April 28, 2021

Chairman James Maloney, M.P.
Standing Committee on Natural Resources
Sixth Floor, 131 Queen Street
House of Commons
Ottawa ON K1A 0A6
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RE: Clean Fuel Standard Proposed Regulatory Approach

Executive Summary

Methanex Corporation (**Methanex**) is the world's largest producer and supplier of methanol, an alcohol used in fuels, industrial and consumer products. Headquartered in Vancouver-BC, Methanex has a production facility in Alberta. Methanex encourages the Standing Committee on Natural Resources' study on Low Carbon and Renewable Fuels Industry and would welcome an opportunity to discuss our recommendations:

1. *Ensure regulatory acceptance of methanol as an alternative fuel*: Methanol is a clean-burning liquid fuel that can be produced from fossil (natural gas) or renewable sources and is used in many energy applications (maritime, vehicles, power, hydrogen, fuel cells). While delivering emission reductions, methanol can leverage existing liquid fuels systems, reducing deployment capital vs. other fuels. Recognition of low-carbon methanol benefits can underpin industrial developments, by leveraging Canada's natural gas, coupled with carbon capture, storage and use (**CCSU**) for quick deployment.

2. *Bolster methanol's environmental, health and safety benefits*: Methanol is bio-degradable and less toxic than gasoline. It has a history of safe handling and can lead to deep decarbonization through low-carbon methanol (**LCMeOH**). In order to support the development of LCMeOH, reducing carbon emissions, we recommend that: A) The government expands its support to CCSU; B) The CFS facilitates the production of bio-methanol from renewable natural gas (**RNG**); C) The CFR develops default carbon intensity (**CI**) values for the LCMeOH production pathways.

3. *Link the delivery of Canada's Hydrogen Strategy to methanol:* Hydrogen is currently enjoying unprecedented political and business support, including from the Canadian Hydrogen Strategy. Methanol has a symbiotic relationship with the 'Hydrogen Economy' as a liquid hydrogen carrier at atmospheric conditions with the greatest hydrogen density, offering the 'Methanol Network' and production pathways as an economically viable solution for hydrogen production and logistics.

4. *Ensure the protection of energy-intensive and trade-exposed sectors in GHG policies:* Cost increases to methanol production, e.g., natural gas or carbon tax, can disincentivize new investments in Canada and lead production to jurisdictions where coal is used as feedstock, defeating the objective of GHG emission reduction. A carbon border adjustment can be a tool to protect the industry, if well defined.

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Introduction

Methanex supplies methanol to markets in North America, Asia Pacific, Europe and South America and our methanol production facilities are located in Canada (Medicine Hat, Alberta), United States, New Zealand, Egypt, Trinidad and Chile. Our global operations are supported by an extensive global supply chain of terminals, storage facilities and the world's largest dedicated fleet of methanol ocean-going vessels. Methanex is also a shareholder of Carbon Recycling International that operates a renewable methanol plant in Iceland, converting green hydrogen and CO_2 to methanol.

Methanol is the simplest alcohol (CH_3OH); it is a clear, colourless liquid fuel that is biodegradable. Methanol production is regarded as the most efficient means of converting natural gas into a liquid fuel. While methanol is typically produced from natural gas, it can also be produced from a wide range of renewable and non-conventional sources, including captured CO_2. Methanol is used in consumer products, industrial products and as a clean-burning alternative fuel for road, marine and other energy applications. Approximately 50 percent of global methanol demand comes from energy applications.

There are a wide variety of end-uses for methanol that align with the objectives of the Government of Canada as it relates to the reduction of greenhouse gas (GHG) emissions as well as other air pollutants. We have previously advocated that the creation of the Clean Fuel Regulations (CFR) is an opportunity to incentivize the growth in the use of low-carbon methanol in many different applications. We have also been engaged with the federal government on the development of its hydrogen strategy.

1. ***Ensure regulatory acceptance of methanol as an alternative fuel in Canada***

Methanol is a fuel for today and the future, providing a range of low carbon fuels and green energy solutions that will help meet the objectives of the CFR. Increased methanol production to support these energy solutions will have the added value of generating economic growth and development in Canada.

