



Unlocking Canada's Biofuel Potential

Addressing Policy Gaps for a Sustainable Future

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Executive Summary

Global demand for renewable fuels is projected to rise from 18.6 billion liters in 2023 to 26.4 billion liters by 2028, which translates to an annual compound growth rate of about 7.2%, according to forecasts by the International Energy Agency—signaling that biofuels are poised to play a major role in global efforts to cut climate-warming emissions. Canada has massive agricultural potential for biofuel production, yet a confusing patchwork of policies still holds back large-scale development. Meanwhile, the EU and U.S. have more cohesive frameworks and incentives, giving their advanced biofuels a serious head start. Cheap American imports continue flooding Canada, undercutting domestic producers and eroding investor confidence. If we unify our national strategy with stable funding, robust infrastructure, and a circular economy approach, we can become a global leader in the bioenergy market.

Canada's Bio Energy Landscape

For the purpose of this policy brief, the focus will be on past and current policy supports in Canada to understand why, despite being a major agricultural producer, agricultural byproducts remain under-utilized or wasted—contributing to emissions rather than being converted into renewable energy. To put in perspective the underdeveloped state of the Canadian biofuel market, Canada is a net exporter of oil, coal, and gas, producing three times more oil and coal than it consumes domestically and around 50% more natural gas than it consumes. Our overall energy import dependency is about -90%. However, in 2022 Canada had net imports of solid biofuels and liquid biofuels. For liquid biofuels, there were 37 PG of bioethanol (51% of domestic consumption) and 14 PG of biomass-based diesel (56% of domestic consumption), predominantly imported from the United States, showcasing the current utilization of the bioenergy market in Canada. (IEA, 2024)

This highlights the current utilization of the bioenergy market in Canada. See Figure 1 for an illustration of the average biofuel production in Canada and the United States in 2022. The data is meant to emphasize the differences in ethanol, biodiesel, and renewable diesel production between the two countries. In addition to the stark differences in production rates, Canada lacks a national framework to support large-scale biofuel and biogas production. Given the increasing global emphasis on sustainability and emissions reduction, identifying barriers to biofuel and biogas development is essential for shaping future policy directions. Unlike other nations that have established policies to promote agricultural waste-to-energy initiatives, we stand out as having made little progress in implementing a cohesive national strategy or a policy for utilizing waste, with a lack of funding allocated to R&D for the next generation of biofuels.

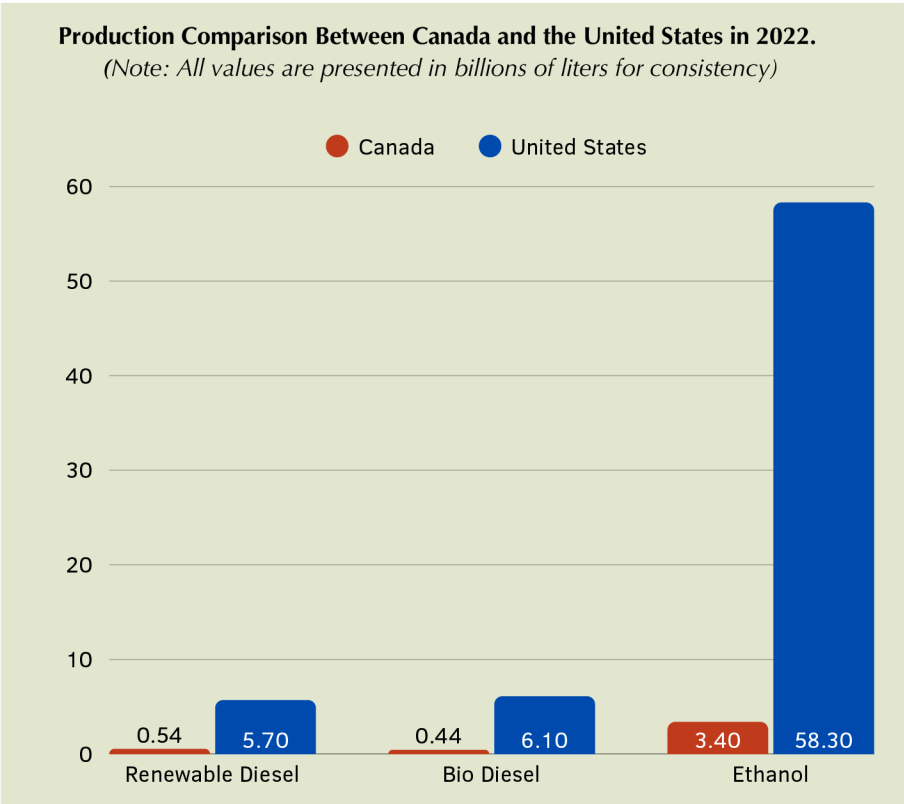


Figure 1: Was created for the purpose of this policy brief, with data sourced from Natural Resources Canada (2022), Canada Energy Regulator (2023), U.S. Energy Information Administration [EIA] (2023), and USDA (2023).

