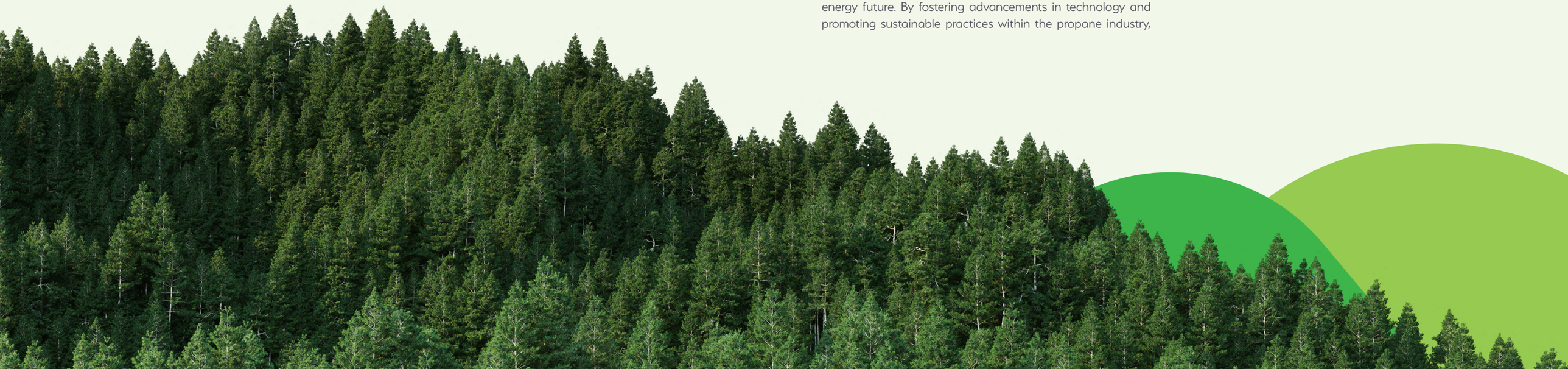
Febuary 2024

# Propane Decarbonization Roadmap for *Canada*

Canadian Propane Association
Association canadienne du propane

# Decarbonization *pathway*







# Foreword

**Shannon Watt**
President and CEO

As Canada progresses toward a future powered by clean energy, the propane sector is ready and willing to do its part. It is my pleasure to present the Canadian Propane Association's ***Propane Decarbonization Roadmap for Canada***.

While propane is already a low-carbon energy choice, the industry is charting its path to produce renewable propane to reduce its emissions even further. Renewable propane can provide up to 85% emissions savings and even more under certain conditions.

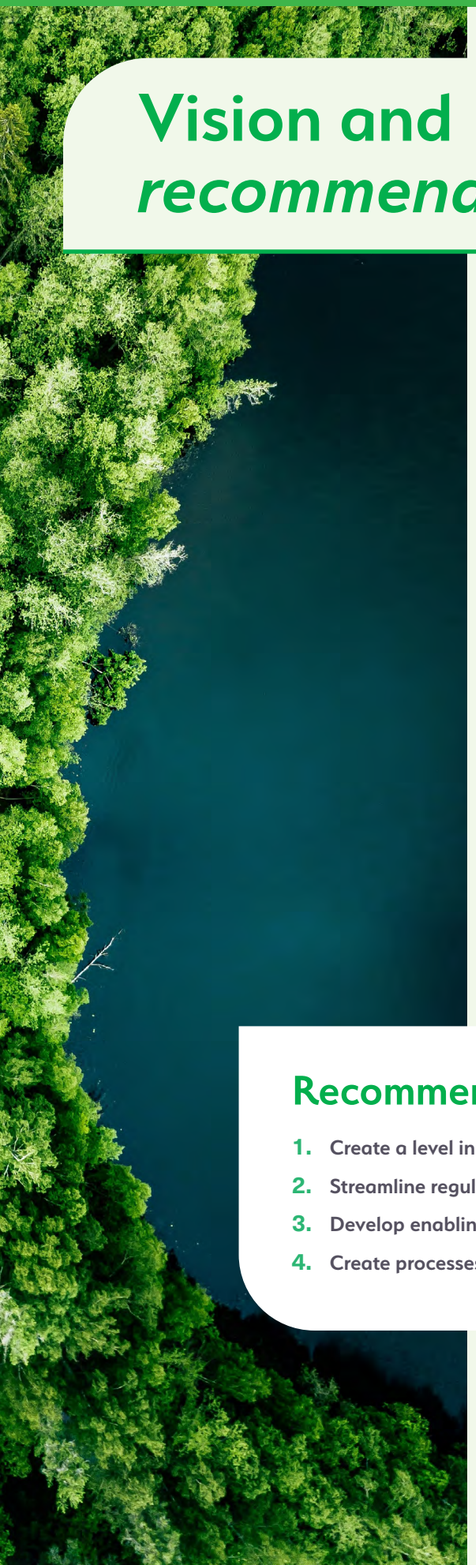
Canada must prioritize investments in renewable propane to safeguard energy security and community resiliency. Propane is crucial for agriculture, industry, transportation and remote, rural and Indigenous communities, offering a dependable and affordable solution, while also serving as critical backup energy for renewables and during emergencies when the grid fails.

