the degree to which the biodiesel is blended with conventional diesel. The use of biodiesel would need analyzed to ensure that it would be within the parameters of use outlined by the equipment manufacturer.

[89] https://natural-resources.canada.ca/energy-efficiency/transportation-energy-efficiency/biodiesel

Renewable Diesel: There is an opportunity to decarbonize diesel use in NL's electricity sector through the blending or full-scale adoption of renewable diesel. This would amount to over 108 million litres of diesel that could be displaced. For context, the Braya Renewable Fuels plant in NL can produce up to 18,000 barrels per day of renewable diesel[90]; this translates to 2,861,771 litres per day. Assuming continuous production (365 days per year), the facility can produce over 1 billion litres per year; potential NL demand represents 10% of the facility's current production potential. Compared to diesel, renewable diesel has the potential to reduce GHG emissions by up to 90% on a lifecycle basis[91]; reductions would be determined by the feedstock used in production, the production method, and the degree to which the renewable diesel is blended with conventional diesel. As renewable diesel can be blended at a much higher rate than biodiesel (up to 100%), the environmental benefits have the potential to be much more significant.

Triple Blend: An alternative is for NL's electricity sector to use a triple blend of conventional diesel, biodiesel, and renewable diesel at rates that could change over time. This would allow for some of the benefits of the use of low-carbon fuels to be accrued while doing so on an incremental basis to reduce risk and align with supply and/or cost constraints.

Considerations

- The above is an oversimplification of how supply and demand operates in the real world in NL. Receipt and use of No. 2 diesel is not centralized and with various suppliers and distributors independently involved. However, it is instructive in helping to understand the scale of the low-carbon fuels opportunity that exists.
- The adoption of low-carbon diesel will help remote/off-grid communities decarbonize while retaining the firm source of energy that is required in order to facilitate the addition of, and integration with, other clean energy sources (i.e., wind, solar, etc.)
- Biodiesel and renewable diesel will invariably be more expensive than conventional diesel for the foreseeable future. Utilities in NL are constrained by legislation and regulation to strive to provide electricity at the least cost possible cost. While environmental impact has recently been introduced as a consideration for the regulatory to consider[92], this provision is untested and it is uncertain the degree to which it can factor into analysis and decision-making. Ultimately, the higher cost of low-carbon fuels will present challenges to utilities.

[90] https://brayafuels.com/
[91] https://www.technoilogy.it/insights/sustainable-biofuels-2025-biodiesel-vs-renewable-diesel/
[92] https://www.gov.nl.ca/releases/2023/iet-en/0523n01/

Utilizing Natural Gas Capabilities

The larger combustion turbines operating in NL have the ability to run on natural gas – and this is likely to be true of the soon to-be constructed Avalon Combustion Turbine. While natural gas is more efficient[93] and creates fewer GHGs when burned[94], there is no supply of the fuel in NL and no supporting infrastructure. However, there is significant production potential offshore NL and it is possible that future developments may make local supply available[95]. Natural gas capability also presents opportunities for NL from the perspective low-carbon fuels.

Renewable Natural Gas (RNG): RNG is chemically identical to natural gas, meaning it can be used within natural gas infrastructure with no modifications to or undesirable effects on equipment. RNG can be produced utilizing methane captured from municipal solid waste landfills, wastewater, agricultural waste, food production facilities, and organic waste. These are all organic wastes that presently are sent straight to landfills in NL, needlessly increasing waste management costs while contributing significantly to the waste management sector's GHG profile – which makes up 8% of NL's total GHGs[96]. Diverting these wastes towards the production of RNG would help to solve the province's waste management challenges while also accruing the benefits outlined in section 4.3. The use of natural gas opens the door to future blending opportunities and the incorporation of hydrogen as outlined in Section 6.2.

Considerations

- The above is an oversimplification. The technical challenges that might be included in the use of dual-fuel capabilities of combustion turbines that have not been exercised since their commissioning have not been considered.
- Utilities will be constrained by their 'least cost' mandates, and thus the economics of RNG use will be a primary consideration.

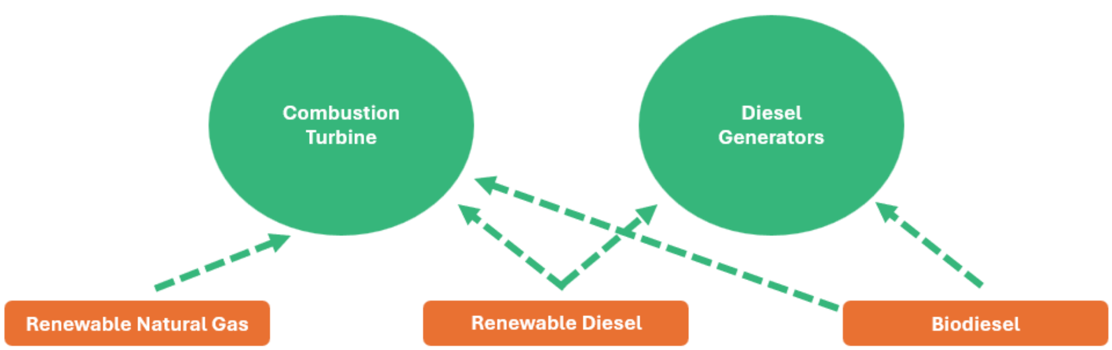

Figure 14: Near term decarbonization pathways for NL electricity system with low-carbon fuels

[93] https://www.sciencedirect.com/science/article/abs/pii/S001623612500239X
[94] https://www.eia.gov/environment/emissions/co2_vol_mass.php
[95] https://www.gov.nl.ca/releases/2026/minesen/0601n03/
[96] https://nlerf.ca/nl-ghgs/

7.2 Future State

There are opportunities for longer term decarbonization of NL's electricity system with the integration of e-fuels.