Current Policy Initiatives and Frameworks:

The Canadian government's policy initiatives and frameworks for renewable energy are expected to expand over the coming years, specifically in the bioenergy market, through the following key programs and initiatives:

1. **Clean Energy for Rural and Remote Communities (CERRC):** Allocated \$453 million CAD until 2027, focusing on investment tax credits and targeted support for renewable energy and clean technology, including solar, smart grids, bioheat, and district energy networks. While not exclusively for biofuels, bioheat is included within the policy framework.
2. **Canada Clean Fuels Fund:** Allocated \$1.3 billion until 2030 to support new domestic clean fuel production, including renewable natural gas, hydrogen, renewable diesel, and ethanol.
3. **Agricultural Clean Technology Fund:** Promotes clean technology adoption to support Canada's transition to a low-carbon economy and drive sustainable growth in the agriculture and agri-food sector through research and innovation.

Despite these initiatives, there is no dedicated federal funding solely for biofuel or biogas production. Instead, bioenergy funding is embedded within broader clean energy programs, resulting in fragmented and inconsistent support. While some provinces have introduced individual policies, the lack of national coordination has led to a siloed approach, creating market uncertainty and discouraging investment, ultimately hindering the growth of Canada's bioenergy sector.

Provincial Initiatives

British Columbia

- **The GHG Reduction Regulation (GGRR)** is a key policy initiative, serving as a market driver by setting a target of 15% renewable gas content in the total gas supply by 2030, including biofuels and biogas.
- **The Low Carbon Fuels Standard (LCFS)**, creates a credit market for lower-emission fuels. The policy helps bridge cost gaps by issuing credits to suppliers of low-emission fuels, which can then be sold to higher-carbon fuel producers needing to offset emissions. It is intended to help offset some of the higher production costs of low-carbon fuels, which remain more expensive than petroleum-based gasoline or diesel, and allow them to be more competitive in the market. It is important to note that BC is the only province to have a LCFS program, and is considered “to be one of the most successful approaches to reducing GHGs from transportation” Figure 2 below illustrates the progression of British Columbia's Low Carbon Fuel Standard (LCFS) and broader low-carbon economy goals within the outlined timeline, highlighting key policy actions and anticipated market transformations. (Province of British Columbia, 2021)

Amongst its program successes, BC's market highlights the challenges posed by the influx of cheaper U.S. renewable diesel, which is allowed under current regulations and serves as a clear example of insufficient federal policy measures to protect the domestic industry.

The U.S. has been able to use the BC market as a dumping ground for excess biofuel, with an oversupply compounded by lower biofuel feedstock prices that make renewable diesel cheaper to produce. An additional obstacle is that low-carbon fuel producers and importers can now claim Canada's Clean Fuel Regulation (CFR) credits for actions that have already earned them LCFS credits. This further increases BC's attractiveness as an outlet for excess U.S. renewable diesel, ultimately hampering domestic growth and limiting industry expansion in Canada.