This "all of the above" approach not only supports Canada's emissions reduction goals but also ensures that every Canadian has access to a reliable, affordable, and sustainable energy source in the pursuit of a cleaner and more equitable energy future. By fostering advancements in technology and promoting sustainable practices within the propane industry, Canadians can continue to rely on this essential energy while minimizing overall environmental impacts. The ongoing evolution of the propane sector holds promise for a cleaner and more sustainable energy future.

Already available on the market today in other countries, renewable propane allows homes and businesses to significantly reduce their carbon footprint without expensive retrofitting or changes to heating systems. We must act now to capitalize on the advantages Canada has to produce its own renewable propane.

This document outlines key actions that we believe governments must take to make renewable propane available in Canada, along with a roadmap of the viable pathways and opportunities for us to get there.

Canadians deserve an energy transition that is fair, affordable, and achievable. We look forward to engaging with the government and all stakeholders to make renewable propane a reality for Canada.



# Vision and *recommendations*

## Roadmap to Renewable Propane

The Canadian Propane Association (CPA) has developed a roadmap for scaling up the production of renewable propane in Canada. By doing so, the CPA and its members can achieve emissions reduction objectives while ensuring end-use resiliency. Canada's diverse landscape, including remote communities and a cold northern climate, underscores the importance of an adaptable energy policy that addresses regional needs and challenges. The emergence of renewable propane and renewable dimethyl ether (renewableDME) can help drive Canada to support the ongoing energy transformation affordably and equitably for transportation, agriculture, industry and commercial use.

## Our Objectives are to

1. Secure government support to incentivize renewable propane production.
2. Ensure renewable propane availability in Canada by 2030.

## Recommendations to Government

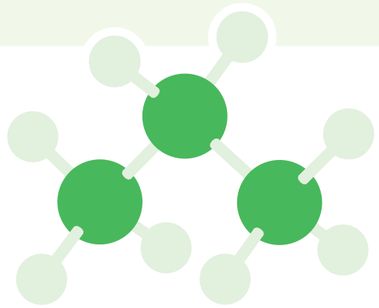
1. **Create a level incentive playing field for propane, in alignment with all other biofuels.**
2. **Streamline regulatory processes.**
3. **Develop enabling regulatory programs to recognize renewable propane.**
4. **Create processes to enable renewable propane and propane blends to reach markets.**



# Why invest in *renewable* propane?

- **Meet Growing Energy Demand:** To meet Canada's emissions reduction goals, the economy will need to be powered by two equally important energy sources – clean power and clean fuels. All energy alternatives are needed to reduce emissions while ensuring reliable and affordable energy for all Canadians.

  Currently, low-carbon fuels make up less than 6% of Canada's total energy supply. Even in an ambitious electrification scenario, it is estimated that 60% or more of national energy demand could be met with clean fuels to achieve net zero in 2050.
- **Canada's Potential:** Canada can be a world leader in renewable propane given our expertise, existing infrastructure, and natural resources.
- **Technology Exists Today to Produce at Scale:** Renewable propane and renewableDME are drop-in ready, leveraging existing infrastructure and the continued use of current appliances and vehicles while significantly reducing GHGs.
- **Cross-Sectoral Application:** Propane offers the opportunity to reduce carbon emissions in various sectors of the economy such as transportation and buildings.
- **Community Resiliency:** Scaling up renewable propane enhances energy security and enables economic benefits and jobs while reducing emissions.

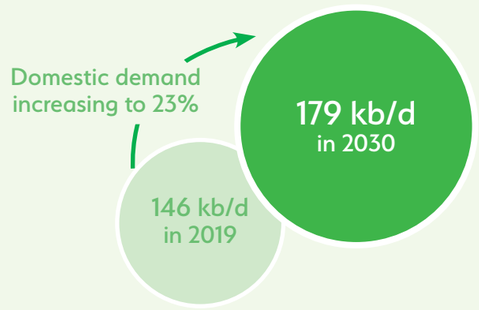


Propane and renewable propane share the same chemical formula, composed of carbon and hydrogen atoms – chemical symbol $C_3H_8$.

# What is propane?

Propane is essential to Canada's energy mix, ensuring millions of homes and businesses have access to an affordable low-carbon energy source with unmatched distribution infrastructure and versatility. Millions of Canadians use propane for heating, hot water, cooking, and power generation at home, work, and on the road and powers essential services such as school buses, fleets, farms, hospitals, and numerous other applications.