Combustion Turbines

Given that developers are on track to produce green hydrogen in NL in the early 2030s, it is logical for decision-makers to focus on the use of hydrogen within the electricity grid as a focus in decarbonization within the combustion turbine fleet.

Hydrogen to Supplement RNG: Hydrogen can be blended with natural gas for end-use, and existing natural gas equipment can typically handle a blend of up to 15% hydrogen without compromising performance or safety[97]. As combustion turbines are inherently fuel-flexible, existing units can be upgraded even after extended service on traditional fuels to operate using e-fuels. The scope of the required modifications to configure a gas turbine to operate on e-fuels depends on the initial configuration of the combustion turbine and the overall balance of plant, as well as the desired fuel concentration[98]. The introduction of green hydrogen into RNG can serve to increase total volumes of fuel supply and further decarbonize generation.

Green Methane to Supplement RNG: As natural gas is 90% methane, there is the potential to use RNG which is supplemented by the blending of green methane. Green methane involves the combination of green hydrogen and sustainably sourced carbon dioxide. Since blending hydrogen with RNG directly can be achieved (see above), this is likely not an action the utility itself would take. Rather, this blending may happen at the source of RNG production as a method to boost fuel production and to further decrease lifecycle GHGs of the product. The benefit of this approach to decarbonization is that the existing dual-fuel capability of the combustion turbine fleet can be utilized with little to no modification.

100% Hydrogen Combustion: Many combustion turbines in operation today can be modified to run up to 100% on hydrogen, with manufacturers working to develop the capabilities for their entire fleets to be 100% hydrogen capable[99]. Depending on prior decision-making relating to the use of the natural gas capabilities of the combustion turbine fleet, the most logical decision may be to work towards retrofits that enable the use of 100% hydrogen.

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[97] https://www.csagroup.org/article/research/appliance-and-equipment-performance-with-hydrogen-enriched-natural-gases

[98] https://www.gevernova.com/gas-power/future-of-energy/hydrogen-fueled-gas-turbines

[99] https://www.gevernova.com/gas-power/future-of-energy/hydrogen-fueled-gas-turbines

Other Fuels: As explored in section 6.1, there are a variety of e-fuels that could be considered for use with NL's combustion turbine fleet. Additional conversion from hydrogen to its derivates (i.e., ammonia, methanol, etc.) would add costs and would likely not be preferred if hydrogen in its pure state was locally available. However, this is a broad assumption that would need to be tested – particularly as combustion turbine technologies for e-fuels advance in the coming years.

Diesel Generators

Decarbonization of NL's diesel generator fleet will depend on their usage. For example, practical decarbonization pathways to support electricity micro-grids in off-grid communities may differ substantially than those for gensets used to supplement to interconnected grids.

Communities and their inhabitants including Indigenous groups may have specific ideas on how they would like to approach decarbonization. This is likely to involve the inclusion of clean energy components such as wind, solar, and small-scale hydro. For the foreseeable future, the most direct and non-disruptive approach to decarbonization will be through blending biodiesel and/or renewable diesel with conventional fuels.

For diesel generators used for other purposes, there is a wide range of options ranging from continued low-carbon diesel blending, to gensets that run on natural gas that can utilize RNG, to the adoption of available e-fuel technology, to battery energy storage systems. It is difficult to prescribe one pathway as each unit serves a unique purpose in unique conditions.

7.3 Important Factors

In exploring the adoption of low-carbon fuels within NL's electricity systems, there are factors – beyond strictly technical feasibility – and Canadian/NL conditions that should be considered.

Economics

As utilities are required to provide electricity with 'least cost' being a key criterion, sound economics in the adoption of low-carbon fuels within the electricity system must be a primary consideration. Given that low-carbon fuels are expected to cost more than the diesel that they will be replacing in NL, all tools available to producers, distributors, and adopters will need to be leveraged. Some of these supports are explored in further detail below.