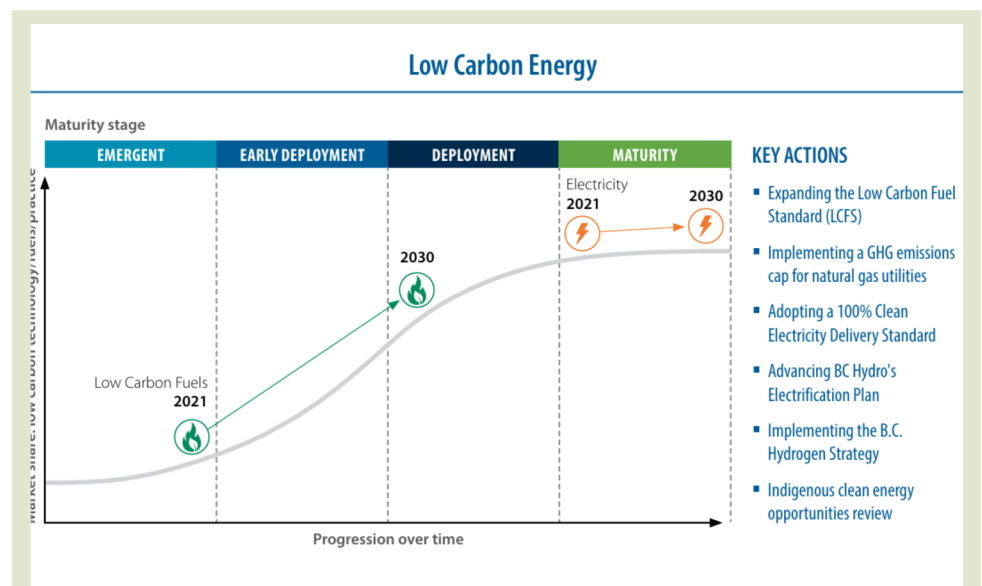


Figure 2: Sourced Province of British Columbia, (2021)

Alberta

Alberta's Technology Innovation and Emissions Reduction (TIER) Regulatory System provides pathways for generating credits through biogas projects. TIER is Alberta's carbon pricing framework, allowing companies to reduce their compliance costs by purchasing offset credits from eligible renewable energy projects, including biogas production (Government of Alberta, 2023).

However, unlike BC's LCFS, TIER does not mandate biofuel or biogas blending targets and instead covers renewable energy projects as a whole, meaning it is not a direct policy to support expanding biofuel markets. While TIER offers some market incentives, Alberta lacks a clear roadmap for bioenergy integration, creating uncertainty for investors and limiting long-term industry growth compared to the traditional oil and gas industry. Below are some additional programs to note, but they lack specific frameworks solely dedicated to biogas or renewable natural gas (RNG) projects, which limits targeted support for biogas sector growth (EXP, 2023).

Additional Alberta Programs that include Bioenergy:

- Bioenergy and Circular Economy Program: Supports projects focused on renewable fuels, waste conversion, and circular economy development (Alberta Innovates, 2023).
- Climate Smart Agriculture – Renewable Energy Initiative: Encourages the use of biogas, bioethanol, and biodiesel to supplement or replace fossil fuels for electricity, heating, and transportation (Government of Alberta, 2023).
- Future Energy Park: An innovative waste-to-energy project that uses low-grade wheat to produce renewable natural gas and ethanol, connecting agriculture and energy sectors (Green Impact Partners, 2023).

Key Previous Federal Policy:

The Eco Energy for Biofuels Program was launched in 2007 and concluded in 2016. The program provided operational incentives to biofuel producers over nine years. It aimed to increase domestic production capabilities of renewable alternatives to gasoline and diesel by offering incentives to support producers' costs. It reportedly played a pivotal role in establishing a foundation for the biofuel industry and could serve as lessons learned for future incentive programs. Over the nine years, the program allotted \$1.5 billion in operational incentives to biofuel users (Natural Resources Canada, n.d.).

From some of the lessons learned in previous government programs, such as the Eco-Energy Program, there was a lack of adaptability to market fluctuations. As with many energy sources, a variety of issues can affect pricing, yet the program did not effectively accommodate changes to feedstock prices, production costs, and international biofuel subsidies, leaving some producers unable to remain competitive.

This is important to note when considering policy recommendations: a variety of supports are needed for emerging industries and new technologies within next-generation biofuels. This is particularly relevant when highlighting the need for educated flexibility in policy support for next-generation biofuels due to the complex nature of industry variations and technological differences (Forman, 2023).