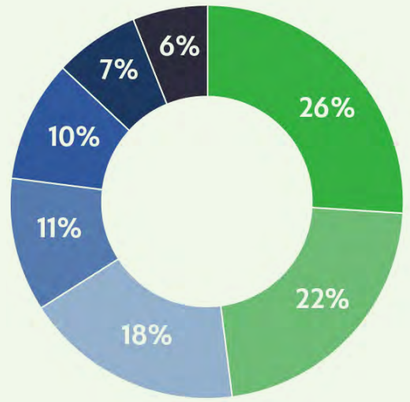
***Demand for propane is growing,*** **especially in areas not connected to natural gas or electricity grids.**




- **Environmentally Friendly:** **Propane is one of the cleanest** burning conventional fuels. It has minimal impacts if accidentally released to water, air or land, and produces significantly less air pollution.
- **Secure and Stable Supply:** **Canada has an abundant amount** of propane and production is expected to continue to increase. It is a critical part of Canada's energy mix and is safely transported to and used in every corner of the country.
- **Versatile:** Propane is easily liquefied and is stored and transported in pressurized cylinders, making it a versatile energy source that can be used almost anywhere.
- **Efficient:** Propane furnaces heat at **90% efficiency,** compared to oil furnaces which operate at a less efficient 60%. Appliances and furnaces that run on propane also have a longer life span, making them an efficient long-term choice.
- **Affordable:** Propane stands out as an economical and low-emission choice, with lower fuel prices, superior efficiency, **reduced long-term maintenance expenses,** and lower infrastructure costs when compared to electric and compressed natural gas alternatives.
- **Ideal Hybrid Solution:** Propane is a highly efficient energy source with long-term storage capability, making it ideal to pair with **hybrid technologies** and renewable energies such as solar and wind.

***Recognized for its low emissions and environmental impact by Canada's Alternative Fuels Act, propane is one of the cleanest and most versatile energy sources in existence.***

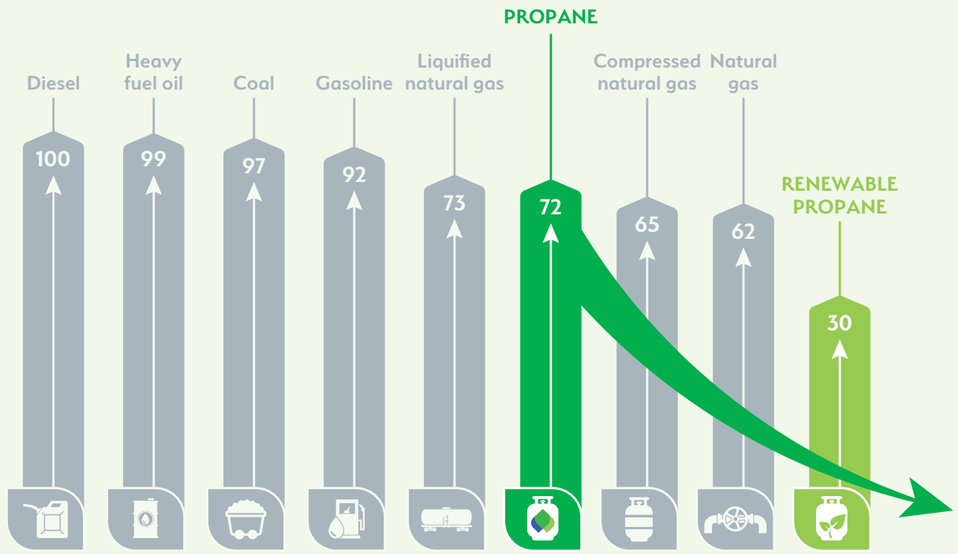





## Propane demand by sector in 2020

- Commercial / Institutional
- Non-energy use & producers' consumption
- Residential
- Transportation
- Mining & oil and gas
- Agriculture
- Manufacturing & construction

## Lifecycle Emission Intensities for Canadian Energy




**Canadian propane has a low emission intensity compared to other fuels: 72 $gCO_2e/MJ$. Renewable propane lifecycle emissions are typically less than half of conventional propane and in certain conditions, they can be even less.**

# What is Renewable Propane?

**Renewable propane** can be made from a variety of renewable feedstocks. The most common form of renewable propane today is a byproduct of renewable diesel and sustainable aviation fuel made primarily from plant and vegetable oils, animal fats, or used cooking oil.

Renewable propane shares an identical molecular structure with conventional propane derived from hydrocarbons - $C_3H_8$, offering all the same benefits of reliability, portability, and power. It can be used alone or in blends with other renewable sources such as DME (dimethyl ether) or low-carbon energy, including conventional propane.

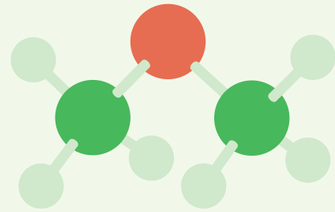
DME is already used extensively worldwide, mainly in industrial settings. It is a colourless gas chemically similar to propane and like propane, it is easy to handle and store in liquid form. **RenewableDME** is produced from renewable feedstocks, such as agricultural and municipal waste, renewable power and $CO_2$, substantially reducing carbon emissions by up to 85%.