Investment Tax Credits

A number of tax credits have been released at the federal and provincial levels in recent years which can help offset some of the capital costs associated with low-carbon fuels production and infrastructure. Federally, the passage of Bills C-59 and C-69 on June 20, 2024[100], activated four tax credits at the federal level with relevance to biomass energy:

- **Clean Technology Investment Tax Credit**[101] – The CT ITC is a refundable tax credit of up to 30% for capital invested in the adoption and operation of new clean technology (CT) property. This includes various electricity generation, energy storage, refueling, etc. equipment – much of which could apply to portions of biomass energy projects.
- **Clean Hydrogen Investment Tax Credit**[102] – The CH ITC is a refundable tax credit of up to 40% that applies to eligible expenses incurred for property that produces hydrogen. These are expenditures that may be applicable to portions of low-carbon fuel production projects if they do involve hydrogen. Property used to convert clean hydrogen to clean ammonia is also eligible at a 15% ITC rate, but unfortunately the ITC is not applicable to property that is used to convert hydrogen to other fuels like methanol.
- **Clean Technology Manufacturing Investment Tax Credit**[103] – The CTM ITC is a refundable tax credit that applies to investment of capital for clean technology manufacturing and processing and critical mineral extraction and processing. This tax credit may not have applicability within the context of low-carbon fuel production, however it should be explored.
- **Clean Electricity Tax Credit**[104] – The CE ITC is a refundable tax credit of up to 15% of investments in projects that generate clean electricity, store electricity without the use of fossil fuels, or transmit electricity between provinces and territories. These are expenditures that may be applicable to portions of low-carbon fuel production projects.

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[100] Government of Canada Launches the First Clean Economy Investment Tax Credits - https://www.canada.ca/en/natural-resources-canada/news/2024/06/government-of-canada-launches-the-first-clean-economy-investment-tax-credits.html
[101] Clean Technology Investment Tax Credit - https://www.canada.ca/en/revenue-agency/services/tax/businesses/topics/corporations/business-tax-credits/clean-economy-itc/clean-technology-itc.html
[102] Clean Hydrogen Investment Tax Credit - https://www.canada.ca/en/revenue-agency/services/tax/businesses/topics/corporations/business-tax-credits/clean-economy-itc/clean-hydrogen-itc.html
[103] Clean Technology Manufacturing Tax Credit - https://www.canada.ca/en/revenue-agency/services/tax/businesses/topics/corporations/business-tax-credits/clean-economy-itc/clean-technology-manufacturing-itc.html
[104] Budget 2024, Chapter 4 - https://www.budget.canada.ca/2024/report-rapport/chap4-en.html

- **Carbon Capture, Utilization, and Storage Investment Tax Credit**[105] – The CCUS ITC is a refundable tax credit of up to 60% that applies to eligible expenditures incurred for a qualified CCUS project. Note that NL, at this time, is not one of the eligible jurisdictions for the CCUS ITC as the credit requires a jurisdiction to have ‘sufficient environmental laws and enforcement governing the permanent storage of captured CO^2. This ITC is related to the acquisition of property used to capture CO_2 emissions from fuel combustion, industrial process or directly from the air, to transport the captured carbon and to store it or use it in industry. This is relevant for any low-carbon fuels project which includes CCUS components.

NL’s provincial government introduced two investment tax credits in 2022 which are potentially relevant to new biomass energy projects:

- **Green Technology Tax Credit**[106] – The GTTC is a refundable tax credit of up to 20% of capital investments in equipment that generates or conserves renewable-source energy, uses fuels from waste, or makes efficient use of fossil fuels.
- **Manufacturing and Processing Investment Tax Credit**[107] – The MPITC is a refundable tax credit of up to 10% if capital investments in qualified activities that may include aspects of biomass energy projects.

In addition to the above, there is a specific investment tax credit available throughout Atlantic Canada:

- **Atlantic Investment Tax Credit**[108] – The ATC is based on specified percentages available for certain investments in new buildings, and new machinery and equipment used in the Atlantic Canada and Atlantic Region including expenditures relating to biomass energy projects: prescribed new energy generation and conservation property; the production or processing of electrical energy or steam in certain areas; and manufacturing and processing.

The above tax credits should be considered and included where appropriate for any future economic analysis of low-carbon fuels production and adoption projects in NL.

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[105] Carbon Capture, Utilization, and Storage Tax Credit - https://www.canada.ca/en/revenue-agency/services/tax/businesses/topics/corporations/business-tax-credits/clean-economy-itc/carbon-capture-itc.html
[106] Green Technology Tax Credit - https://www.gov.nl.ca/fin/tax-programs-incentives/business/green-tech-tax-credit-gttc/
[107] Manufacturing and Processing Investment Tax Credit - https://www.gov.nl.ca/fin/tax-programs-incentives/business/manufacturing-and-processing-investment-tax-credit/
[108] Atlantic Investment Tax Credit - https://www.canada.ca/en/revenue-agency/services/tax/individuals/topics/about-your-tax-return/tax-return/completing-a-tax-return/deductions-credits-expenses/line-41200-investment-tax-credit/atlantic-investment-tax-credit.html

Clean Fuel Regulations

Canada's Clean Fuel Regulations (CFRs) came into effect in 2023 and create incentives for the development and adoption of clean fuels, technologies and processes[109].

The stated goal of the CFRs is to significantly reduce pollution by making the fuels Canadians use every day cleaner over time. The CFRs require liquid fossil fuel (gasoline and diesel) suppliers to gradually reduce the carbon intensity – or the amount of pollution – from the fuels they produce and sell for use in Canada over time, leading to a decrease of approximately 15% (below 2016 levels) in the carbon intensity of gasoline and diesel used in Canada by 2030.