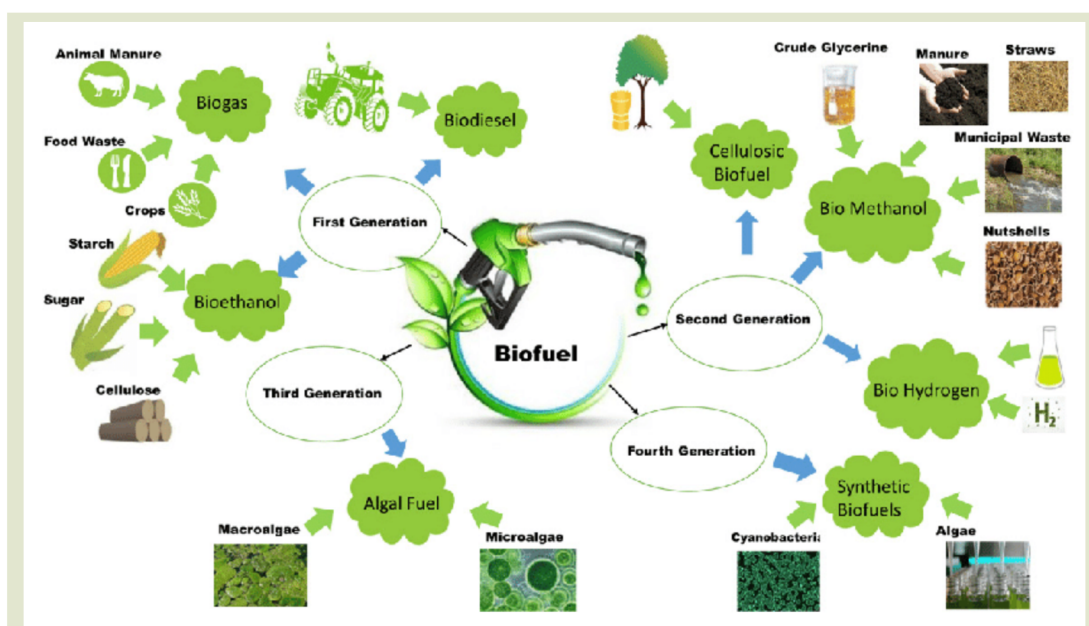


Figure 3. Schematic representation of biofuel types and their generation, various generation of biofuels based on feedstock and technology used.
Sourced from Mishra, (2019)

Gaps in Initiatives for Waste to Biofuel

Canada, as an agricultural nation, seems like a natural fit for leading in the biofuel economy if viewed through a circular economy approach, as we generate massive amounts of food, agricultural, and byproduct waste. Despite this, biofuel from waste is underutilized. This gap in biofuel adoption for waste streams can be attributed to policy gaps, infrastructure challenges, and outdated economic approaches, among other factors discussed earlier. This also relates to the lack of overall R&D funding for the bioenergy market, as next-generation biofuels are still primarily in the R&D phase and are not linked with unified policy integrating biofuels with waste reduction strategies (Natural Resources Canada, 2023).

Existing mandates favor first-generation fuels, such as corn- and canola-based biofuels, over those derived from waste streams. This reliance on food-based biofuels rather than advanced biofuels from waste can also be attributed to the lack of R&D funding, given that producing next-generation biofuel from waste streams is more expensive and more intensive. Specifically focusing on the subject matter, policies governing waste management, agriculture, and energy operate in silos, preventing a holistic approach to waste optimization (Forman, 2023). For example, food loss from farms, processing plants, and grocery stores is often discarded instead of repurposed for energy.

There are also significant technology gaps: there are few biofuel refineries designed for waste-based biofuels, and most biofuel production in Canada still relies on primary crops rather than repurposing agricultural or food processing byproducts (CER, 2023). According to the Canadian Biogas Association (2022), if fully utilized, biogas and RNG could contribute up to 26.7 Mt CO₂e in reductions by 2030, with landfills and agriculture being the primary sources, see figure 4 below for the potential impact on a provincial basis. Government support in Canada primarily subsidizes first-generation biofuels, making second-generation, waste-based biofuels less attractive for producers. This perpetuates a cycle where first-generation biofuels, sometimes criticized for their limited sustainability, remain dominant due to a lack of direct investment in next-generation biofuels. Without strategic investment and a national approach, Canada risks falling further behind in the global biofuel sector.