Methanol is a clean-burning fuel used in multiple energy applications and jurisdictions around the world. It can be used as a diesel substitute in trucks, or be blended with gasoline (i) in low-quantities up to 15% to be used in existing road vehicles, or (ii) in high-proportions (e.g., M85 with 85% methanol and 15% gasoline blend) in flex-fuel vehicles or 100% dedicated methanol-fueled vehicles (M100).

Methanol is also a proven marine fuel, displacing diesel to meet the shipping industry's increasingly stringent SOx, NOx emissions regulations defined by the IMO. The dual-fuel engines used on *Stena Germanica*, a ferry running in Europe, and *Waterfront Shipping*'s chemical bulk carriers have surpassed 90,000 operating hours of successful commercial operation running on methanol. Recently, Maersk also committed itself to use low carbon methanol to deliver zero-emission transportation. *Waterfront Shipping*, a wholly-owned subsidiary of Methanex, and *Marinvest* have launched second-generation two-stroke vessels with MAN B&W ME-LGUM in compliance with IMO 2020 emissions regulations and IMO Tier III NOx emission standards through water emulsion (i.e., no need for exhaust gas after treatment).

The same logistics systems that are used for gasoline and ethanol can be used for methanol, limiting the capital requirements for infrastructure development, unlike other alternative fuels, such as LNG and hydrogen. Methanol is one of the top five commodities shipped globally through an extensive global supply chain and distribution network of terminals and storage facilities. Methanol is delivered to customers worldwide by tanker, barge, rail, truck and pipeline. Risks related to methanol are similar to

gasoline and diesel fuel, therefore infrastructure transition can be relatively simple when contrasted to electrification, compressed natural gas or ammonia.

Methanol fuel is most widely used in China where approximately 50% of global methanol demand resides, and President Xi Jinping pledged carbon neutrality by 2060. In China, a fleet of more than 20,000 taxis runs on M100, creating a network of fueling stations that can be further leveraged for methanol-powered FCEV. There are also over 2,000 boilers and thousands of cooking stoves that use methanol as fuel.

As technologies mature and become commercially viable, methanol will be able to provide significant GHG emission reductions through low-carbon methanol produced from renewable feedstocks and/or the use of alternative energy systems, such as fuel cells. The use of CCSU can readily produce low-carbon methanol if implemented on Methanex's Medicine Hat, AB facility under appropriate economics.

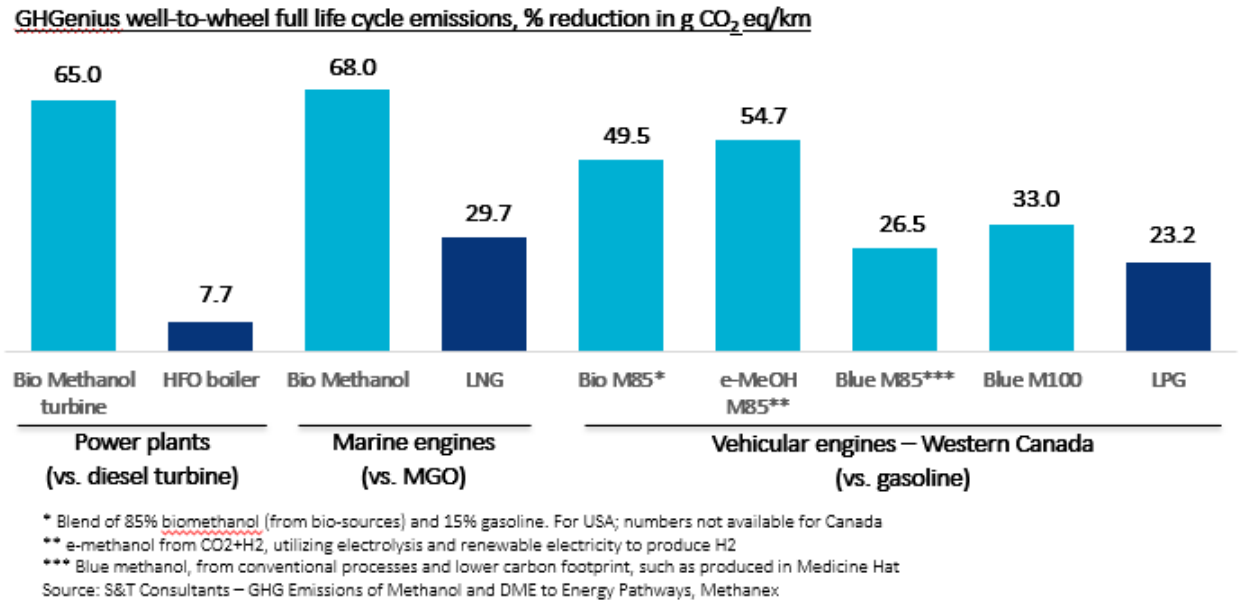
Supporting methanol as a fuel can further create regional manufacturing facilities, generate well-paying jobs and taxes, and increase regional energy independence and security. Abundant Canadian natural gas and established logistic routes through Canada have enabled existing production in Alberta and there is potential for additional methanol investment. Methanol has a long history of safe manufacture, distribution and use in Canada and is readily available for multiple energy applications. Western Canada's vast natural gas reserves can be monetized through the creation of a strong methanol industry, as a diversification strategy, similar to Liquified Natural Gas.