There are a number of methods for regulated industry to be compliant with the CFR.

econext's emissions reduction fund is a mode of compliance under the CFR (www.nlerf.ca)

The first approach is the creation of compliance credits. There are three compliance categories, with the first two being relevant in the context of low-carbon fuels:

Compliance Category 1: Undertaking projects that reduce the lifecycle carbon intensity of liquid fossil fuels (e.g., carbon capture and storage, on-site renewable electricity, co-processing). This includes the blending of fuels with lower carbon GHG intensity with conventional fuels.

[109] Government of Canada: What are the Clean Fuels Regulations? - https://www.canada.ca/en/environment-climate-change/services/managing-pollution/energy-production/fuel-regulations/clean-fuel-regulations/about.html

Compliance Category 2: Supplying low carbon intensity fuels (e.g., biodiesel, hydrogen, e-methanol, etc.)[110].

There is, therefore, an incentive structure that exists for the production and supply of low-carbon fuels to customers like those found within the electricity sector – including when those fuels are blended.

The second approach to compliance is for regulated industry to contribute to an Emissions Reduction Fund (ERF) authorized by the Minister of Environment and Climate Change Canada (ECCC). econext's Newfoundland and Labrador Emissions Reduction Fund is one of a select few organizations in Canada with a registered ERF approved as a compliance mechanism under the CFR. ERF funded projects could also conceivably involve partnerships between low-carbon fuel producers, distributors, and users.

Output-Based Pricing System (OBPS)

NL implemented a carbon pricing system in 2019 to reduce GHGs. The system includes performance standards for large industrial facilities through the *Management of Greenhouse Gas Act* (MGGA) and its regulations. Under this legislation, industrial facilities that emit 15,000 tonnes or more of GHG emissions per year are required to report their emissions on an annual basis.

MGGA also provides for the establishment of a GHG reduction target for industrial facilities that have either emitted 25,000 tonnes or more of GHG emissions per year or emitted 15,000 tonnes or more and opted to be regulated by the Act[111].

Credits can be generated by regulated facilities by exceeding their GHG reduction targets in any given year. These credits can be sold to other MGGA-regulated facilities who have not met their GHG reduction targets and need to achieve compliance.

The Holyrood Gas Turbine is regulated under the MGGA with GHG emissions that have, at times, exceeded the 25,000 tonnes of GHGs annual threshold[112], but operation of the unit has changed substantially with the completion of Muskrat Falls in the LIL resulting in far fewer GHGs in recent years. It is unknown if the future Avalon Combustion Turbine will be considered as being the same 'facility' as the existing gas turbine or if these assets will be treated differently under the regulations.

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[110] https://www.canada.ca/en/environment-climate-change/services/managing-pollution/energy-production/fuel-regulations/clean-fuel-regulations/compliance.html
[111] https://www.gov.nl.ca/eccc/occ/greenhouse-gas-data/
[112] https://www.gov.nl.ca/eccc/files/Facility-GHG-Data-for-Website-by-Gas-2016-24-Jan-2026.pdf

While there are many credits active within the OBPS market[113], credits may become more scarce in the medium to longer term. The adoption of low-carbon fuels may help utilities generate credits within the OBPS which can be sold to others regulated under the OBPS to potentially generate revenues.

Carbon Offsets

The production and use of low-carbon fuels can be net negative in terms of GHGs, making production and adoption projects potentially eligible to achieve carbon offsets.

The federal government has created a Greenhouse Gas Offset Credit System, which will allow for the purchase and trading of eligible carbon offsets as a means of compliance for federally regulated activities[114]. Eligible offsets must meet the stringent requirements of 'protocols' which are developed for each specific type of negative emissions activity.

The system was introduced in 2022, but only a few protocols have been developed thus far including: (1) Landfill Methane Recovery and Destruction; (2) Reducing Greenhouse Gas Emissions from Refrigeration Systems; and (3) and Improved Forest Management on Private Land; and (4) Reducing Enteric Methane Emissions from Beef Cattle. ECCC is currently developing more protocols including Direct Air Carbon Dioxide Capture and Geological Storage, Reducing Manure Methane Emissions, Enhanced Soil Organic Carbon, Improved Forest Management on Public Land, and Bioenergy with Carbon Dioxide Capture and Geological Storage[115].

These offsets can currently be traded under federal output-based pricing system (OBPS)[116]. Note that NL has its own federally authorized carbon pricing system for large emitters within the province (see above), and this system is independent of the federal OBPS. Emitters in NL cannot achieve compliance through the purchase of federal offsets. It is expected that federal carbon offsets will be tradeable under the forthcoming Clean Electricity Regulations (CER).

It is possible that some of the protocols under the federal system will present opportunities for generation of credits from low-carbon fuels production and adoption initiatives – creating a revenue stream to improve project economics.

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[113] https://www.gov.nl.ca/eccc/files/GHG-Annual-Outcomes-Report-2019-2024-1.pdf
[114] https://www.canada.ca/en/environment-climate-change/services/climate-change/pricing-pollution-how-it-will-work/output-based-pricing-system/federal-greenhouse-gas-offset-system.html
[115] https://www.canada.ca/en/environment-climate-change/services/climate-change/pricing-pollution-how-it-will-work/output-based-pricing-system/federal-greenhouse-gas-offset-system/protocols.html
[116] https://www.canada.ca/en/environment-climate-change/services/climate-change/pricing-pollution-how-it-will-work/output-based-pricing-system.html

Displacement of Waste Management Costs

Organic waste – an important feedstock for various low-carbon fuels – is currently sent directly to landfill in NL. Organic waste makes up approximately 30% of waste that enters into landfills, with much more estimated to be disposed of elsewhere. Landfilling is not free, and therefore there are financial benefits associated with the diversion of this volume of material.