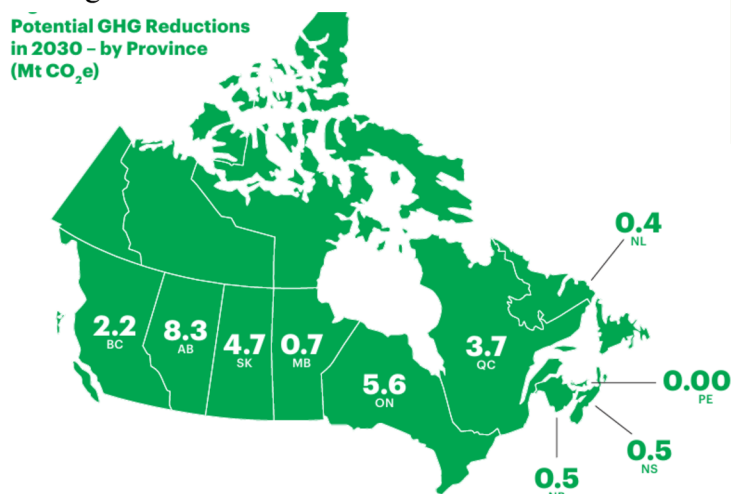


Figure 4 Sourced from Canadian Biogas Association, (2022)

This data highlights the potential for biogas and renewable natural gas (RNG) to reduce greenhouse gas emissions, with the biggest opportunities coming from landfills and agriculture. (Canadian Biogas Association, 2022)

Risks such as potentially low profit margins and market disruptions tied to U.S. tax-credit policies further deter investors (Lubieniechi & Smyth, 2016). Biofuel producers face stringent sustainability assessments, whereas fossil fuel industries often do not have equivalent requirements, placing additional burdens on development (AgBioForum, n.d.). Canada would need to more than double its current R&D expenditures to match leading countries with comparable funding and policy support. While recent investments in the broader bioeconomy are notable, they span multiple industries and product uses, leading to fragmented funding. For example, a \$6.5 million investment in August 2024 for bioproduct R&D using agricultural feedstocks is a step forward but remains limited.

Additionally, subsidized biofuels from countries like the United States are often cheaper than domestically produced biofuels, undermining local production. Canada's limited biofuel production infrastructure and reliance on imports to meet domestic demand further exacerbate market fluctuations.

Policy & Regulatory Barriers

No national mandates require biofuel blending in transportation fuel. There is a complex interjurisdictional policy landscape between federal and provincial governments and a lack of long-term incentives for agricultural waste-to-energy projects. The renewable fuel sector remains heavily reliant on government support, making it vulnerable to policy changes.

Private Sector Investment and Market Stability

There is a policy failure in stimulating private investment as many of the programs are government-funded and do not adequately encourage long-term private sector investment in biofuel production infrastructure. This is paired with frequent policy changes and the absence of a long-term national biofuel strategy, creating uncertainty for investors. Canada lacks a subsidy framework similar to the U.S. Inflation Reduction Act (Natural Resources Canada, 2023), which provides multi-decade support for biofuels. Shorter-term incentives in Canada do not guarantee long-term returns, and carbon pricing remains unpredictable. Although pricing is expected to rise to CAD \$170 per tonne by 2030, industry players remain skeptical due to shifting political landscapes (Forman, 2023).

Approvals for clean fuel projects can take years, discouraging private investment in next-generation biofuels. Some provinces, such as British Columbia, as mentioned, do have aggressive low-carbon fuel standards, while Alberta and Saskatchewan prioritize oil and gas development. This lack of national alignment weakens biofuel promotion efforts. Infrastructure challenges also persist—Canada lacks sufficient refining capacity for second-generation biofuels, making it reliant on U.S. imports.

Market Dynamics

It's important to note when talking about investment that due to the influx of renewable diesel exports from the United States, the U.S. exported at least 530,000,000 L of renewable diesel to Canada in the first half of 2024, up from 150,000,000 L during the same period the previous year, greatly affecting returns and market investment.