2. Bolster methanol's environmental, health and safety benefits

From an environmental perspective, when mixed with water, methanol quickly biodegrades to harmless substances, with none of the severe, long-term soil and water contamination issues associated with petroleum spills. This is an important consideration when working to protect Canada's coastlines. Overall, methanol is a well-proven, simple-to-adopt solution that fully complies with IMO 2020 SOx and NOx regulations and provides a pathway to meeting IMO 2030 and 2050 CO_2 emission targets.

Methanol produced through renewable or alternative sources (i.e., Bio-Methanol, e-Methanol and Blue methanol, collectively referred to as Low Carbon Methanol or LCMeOH) results in significant reductions in GHG emissions, as demonstrated in the figure on the next page.

Also, LCMeOH does not utilize any material land resources and locally produced LCMeOH would provide environmental, energy security and balance of trade benefits versus imported fuels or fuel components. This is in large contrast to other biofuels that have land-use environmental impacts.



To support the development of LCMeOH, we urge the committee to recommend that:

A. The government expands its support for Carbon Capture, Storage and Use (CCSU)

The explicit recognition of manufacturing pathways for generating fuels with/from CCSU can increase investment in these technologies. This can be achieved, by a) including technological pathways for fuels produced through captured CO_2 into the CFR, and b) supporting CCSU projects through capital, tax and other economic support. This would unleash two methanol production pathways through CCSU:

a) *E-Methanol*: Producing methanol through the combination of $CO_2 + H_2$; utilizing hydrogen from electrolysis through renewable electricity. Similarly, H_2 from petrochemical co-products, such as steam methane reformers, ethane crackers or propane dehydrogenation units, can also reduce emissions and therefore should be credit generating fuels. Methanol is the most efficient and cost-effective fuel produced through electricity (e-fuel) and captured CO_2.

b) *Blue Methanol*: Utilizing production technologies with a lower GHG footprint for the production of methanol from natural gas such as (i) injection of waste CO_2 into the methanol production process, or (ii) by capturing CO_2 before it is emitted. Methanex currently produces blue methanol at its Medicine Hat facility through CO_2 injection from a neighbouring ammonia facility which results in a low carbon footprint for a portion of the methanol produced.

B. The CFR facilitates the production of bio-methanol from renewable natural gas (RNG).

Methanex has started to produce bio-methanol in its Geismar, Louisiana (US) facility to attend the European market, under the European environmental regulations, Renewable Energy Directive 2 (**RED 2**). The RED 2 has two mechanisms that make this viable: (i) it recognizes the process of 'Book and Claim', which allows the RNG produced far from the methanol facility to be utilized into the production of bio-methanol, being recognized as credit generating fuel, and (ii) it allows "plant partition" considering the

specific flows produced only with RNG for the bio-methanol production, while still being able to produce conventional methanol in the same plant. We recommend that the CFR recognizes 'Book and Claim' and "plant partition" mechanisms in the CFR similarly to RED 2, as a way to increase the value of renewable inputs across the country as they diversify RNG markets and expand the production of both RNG and bio-methanol, allowing each production facility to be placed in the most competitive cost location.