Robin Hood Bay Waste Management Facility in St. John's, NL (Tract Consulting Inc.)

Each region within the province sets a 'tipping fee', or the cost per tonne of waste disposed of at their site(s). Tipping fees can vary depending on the material being disposed and who is disposing of it but, generally speaking, fee ranges from $90.75 per tonne in Eastern Newfoundland[117] to $145 per tonne in Central Newfoundland[118] to $164 in Corner Brook and area[119] (amongst a variety of areas across the province).

[117] Eastern Regional Service Board - https://easternregionalserviceboard.com/residents/fees-and-payment/
[118] Central Newfoundland Waste Management - https://www.cnwmc.com/services/fee-schedule/
[119] Western Regional Waste Management - https://wrwm.ca/corner-brook-area/

Approximately 155,000 MT of organics waste is generated annually in NL with only a small fraction (2.5%) diverted[120]. If all organic waste was diverted at an average tipping fee of $100 per tonne, $15,500,000 in annual savings would be realized. In municipalities, it is often the case that tipping fees are paid by the municipality itself with costs blended into tax rates for residents; in these cases, direct savings are possible for municipalities.

Tipping fees are not a perfect indicator of organic waste management costs as they are often reflective of landfill operational costs and may not cover the true cost of landfill waste (capital expenses, closure/post closure expenses etc.). If organic waste makes up 30% of all waste, landfill operators may face difficulties operating with 30% less revenue from lost tipping fees. 100% diversion of organic waste is also, of course, highly unlikely. However, this serves as a starting point for stakeholders to consider expenses that could be used instead as investments in solutions that are more economically impactful and environmentally sustainable – such as the decarbonization of NL's electricity sector.

Policy Drivers

Canada's CFR were not the first national policy intervention to decrease the carbon intensity of fuels in the country.

The Renewable Fuels Regulations came into force in 2010. These standards required fuel producers and importers across Canada to have an average renewable fuel content of at least 5% based on the volume of gasoline that they produce or import and of at least 2% based on the volume of diesel fuel and heating distillate oil that they produce or import into Canada[121]. Newfoundland and Labrador has a permanent exemption from these regulations for diesel fuel and heating distillate oil to account for logistical challenges in blending in the region[122].

Beyond these regulations, individual provinces have taken additional steps that require fuel blending.

British Columbia established its 'low carbon fuel standard' in 2008 which adds an additional requirement on fuel suppliers to progressively decrease the average carbon intensity of their fuels to achieve a 10% reduction in 2020 relative to 2010[123].

[120] Report on Review of Provincial Waste Management Strategy - https://www.gov.nl.ca/releases/2020/mae/0129n08/
[121] https://www.canada.ca/en/environment-climate-change/services/managing-pollution/energy-production/fuel-regulations/renewable.html
[122] https://stikeman.com/en-CA/kh/canadian-energy-law/2017/08/23/21/19/canada-requires-2-percent-biofuel-content-in-diesel-fuel-and-heating-oil-as-of-july-1
[123] https://www.c2es.org/document/canadian-provincial-renewable-fuel-standard/

Saskatchewan enacted regulations in 2007 establishing an ethanol fuel mandate. The standard requires fuel suppliers to blend their fuel to contain at least 7.5% ethanol for gasoline and 2% ethanol for diesel[124].

Manitoba enacted a regulation in 2007 that established a renewable fuel standard. The standard requires fuel suppliers in the province to blend their fuel to contain at least 8.5% ethanol for gasoline and 2.0% ethanol for diesel[125].

Ontario's Cleaner Transportation Fuels regulation requires that fuel suppliers blend 10% of renewable content in gasoline from 2020 to 2024. The renewable content requirement increases to 11% in 2025, 13% in 2028, and 15% in 2030 and onward. This renewable content must emit 45% fewer greenhouse gas emissions than fossil gasoline on a lifecycle basis before 2030, and 50% fewer from 2030 onward[126].

In **Quebec**, fuel blending requirements for conventional gasoline and diesel are included under the **Regulation Respecting the Integration of Low-Carbon Intensity Fuel Content into Gasoline and Diesel Fuel** (2021). Under this regulation, distributors must include an increasing percentage of low-carbon intensity fuel into gasoline, requiring 10%, 12%, 14%, and 15% by volume in 2023, 2025, 2028, and 2030, respectively. Similarly for distributors of conventional diesel, there is a low-carbon intensity fuel requirement of 3%, 5%, and 10% by volume for 2023, 2025, and 2030, respectively.[127] Under this regulation, qualifying low-carbon intensity fuels are those that are manufactured from organic material, waste materials, or carbon monoxide (CO) and CO_2.