## Renewable propane and renewable feedstocks:




# What is RenewableDME?

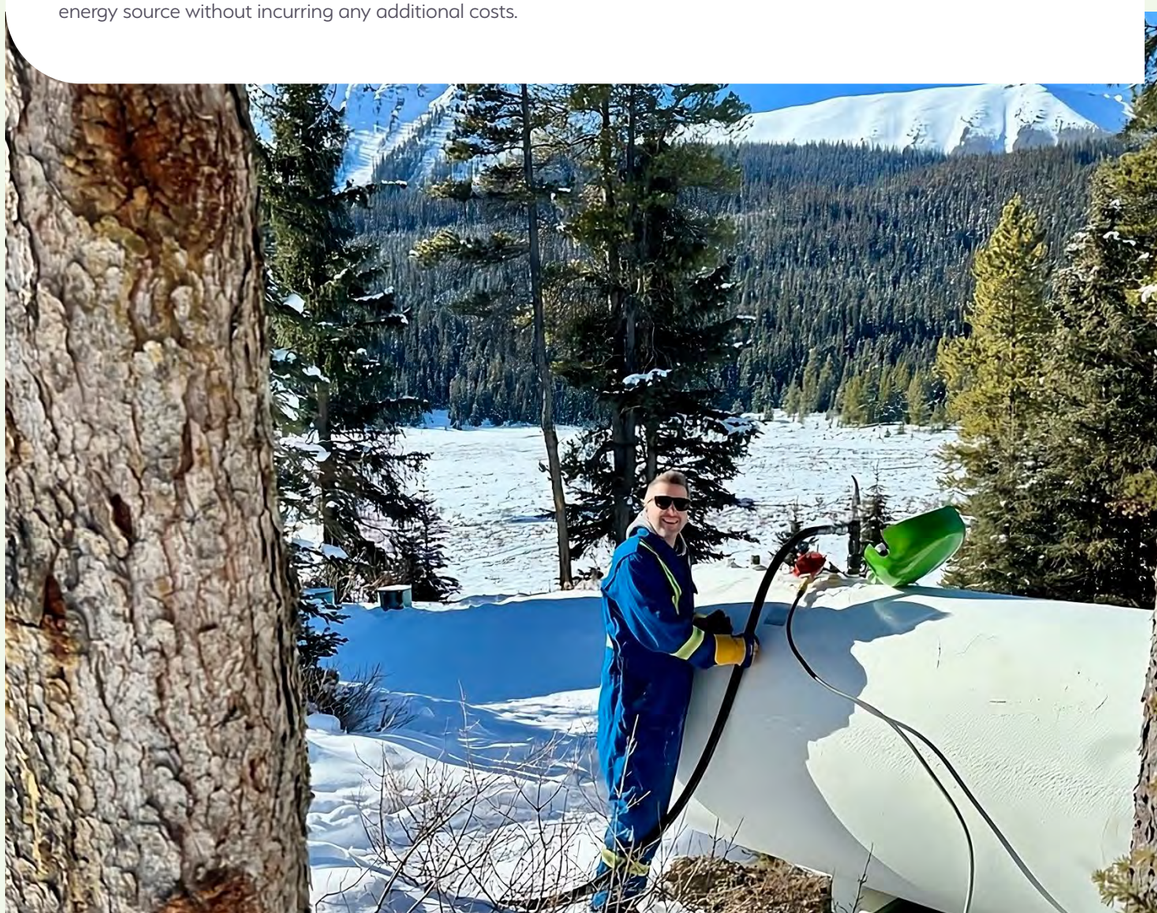
RenewableDME is a clean, colourless, non-toxic gas that is easy to liquefy and transport. At standard temperature and pressure, it is a gas, but it can be liquefied under moderate pressure, similar to propane for storage and handling.



RenewableDME/DME
Chemical symbol $CH_3$ $OCH_3$

## A Drop-In Solution

Renewable propane or propane blended with renewableDME are considered 'drop-in' solutions allowing consumers to continue enjoying the benefit of gas without having to purchase new equipment. Renewable propane is compatible with all existing propane equipment, such as furnaces, water heaters, stoves, and grills, as well as vehicles that run on auto propane. This means that consumers can easily switch to renewable propane and enjoy the benefits of a low-carbon energy source without incurring any additional costs.