Economic Barriers

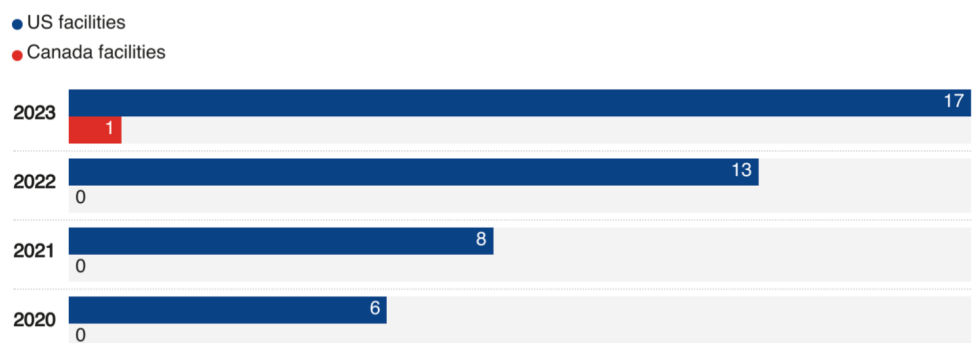
High initial investment costs for biofuel and biogas plants, and a lack of guaranteed market demand for bio-based energy, pose significant challenges. One of the largest economic barriers within the Canadian biofuel industry is inconsistent or unclear policies across federal and provincial levels. As noted with the BC LCFS credit system and the influx of excess U.S. biofuels, prices can be driven down and the high capital costs for first-of-its-kind projects and new production processes deter investment without government support. R&D spending on bioproducts and bioprocesses remains significantly lower in Canada compared to other developed nations, such as the U.S. and Europe. Funding is often bundled with other renewable energy projects, forcing companies and researchers to compete with unrelated industries for financial support. While the U.S. Department of Energy (DOE) and U.S. Department of Agriculture (USDA) allocate over \$200 million annually toward bioeconomy research, Canada's total investment from 1998 to 2003 through the Natural Sciences and Engineering Research Council (NSERC) and the Canadian Foundation for Innovation (CFI) was only \$50 million—far lower in scale (Lubieniechi & Smyth, 2016).

Future clean fuel prices remain highly volatile, influenced by fossil fuel market dynamics and policy incentives. Reliable, low-cost feedstocks such as renewable electricity, agricultural waste, or municipal solid waste are inconsistent in availability, increasing operational costs and investment risks.

Carbon pricing impacts market stability but remains unpredictable, further deterring investment in Canada. (Forman, 2023). In contrast, it should be noted with adequate policy support as of 2023, the U.S. had 17 standalone renewable diesel production facilities, while Canada inaugurated its first facility that year, showcasing the stark differences in investment and infrastructure development between the two countries. Figure 5 illustrates this contrast, highlighting the scale of U.S. production compared to Canada's emerging industry (Khan & Williams, 2024).

Total renewable diesel producers in the U.S. and Canada

Canada opened its first standalone renewable diesel production facility last year, when the U.S. had 17 plants already



Note: Data only for standalone renewable production facilities, excludes those co-processing petroleum

Figure 5 sourced from: Khan, S., & Williams, N. (2024, October 29)

Infrastructure & Technological Barriers

Limited refining and distribution infrastructure for biofuels are major hurdles. While technology is available, adoption is slow due to insufficient policy support and funding. Interestingly, given existing capabilities, one might expect more government support for drop-in biofuels, which can be used in existing engines and reduce the need for entirely new transportation infrastructure.

When looking at the broader energy transition, even though current first-generation biofuels are not universally considered fully clean due to concerns over using food crops, they remain cleaner than fossil fuels and can serve as a partial step toward decarbonization. For example, next-generation biofuels derived from waste may offer more benefits than waiting for other solutions that require even more significant infrastructure changes. Canada's infrastructure is not yet set up for full electrification, so supporting a transitional industry could still yield significant impact. Bio-refineries can integrate with existing petroleum supply chains, helping ease the transition to renewables (Natural Resources Canada, 2023).

Policy Success In Other Countries

United States

In the U.S., government biofuel support exceeds \$1 billion annually, while Canada allocated \$500 million to the Next GEN Biofuels Fund. However, Canadian policies do not provide the same level of financial incentive to encourage R&D, commercialization, or infrastructure expansion. This is paired with regulatory complexity and inconsistency, as biofuels must prove sustainability compared to fossil fuels, which do not face equivalent requirements (Lubieniechi & Smyth, 2016, p. 221).

U.S. biofuels also receive higher subsidies, making them cheaper domestically. The free market allows U.S. imports to undercut Canadian producers, as Canadian tax dollars end up supporting U.S. corn growers instead of domestic agriculture. Canadian ethanol plants are set up to process grain other than corn, yet U.S. corn is often cheaper, leading to Canadian plants importing U.S. corn (Lubieniechi & Smyth, 2016, p. 223). The U.S. heavily subsidizes corn ethanol and biodiesel, making it cheaper for Canada to import biofuels than to produce them domestically. Canada imports nearly 30% of its biofuels from the U.S. rather than developing its own waste-to-biofuel industry (Canadian Climate Institute, 2023).