While not strictly related to fuels, in 2022 **Nova Scotia** ordered its utility to use biomass to generate 135,000 MW/h of electricity each year until 2025[128]. In 2025, the province ordered its utility to use biomass to generate 160,000 MW/h of electricity each year until 2027[129].

While the motivations for these policy interventions may differ from GHG reductions to supporting the success of adjacent industries (i.e., agriculture, forestry), it does demonstrate that there is a precedent across Canada for making fuel blending a requirement.

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124 https://www.c2es.org/document/canadian-provincial-renewable-fuel-standard/
125 https://www.c2es.org/document/canadian-provincial-renewable-fuel-standard/
126 https://www.ontario.ca/page/cleaner-transportation-fuels
127 https://www.legisquebec.gouv.qc.ca/en/document/cr/P-30.01,%20r.%200.1
128 https://www.cbc.ca/news/canada/nova-scotia/biomass-forestry-electricity-nova-scotia-power-tory-rushton-1.6691389
129 https://www.cbc.ca/news/canada/nova-scotia/biomass-renewable-energy-electricity-1.7483028

Partnerships

The considerations and supports above are relevant to different potential future actors in the adoption of low-carbon fuels within the electricity sector – from those with feedstock(s), to regional service boards, to project developers and fuel producers, to fuel suppliers and distributors, to municipal, provincial, and federal governments. All are likely to be involved in the low-carbon fuels adoption; there may be opportunities for strategic partnerships between these stakeholders to maximize the opportunity for low-carbon fuels adoption within the electricity sector and to help the province realize the associated environmental, economic, and security benefits.

Other Fuel Demands

Future low-carbon fuels demand in NL is not restricted to the electricity sector.

For example, a recent discussion paper released by econext exploring decarbonization of the marine transportation sector within the province[130] points to expected future demand for RNG, biodiesel, renewable diesel, and methanol. According to research undertaken by econext[131], the demand for low-carbon fuels in the marine sector may dwarf that of the electricity sector.

Moreover, there are significant fuel demands in heavy industry, on-road transportation, and construction sectors which are also potential users of low-carbon fuels.

The above means there are a variety of potential domestic uses for low-carbon fuels produced in NL. As there are myriad fuel pathways for different available feedstocks, analysis will be required to determine what resources should be used for what purpose to maximise environmental, economic, and security benefits for NL.

Safety

The production, handling, transportation, storage, and use of different fuels presents different safety considerations. For example, hydrogen has high ignition energy and flame speed[132]. Ammonia has a low flame speed and has higher toxicity[133]. RNG would also

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[130] https://econext.ca/discussion-paper-marine-transportation-decarbonization-in-newfoundland-and-labrador/

[131] https://econext.ca/discussion-paper-opportunities-for-domestic-clean-fuels-use-in-newfoundland-and-labrador/

[132] https://www.siemens-energy.com/global/en/home/products-services/solutions-usecase/sustainable-fuels.html#Hydrogen-tab-0

[133] https://www.siemens-energy.com/global/en/home/products-services/solutions-usecase/sustainable-fuels.html#Ammonia-tab-1

present different considerations as natural gas is not used in NL and users would not be used to its characteristics. Each of these fuels (or their chemically identical conventional alternative) have been widely and globally used at scale safely for many years. Processes, procedures, and measures exist that allow for their safe use. However, as these fuels would be 'new' to NL, a degree of training and skills development would be required in advance of their domestic use. This is the subject of a future econext discussion paper.

Culture

Culture plays a role in the acceptance of different products and process. Those engaged in the adoption of low-carbon fuels have reported resistance to change from front line personnel. It is econext's experience that there is a very low level of understanding in NL on the important benefits that low-carbon fuels can yield. As the province has had an exemption from the Renewable Fuel Regulations, the concept of blended fuels is not commonly known. Continued education, testing, and demonstrations are needed to demystify low-carbon fuels and the benefits that they can present to NL.

Fuel Blending and Testing Capabilities

Fuels can be blended in liquid, gaseous, or solid forms, with liquid blending being the most common.

Effective liquid blending often requires precise flow measurement, calibrated equipment, filtration, and sampling to manage risks such as phase separation, contamination, incorrect blend ratios, cold-weather gelling (particularly for biodiesel), corrosion, and clogging. Gaseous blending most commonly involves injecting hydrogen into natural gas pipelines, with blend limits determined by infrastructure constraints and safety considerations such as hydrogen embrittlement and energy density differences[134].

There are many different possible fuel blends with optimizations unique to their specific use cases and application. As industry is averse to affecting the integrity of their equipment, the safety of their employees, and the experience of its customers – risks to low-carbon fuels adoption must be mitigated to greatest extent possible. This is true for most industry, but particularly the electricity sector which is highly regulated and scrutinized for the attention it pays to grid reliability and safety.

To achieve this risk mitigation and enable the adoption of low-carbon fuels, adequate research and deployment capabilities in terms of equipment and personnel is required.

[134] Forthcoming discussion paper from econext on Fuel Blending

The availability of accessible blending and testing equipment appears to be scarce. econext is undertaking work to delineate capabilities in Canada that can be leveraged and gaps that may need to be filled within NL to advance the adoption of low-carbon fuels.