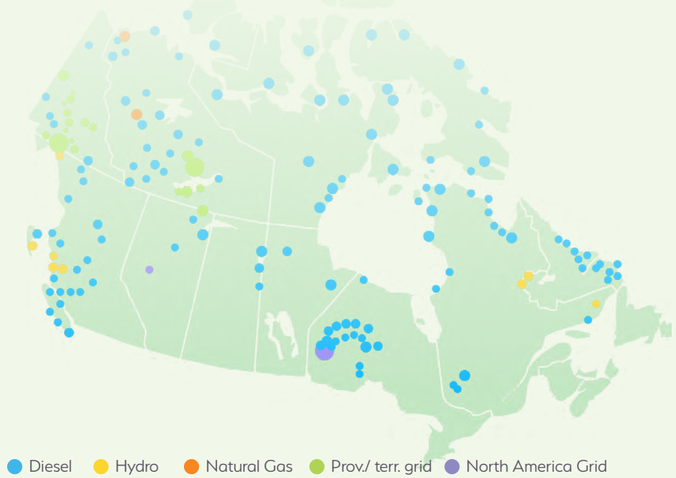
# The Renewable Propane Advantage

**Price and efficiency matters:** As renewable propane is a 'drop-in' fuel, propane infrastructure is already prepared for the future, no retrofitting or new equipment is required.

**Strategic advantages over other renewable fuel options and electrification:** Storability, portability, and versatility for many end-use applications from heat to transport including the possibility of being a low GHG non-HFC refrigerant for refrigerators. It is also less expensive than other fuel options like renewable diesel and hydrogen.

**Ideal pairing with electric heat pumps:** Heat pumps need a primary heat source from a conventional fuel source – renewable propane is ideal due to its high efficiency and long-term storage capacity. It can also be used as a non-HFC refrigerant for heat pumps.

## Canada's Remote Communities Overview




Source: Natural Resources Canada

**Cost-effective energy solution for off-grid:** About 200,000 people live in rural and remote regions across Canada. Hybrid energy systems could provide a cost-effective energy solution for off-grid and remote buildings, facilities and communities.

**Support local development and waste capture:** Producing renewable propane is a smart way to use small, distant sources of biogas like those from farms and waste. It helps local growth, and it also collects and uses waste gases such as methane and carbon dioxide.

**Low-cost production:** Renewable propane production costs per unit of energy are relatively low, making it a good option for many uses and providing a significant opportunity to reduce carbon emissions in Canada at a low cost, especially in remote and rural areas.



# Pathways to Renewable Propane and renewableDME

Currently, renewable propane is being globally produced in biorefineries linked to petroleum refineries. This process involves the hydrotreatment of vegetable oils or animal fats to produce liquid biofuels. In this case, the technology is mature, but renewable propane is a by-product that is currently not marketed externally in Canada, as it is in other jurisdictions such as the U.S.

The first-of-kind renewable propane production pathways that hold the most promise of being commercialized in the near-term are gasification technologies that use inexpensive materials like wood waste and using a catalyst to transform biogas wastes to renewable propane or renewableDME.

| Feedstock | Pathway Process | | Products | Range |
|---|---|---|---|---|
| Vegetable Oils, Animal Fats | Biorefinery (hydroprocessing / hydrotreating) | | Biopropane (2-7% byproduct) | 10 to 80 |
| Green Electricity for Hydrogen | Hydrogen carriers in propane infrastructure | | Green ammonia transported in propane infrastructure | 0 to 20 |
| Wood, Agriculture residues | Conversion of biomass into gas through biochemical processing | Methanol to liquid to bioDME or biopropane | Biopropane (10-30% byproduct), bioDME | -76 to 40 |
| | | Fischer-Tropsch | Biopropane (1-3% byproduct) | 5 to 17 |
| | | Pyrolysis - Hydrotreating | Biopropane (2-10% byproduct) | 4 to 27 |
| Biogas from wastes (e.g., manure, sewage) | Converting biogas through catalytic reforming | Upgrading | Biopropane | -200 to 80 |
| | | Distillation of Biomethanol and Upgrading | Biomethanol, rDME | -200 to 80 |
| Glycerine / Glycerol | Dehydration / Hydrogenation | | Biopropane | NA |
| Sugars / Starch | Aquaeous Phase Reforming | | Biopropane | 10 to 20 |
| | Fermentation | | Biopropane | 10 to 20 |
| Atmospheric or Captured CO2e | Use of carbon capture and hydrogen electrolysis to produce E-fuels | | Many possible products including biopropane | 0 to 20 |

(<--decreased) Technology Readiness Level (increased ->)