European Union

Europe has policy to support the use of waste in Bio energy with co locating waste processing facilities with agricultural zones, which is something that Canada lacks—regional bio hubs that integrate waste processing and could serve as a notable model for Canada. Additionally they have begun levying anti-dumping tariffs on Chinese biofuel this year after complaints that Chinese producers benefit from artificially low input costs. They have extended these tariffs to U.S. and Canadian biofuel imports, following similar concerns, particularly in BC, where insufficient federal regulatory support has allowed excess U.S. renewable diesel to flood the market. (Khan & Williams, 2024).

Notable Policies:

EU Renewable Energy Directive:

- Mandates a 14% share of transport fuel from renewable sources (including biofuels) by 2030.

Germany's Renewable Energy Act:

- Successfully integrated farm-based biogas plants into the grid, reducing fossil fuel dependency.

The policy framework shown in figure 6 highlights the contrast with Canada's fragmented biofuel strategy, emphasizing the need for long-term policy stability and investment frameworks to support industry growth.

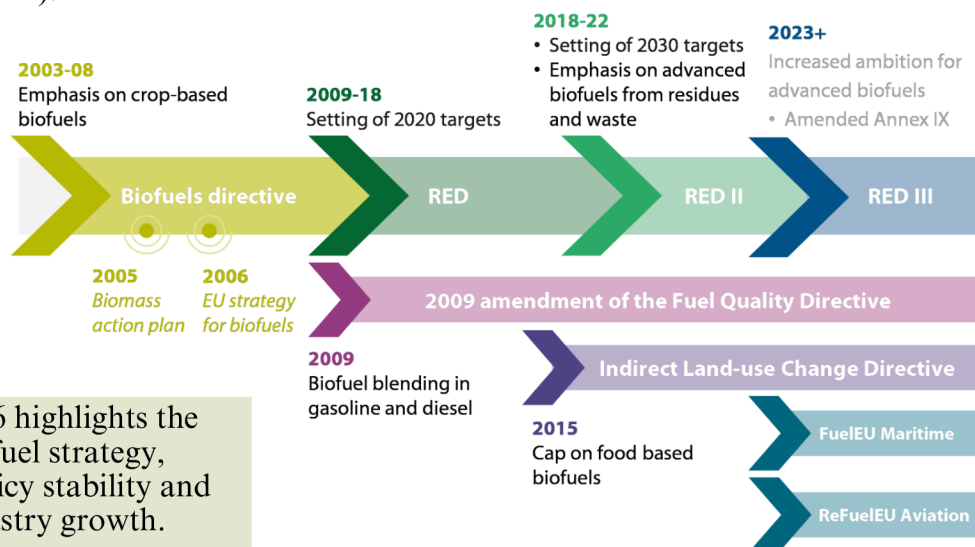


Figure 6 Sourced from European Court of Auditors. (2023)

Recommendations

1. Unified National Policy

Canada has the potential to become a global leader in biofuels. A national policy to support large-scale development with clarity and stable funding mechanisms is crucial to attract private investment. However, unlike the U.S. and Europe, Canada does not have a single funding body focused exclusively on bioproducts and bioprocess research, so funding for this sector is scattered across different programs. In addition, there is no unified research body or robust framework coordinating stakeholders across academia, industry, and government. A national bioeconomy strategy with direct funding allocated for next-generation biofuel and biogas development would provide long-term R&D funding, similar to U.S. DOE programs, and align with Canada's goal of reducing carbon emissions.

Expanding participation with Indigenous communities is also critical for project success, although there are limitations due to policy constraints such as the Indian Act, which can limit Indigenous communities' ability to secure loans. Government loan guarantees, such as those from the Alberta Indigenous Opportunities Corporation, can help mitigate these barriers. Indigenous partnerships can also create long-lasting community impacts. These efforts should be paired with modernizing infrastructure and incentivizing R&D to develop enabling platforms and technology infrastructure.

A well-structured national policy should also support investment incentives such as tax credits (similar to the U.S. Inflation Reduction Act) and contracts for difference (CFDs) to reduce investor risk. Streamlining regulatory approvals and enhancing private-sector partnerships is equally important, as smaller and privately funded investments often face lengthy regulatory hurdles for approval, subsidies, or R&D. Reducing permitting times and ensuring consistent policies across provinces would contribute to a national biostrategy by lowering market risk and encouraging public-private collaboration.