8. Recommendations

Further analysis of low-carbon fuels adoption possibilities within NL's electricity reveal a number of next steps which should be taken in order for environmental, economic, and energy security benefits to be realized.

8.1 Identify capacity for current generation infrastructure for low-carbon fuels adoption

A definitive understanding of the degree to which current generation assets and equipment can accommodate low-carbon fuels (i.e., biodiesel, renewable diesel, natural gas, RNG, hydrogen) is required. This investigation will be specific to each technology, its manufacturer and warranty, and its application. The investigation should include the identification of challenges and barriers specific to each context. With this information, more informed decision-making can occur regarding strategies to adopt low-carbon fuels.

8.2 Define best use cases for available biomass in NL and techno-economic feasibility of low-carbon fuels production

There are multiple fuel production pathways using locally available biomass that are relevant in the electricity generation context. Moreover, there are multiple different sources of biomass that each has their own characteristics influencing how they would be best used in fuel production. Lastly, there are other fuel demands that are expected to arise over time – particularly in support of marine transportation decarbonization. A techno-economic analysis is required to determine the best end uses at a provincial level for each of these organic waste materials (in addition to landfill gas) and the feasibility of low-carbon fuel production and adoption business cases. This study should include research identifying the best available commercial technologies that align with best use cases and the NL context, as well as consideration for the various supports and frameworks (i.e., ITCs, CRF, CER, waste diversion, etc.) that can impact economics.

8.4 Implement required policy and regulatory adjustments

As some of the low-carbon fuels identified in this discussion paper would be 'new' in the NL context, stakeholders must understand any policy and/or regulatory barriers that exist for their production and use. In addition, policies that relate to inciting supply and demand of low-carbon fuels should be investigated. For example, it is known that there would be benefit to the expansion of federal Clean Hydrogen ITCs to include fuel derivatives in addition to ammonia (e.g., e-methanol, LOHC). In addition, consideration could be given to policies that incentivize or even require the use of blended fuels in certain applications (i.e., electricity generation).

8.5 Align provincial climate and energy strategy with domestic production capabilities

The fact that renewable diesel is already in production in NL should drive low-carbon fuels adoption decision-making in the near term as it is directly compatible with all of the existing generation assets and equipment. Meanwhile, if and when final investment decisions are made on hydrogen production projects in NL and development commences, this development should drive low-carbon fuels adoption decision-making in the medium and long term. Hydrogen is present – in one shape or form – in a variety of low-carbon fuels adoption pathways. Only when locally produced low-carbon fuels are used are the full benefits relating to environment, economy, and energy security realized.

8.6 Invest in fuel blending/testing research and infrastructure

To overcome industry risk aversion with the adoption of new technologies, adequate research and development capabilities in terms of equipment and personnel is required. These capabilities must be relevant to the NL context and accessible. Blending and testing capabilities are understood to be few and difficult to access in Canada, presenting an opportunity for the province to create facilities that would be in-demand and attract interest and investment. The testing of biodiesel and renewable diesel blends in real-world NL scenarios should be an immediate priority, followed by hydrogen and relevant derivates.

9. Conclusion

There are important benefits to be realized from the adoption of low-carbon fuels in NL's electricity sector: decreased GHGs; reduced air pollutants; increased energy security; more availability of dispatchable energy; the valorization of wasted biomass resources; and economic development and growth within NL.

There are challenges to overcome, including utility mandates (around cost and reliability), guaranteed fuel supplies, logistics and storage, safety, and the need for testing, demonstration, and optimization.

NL's current and future electricity generation assets are compatible with proven and commercialized low-carbon fuels like biodiesel and diesel. Meanwhile, combustion turbines may have the potential to run on RNG, RNG/hydrogen blends, and/or exclusively hydrogen with modifications.

NL can advance the adoption of low-carbon fuels in its electricity sector by: (1) identifying capacity for current generation infrastructure for low-carbon fuels adoption; (2) defining best use cases for available biomass in NL and techno-economic feasibility of low-carbon fuels production; (3) implementing required policy and regulatory adjustments; (4) aligning provincial climate and energy strategy with domestic production capabilities; and (5) investing in fuel blending and testing infrastructure.

Appendix A:

List of Electricity Generation Assets in Newfoundland and Labrador

ASSET	MW
Hydro	
Churchill Falls Hydroelectric Generating Facility (5,428 MW)	5428
Muskrat Falls Hydroelectric Generating Facility (824 MW)	824
Bay d'Espoir Generation System	729
Cat Arm Hydroelectric Generating Station (127 MW)	134
Exploits System	80
Hinds Lake Hydroelectric Generating Station (75 MW)	75
Menihek Hydroelectric Generating Station (18 MW)	18
Paradise River Hydroelectric Generating Station (8 MW)	8
Roddickton Hydro Plant (0.4 MW)	0.4
Deer Lake Hydroelectric Generating Station Lake (126 MW)	129.6
Petty Harbour Hydroelectric Generating Station (4.9 MW)	4.9
Pierre's Brook Hydroelectric Generating Station (4.3MW)	4.3
Tors Cove Hydroelectric Generating Station (6.9 MW)	6.9
Rocky Pond Hydroelectric Generating Station (3.3 MW)	3.3
*Mobile Hydroelectric Generating Station (12 MW)	12
Cape Broyle Hydroelectric Generating Station (6.3 MW)	6.3
*Horse Chops Hydroelectric Generating Station (8.3 MW)	8.3
Topsail Hydroelectric Generating Station (2.6 MW)	2.6
Seal Cove Hydroelectric Generating Station (3.5 MW)	3.5
Heart's Content Hydroelectric Generating Station (3.5 MW)	3.5
New Chelsea Hydroelectric Generating Station (3.7 MW)	3.7
*Morris Hydroelectric Generating Station (1.1 MW)	1.1
Rattling Brook Hydroelectric Generating Station (15.1 MW)	15.1
Sandy Brook Hydroelectric Generating Station (5.5 MW)	5.5
Lockston Hydroelectric Generating Station (3 MW)	3
Port Union	
Lookout Brook Hydroelectric Power Station (6.2 MW)	6.2
Rose Blanche Brook Hydroelectric Power Generating Plant (6 MW)	6
Fall Pond	
Victoria	
Pittman's Pond	
West Brook	
Lawn	
Snooks Arm and Venams Bight (1 MW)	
Watsons Brook Hydroelectric Generating Station (9 MW)	
Norris Arm Rattling Brook Hydroelectric Generating Station (12.5 MW)	
Mary's Harbour Renewable Project (Hydro)	0.2

Thermal Generation / Combustion Turbines	
Holyrood Thermal Generating Station	490
Holyrood Combustion Turbine	123.5
Stephenville Diesel Generating Station	50
Hardwoods Diesel Generating Station	50
Happy Valley Goose Bay Gas Turbine	25
Wesleyville Gas Turbine	8
Greenhill Gas Turbine	20
Mobile Gas Turbine	6
Mobile Gas Turbine #2	5
Diesel Generation	
Port aux Basques Diesel	2.5
Mobile Diesel	3
St. Anthony Diesel Generating Station	9.7
Hawkes Bay	
St. Brendan's Diesel Generating Station (0.712 MW) - Off-grid (Island)	0.712
McCallum Diesel Generating Station (0.446 MW) - Off-grid (Island)	0.446
Francois Diesel Generating Station (0.635 MW) - Off-grid (Island)	0.635
Grey River Diesel Generating Station (0.522 MW) - Off-grid (Island)	0.522
Ramea Wind-Diesel Energy Project (3.165 MW) - Off-grid (Island)	3.165
L'Anse au Loup Diesel Generating Station (8 MW) - Off-grid (Labrador)	8
Mary's Harbour Diesel Generating Station (2.54 MW) - Off-grid (Labrador)	2.5
St. Lewis Diesel Generating Station (1 MW) - Off-grid (Labrador)	1
Port Hope Simpson Diesel Generating Station (2.3 MW) - Off-grid (Labrador)	2.3
Charlottetown Diesel Generating Station (2.5 MW) - Off-grid (Labrador)	2.5
Norman's Bay Diesel Generating Station (0.16 MW) - Off-grid (Labrador)	0.2
Black Tickle Diesel Generating Station (1 MW) - Off-grid (Labrador)	1
Cartwright Diesel Generating Station (2.45 MW) - Off-grid (Labrador)	2.5
Paradise River Diesel Generating Station (0.15 MW) - Off-grid (Labrador)	0.2
Mud Lake - Off-grid (Labrador)	
Rigolet Diesel Generating Station (1.3 MW) - Off-grid (Labrador)	1.3
Makkovik Diesel Generating Station (2 MW) - Off-grid (Labrador)	2
Postville Diesel Generating Station (1 MW) - Off-grid (Labrador)	1
Hopedale Diesel Generating Station (2.6 MW) - Off-grid (Labrador)	2.6
Nain Diesel Generating Station (3.945 MW) - Off-grid (Labrador)	3.9
Natuashish Diesel Generating Station (4.3 MW) - Off-grid (Labrador)	4.3
Other	
St. Lawrence Wind Farm	27
Fermeuse Wind Turbine Power Project	27
Corner Brook Biomass Cogeneration Plant	17.6

Mary’s Harbour Renewables Project (Solar)	0.2
Nunatsiavut Community Solar Projects	0.121
New World Dairy (Anaerobic Digester)	0.4
TOTAL	**8428.201**

List derived from public sources including:

- http://www.pub.nl.ca/indexreports/20152019energysupply/From%20NLH%20-%20Energy%20Supply%20Monthly%20Report%20-%20December%202025%20-%202026-01-19.PDF
- https://opendata.gov.nl.ca/public/opendata/page/?page-id=datasetdetails&id=681
- https://nlhydro.com/wp-content/uploads/2025/06/Newfoundland-and-Labrador-Hydro-2024-TAA-FINAL-For-Web.pdf
- http://www.pub.nl.ca/indexreportspages/energysupply.php
- http://www.pub.nl.ca/applications/NLH2025AvalonCombustionMarch/report/Bates%20White%20-%20Expert%20Report%20-%20Assessment%20of%20NLHs%20-%202024%20Resource%20Adequacy%20Plan%20-%202024-08-30.PDF

No information found for facilities listed with no generation quantity, but capacity likely very low in each case.