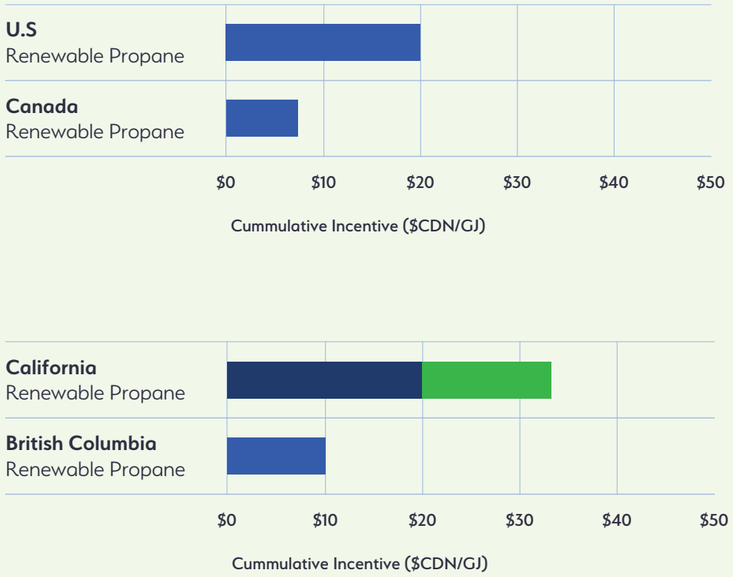
# Production Cost Incentives

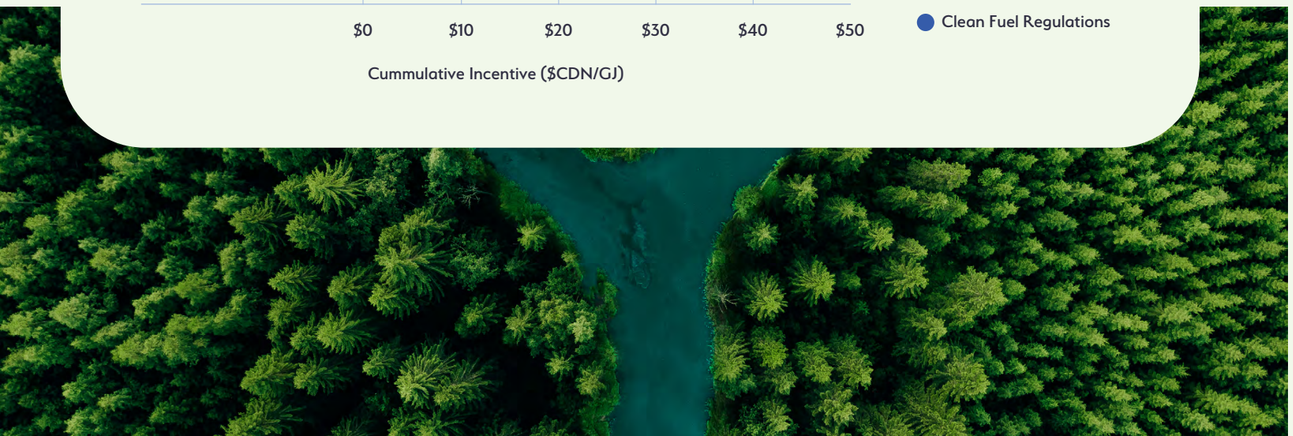
The U.S. is at the forefront of producing renewable propane and renewableDME. **Canada must grasp our opportunity to decarbonize the propane fuels market quickly and efficiently.**

Incentives can drastically increase the production of renewable energies, as exemplified with the production of renewable diesel, which increased from 968 million gallons in 2020 to almost 1,900 billion gallons in 2022 – a doubling in two years.

Should propane producers and retailers in Canada have access to incentives akin to those available in the U.S. for renewable propane, it is expected that many first-of-kind renewable propane production facilities could be built in Canada. Incentives would offer a cost-effective and efficient route to decarbonization, particularly for challenging-to-electrify applications.

**Production Cost Incentives Comparison - Canada vs U.S.**





# Benefits of Fuel Switching to Propane

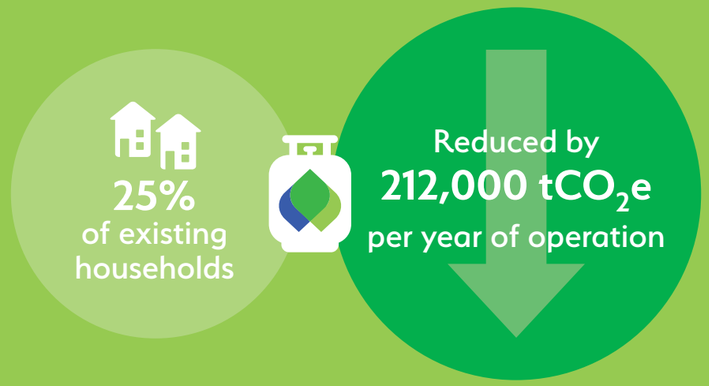
Case Studies I

## Heating Oil Furnaces

Switching out inefficient heating oil furnaces with propane furnaces is a cost-effective, lower-emitting solution that can reduce Canada's greenhouse gas emissions.