2. Funding & R&D:

To ensure strategic investment, funding should be allocated across key categories: developing new generations of biofuels, creating versatile bioproducts for commercial applications, conducting bioprocess research to improve efficiency and reduce waste, and investing in governance, modeling, operational research, and market intelligence. Some policymakers are concerned about investing in a fuel that is not as "clean" as other renewable energy sources. However, examining the bigger picture reveals that other alternatives are not yet fully capable, and many have unaddressed environmental rebound effects. Biofuel, even if not entirely carbon-neutral, is still considered renewable and significantly cleaner than fossil fuels—especially since it can be made from waste products otherwise destined for landfills. Focusing on next-generation biofuels R&D funding, could be a bridging solution, allowing the use of existing infrastructure, enabling a smoother energy transition.

If Canada wants to fully capitalize on its agricultural byproducts and bioindustry potential, it must ensure coordinated R&D funding, infrastructure investment, and policy alignment. Developing a comprehensive bioeconomy strategy would not only provide funding stability but also establish a more effective framework for stakeholder collaboration across academia, industry, and government.

Reducing permitting times and aligning funding structures with long-term goals would help address the root causes of Canada's lag in biofuel development. A coordinated effort between government, industry, and Indigenous partners will be essential to unlocking Canada's potential as a biofuel leader.

Overarching Recommendation: A Circular Economy Approach

There could be incredible benefit if policy was created and implemented with a circular economy approach to biofuels in both government policies and private partnerships, and foster waste, agricultural residue, and forestry products that are repurposed into energy, providing economic, environmental, and social benefits while advancing next-generation technology. Looking at economic benefits alone, there is an estimated CAD 49 billion in wasted and recoverable value from food and agricultural waste. Redirecting even 20% of this waste to biofuels could significantly reduce biofuel costs, counter the high cost of food crops, and stabilize feedstock inputs. It would also create a new market for farmers and processors, allowing them to sell crop residue, processing waste, and spoiled produce for energy production.

A Circular Economy Approach Continued:

There are many examples of the benefits to examining solutions from a whole-system perspective, rather than a siloed approach, which can achieve a measurable impact. There is also decreased land and water use for energy crops because, unlike first-generation biofuels, waste-based biofuels do not compete with food production. Supporting innovation in advanced technologies like anaerobic digestion and gasification, and establishing public-private partnerships to scale up commercialization, is crucial.

Conclusion: A Call to Action

Canada has the agricultural resources to be a leader in biofuel and biogas development. However, policy gaps, economic challenges, and infrastructure limitations have slowed progress. By adopting strategies that have proven successful in other nations—such as clear mandates, financial incentives, and infrastructure investments—Canada can transform agricultural waste into a valuable energy source. This shift would not only reduce emissions but also create new revenue streams for farmers and strengthen the country's renewable energy sector.

Policymakers, industry stakeholders, and researchers must collaborate to develop a cohesive national strategy that maximizes Canada's agricultural potential while supporting the transition to a sustainable energy future. Failing to support next-generation biofuels and the bioeconomy would be a significant oversight, given both the economic and environmental benefits—particularly in hard-to-decarbonize sectors like aviation, marine transport, and heavy trucking, which cannot easily transition to electrification. Moreover, drop-in biofuels have the advantage of compatibility with existing infrastructure, reducing the need for costly overhauls to transportation systems. It would be shortsighted not to provide stronger policy support for an industry that offers an immediate, practical pathway to emissions reductions while next-generation advancements continue to develop.

The ongoing energy transition reveals a tendency toward extremes—pushing for an idealized, long-term renewable solution while neglecting interim measures that could make a substantial impact now. While first-generation biofuels are not universally considered "clean" due to concerns over agricultural land use, they are still a significant improvement over fossil fuels. Instead of dismissing these solutions outright, Canada must adopt a pragmatic approach that advances cleaner energy in achievable steps rather than waiting for an unattainable perfect solution.

Canada has immense potential to lead in next-generation biofuels, but its historical lack of policy coordination, R&D funding, and infrastructure investment has hindered progress. To remain competitive in the global clean fuel economy, Canada must shift toward a long-term, stable policy framework, combined with private-sector investment and infrastructure expansion. Without these changes, Canada risks falling further behind its global competitors. Forging a unified national biofuel strategy—backed by stable funding, strong policy commitments, and industry collaboration—is critical. By harnessing its agricultural resources and investing in next-generation biofuels, Canada can secure its role as a global leader in sustainable energy while driving economic growth and significantly reducing carbon emissions.