**There are about 440,000 households using heating oil as a primary source of heat in Canada. Switching these oil furnaces to propane can offer considerable emission and cost reductions.**

**As an example, if 25% of existing households with heating oil furnaces were switched to propane, GHG emissions could be reduced by 212,000 $tCO_2e$ per year of operation.**




Footnote: These calculations are based on lifecycle analysis and could be achieved for the lifetime of the furnaces (at least 10 years)

# Benefits of Fuel Switching to Propane

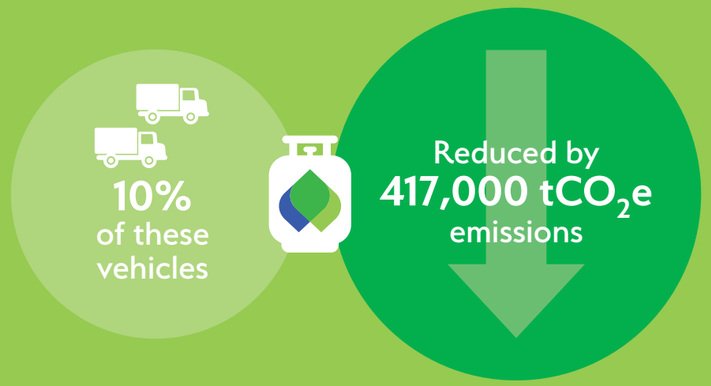
Case Studies II

## Commercial non-passenger medium-duty trucks and vans

Switching from gasoline or diesel to propane for smaller commercial trucks and vans can save money and reduce emissions. This is especially beneficial for fleets that are not yet using electric vehicles, and where propane options are readily available. This case study focuses on medium-duty trucks and vans that weigh between 4.5 to 12 tonnes, excluding larger tractor-trailers and smaller pickup trucks.

**In Canada, there are approximately 113,000 vans and 151,000 trucks in this category.**

**If around 10% of these vehicles (about 26,000) switch to propane, it could lead to a yearly reduction of 417,000 tons of $CO_2$ emissions.**




Footnote: These estimates are based on a vehicle's entire lifespan, which is at least 10 years.

**Switching on-road vehicles from gasoline or diesel to propane can have cost-saving and emission-reduction benefits. Targeting smaller commercial truck and van fleets where electric options are not yet available and where propane vehicles and conversions are readily available may be the most attractive option.**



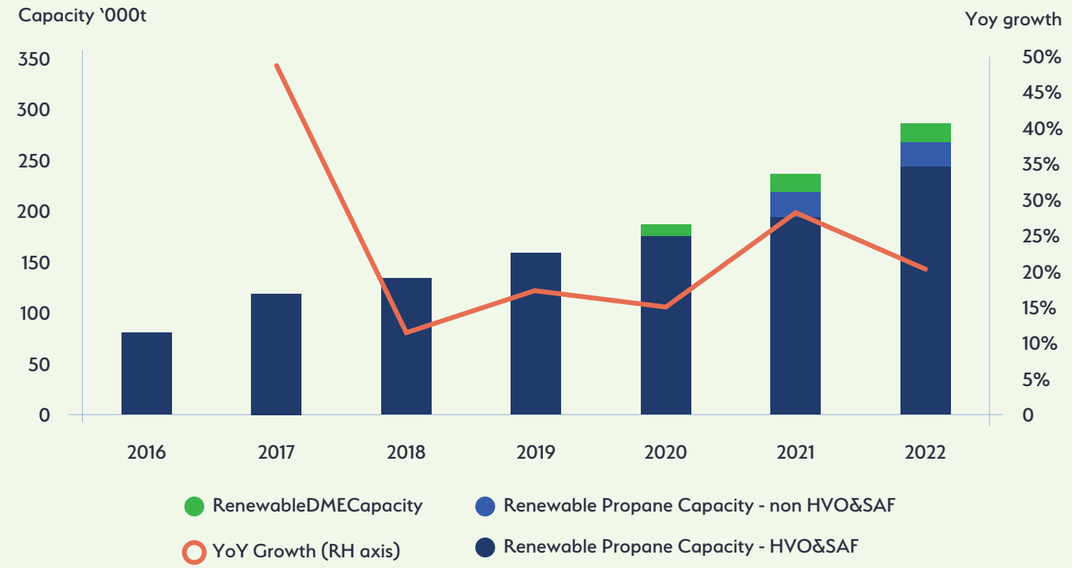
# A Global Perspective

Propane serves as a crucial energy source for billions of people worldwide for cooking, heating, generating power, cleaning and drying clothes, and powering automobiles and equipment such as forklifts. **Canada exports over 50 per cent of its propane, with growing demand from South Korea, Japan and Mexico markets.**

Renewable energy sources that check all the boxes – clean-burning, versatile, and have a dual role as both a petrochemical feedstock and a compatible energy source within established propane infrastructure – can be key players in the energy transformation.

**There is a significant opportunity for the growth of renewable propane and renewableDME on a global scale with the market consistently growing at double-digit rates year after year.** Large-scale production facilities are becoming more prevalent, and forecasts suggest that production will surpass 500,000 tons per year by 2025, driven by announced projects and anticipated further investments.

## Renewable propane capacity growth




Source: Statistical Review of Global LPG 2022 - World Liquid Gas (WLGA)

***Asian propane import needs will continue to grow in the coming decades, supporting higher Canadian exports.***

***Sub-Saharan Africa is a significant untapped market with the most potential growth in the long term.***

# Propane in Action

## Transition to propane provides clean solution

The surge in housing demand in Nova Scotia, particularly from individuals migrating from Ontario in search of a simpler lifestyle, is evident. Such was the case for Tom MacKenzie and his wife who traded in the city for small-town life in Pictou County, Nova Scotia – where they both were raised.

The Mackenzie's bought a 3,000 sq ft, 140-year-old historic home in New Glasgow. Their new purchase, like most homes in the area, where natural gas is not available, was heated with oil so their focus was to find a cleaner solution. The couple chose propane, not just for heating, but for their appliances too.

***"For us, it was really about trying to maximize propane wherever we could in the home. It's single source, fairly clean and environmentally friendly. So, we wanted to be able to use it wherever we could."***

## Propane buses a positive start to the day for students

The Brandon School Division spans a vast Manitoba area of 1,300 sq. kms, with Ron Harkness overseeing 34 buses transporting 3,000 students daily. Facing harsh wind chills reaching minus 50, the district tackled cold start challenges by embracing propane buses in 2014. Propane brought enhanced reliability in cold weather, faster and warmer bus heating compared to diesel, and eliminated the previous issue of 30 to 40 percent of buses not starting in extreme cold.

Health reasons were another impetus for the change. ***"We have a central yard where all our buses are parked," says Ron. "Having all those diesel buses starting up in cold weather together caused a diesel fog, which is not healthy at all. We have a huge increase in air quality now with the size of the propane fleet we have."*** Ron highlights drivers' positive feedback, citing warmth, easy starts, reliable performance, and reduced noise, which also provides a positive start to the day for students.

## Keeping the family farm going

Lindsay Masse is a fourth-generation farmer at Masse Bros Farms in Starbuck, Manitoba. He's joined by his father and uncle in producing corn, soybeans, oat, wheat and flax. For Lindsay and his family, keeping the farm going during the ups and downs of weather and – more recently – inflation, means embracing technology and innovating. One thing that's proven reliable during unsettled times is the propane used for heating buildings and drying grain – especially corn.

What most impresses Lindsay about propane is the supply: ***"It's amazing. Maybe I'm just lucky, but we use a lot of propane during the drying season. You can call those guys and there'll be a truck in your yard in an hour or a few hours. We've never had to shut something down waiting for propane...They work just as hard as we do come drying season."***

## Living and Working Off-grid

Craig Timmerman decided to pull the plug in 2020. While moving his business, which includes two radio stations, to an 84-acre parcel of land he owns in Little Current, Northern Ontario, the province's electric utility quoted him $80,000 to get connected.

Solar and propane were the perfect solution. "***When I looked at all the different heating systems, I found that propane is hands down the most efficient." Solar-generated electricity runs the air conditioning in summer. The system has been amazingly reliable," he says. "Even on cloudy days we are producing electricity."***

The house the Timmermans are now building at the same site will run exclusively on propane. He wanted propane appliances due to their efficiency. ***"A propane cooking stove is the best cooking appliance...The heat is continuous, it's instant. It just works so well."***

## Propane indispensable for construction projects

For Jeff Goodwin and the team at Shaw Steel, propane is indispensable as the energy they need to meet customers' demands. "We use propane to heat our equipment because we're in a 600-foot-long space with a roof and no walls. We need to pump heat to the equipment to keep hydraulic and pneumatic systems working; sometimes they don't like [being outside]."

***"The nature of the business means that propane is a good solution...There's not an endless supply of natural gas; in cases like that, you need to supplement it with propane. Propane is just a perfect fit," he says. "It's quick heat, fast and reliable."***

# About the Canadian Propane Association

The Canadian Propane Association is the national association representing the Canadian propane industry. With members across Canada, the CPA represents every segment of a growing, multi-billion-dollar propane industry that impacts the livelihood of millions of Canadians. Our members are an influential group and include producers, wholesalers, transporters, retailers, manufacturers, distributors and service providers of equipment and appliances, and associated industries.

As the trusted voice of the propane industry, the CPA creates the conditions for responsible market growth through advocacy, training, and emergency response.

Collaborating with government bodies and regulators, we prioritize health and safety standards while actively promoting the interests of Canadian propane businesses. We help the industry stay abreast of regulatory and safety requirements, providing forums for the industry to collaborate on best practices and offer industry training through the CPA's Propane Training Institute. The CPA's subsidiary, Emergency Response Assistance Canada, provides rapid and effective emergency response services for incidents involving liquid petroleum gas and flammable liquids, enhancing the overall safety and resilience of the propane industry in emergencies.

Looking ahead, the CPA envisions propane as a safe, innovative, and accessible energy choice crucial to Canada's low-carbon future and a key player in shaping a sustainable energy landscape for the nation.



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