C. The CFR develops default carbon intensity (CI) values for the LCMeOH production pathways.

Default CI values can instigate the early deployment of these technologies, instead of waiting for the development of the Fuel Lifecycle Assessment Modeling Tool. Based on a study commissioned by Methanex to (S&T)^2 Consultants Inc. utilizing GHGenius, the carbon intensity for the production of LCMeOH was calculated as:

Green Methanol type	**Feedstock**	**Location**	**CI (g CO_2 eq/MJ, LHV)**
Bio-methanol	Municipal Solid Waste	Western Canada	21.9
Bio-methanol	Wood Residue	U.S.	25.2
e-Methanol	Renew power+CO_2+H_2	British Columbia	30.6
e-Methanol	Renew power+CO_2+H_2	Quebec	27.1

We recommend the pre-calculation of default CIs for LCMeOH and would be interested in supporting the authorities with these calculations. These default CIs are to be added by the emissions related to the energy systems (e.g., combustion engines, fuel cells) for a full life cycle analysis. We can share the above-mentioned study, provide additional information, contribute to a new study or any other activities deemed necessary by the CFR to accomplish this task.

3. Link the delivery of Canada's Hydrogen Strategy to methanol

Methanol can also be a pillar for the hydrogen economy, as the best energy carrier for hydrogen, due to its low mass ratio of carbon relative to hydrogen and its liquid state at atmospheric temperature and pressure which lowers logistic costs and infrastructure conversion. The expansion of the Hydrogen Economy would be synergistic with the methanol industry.

Global support to the Hydrogen Economy is expanding quickly. It is encouraging to see the recognition and support to the Hydrogen Economy by the Canadian and provincial governments. Canada can lead this technological revolution with the appropriate regulatory levers in place and with stakeholders incentivized to dedicate resources to support it.

Nevertheless, hydrogen logistics pose challenges because the compression and storage of hydrogen are energy-intensive and difficult, with a high impact on logistic costs. Methanol, which is easy to store and transport as a liquid, provides an opportunity for a simplified supply chain. Methanol has a symbiotic relationship with developing the Hydrogen Economy due to it being a liquid hydrogen carrier at atmospheric temperature and pressure (refer to the *Appendix* for details). The 'Methanol Network' is a readily available, economically viable solution for hydrogen logistics and capital costs. There are also complementary manufacturing designs between hydrogen and methanol, and complementary technologies between Fuel Cell Electrical Vehicles (**FCEV**) and methanol fuel cells.

A recent study by *VoltaChem*, *TNO, SmartPort* and market parties into the most promising e-fuels for heavy transport applications *(https://files.constantcontact.com/9117ab81401/80e9b03f-3356-42a6-ba4f-4cd320f69408.pdf)* surmises that green hydrogen applicability as a fuel in heavy transport is limited and could be better used to produce e-fuels. For long-distance truck transport e-fuels, such as e-methanol produced from green hydrogen and captured CO_2, are the most attractive options because of their high energy density requiring smaller, cheaper tanks. E-methanol can also serve as a hydrogen carrier, producing green hydrogen in the most competitive renewable electricity locations (e.g., Quebec) and, combining it with captured CO_2 from industrial plants, to transport it to far locations such as the Canadian West Coast.

Hydrogen is also produced in methanol-producing Steam Methane Reformers and can be readily available close to methanol-producing facilities, such as Methanex's facility in Medicine Hat. Furthermore, low-carbon hydrogen can be produced if these facilities utilize CCSU to reduce the impact of the additional natural gas utilized in the fuel streams, as a substitution for the hydrogen diverted for noble purposes.

The methanol fuel cell can be built as a hydrogen fuel cell with a micro-methanol reformer on board vehicles, all carried together for fueling convenience and safety compliance. For example, *Palcan,* a Chinese fuel cell producer, has developed a mobile technology where methanol and water are pushed through an evaporator and reformer to charge high-temperature fuel stacks to generate a DC charge, similarly to *Blue World*, a Danish company dedicated to developing methanol fuel cells for transportation. The technology has been deployed in China to charge shipping vehicles, buses and cold-chain logistic vehicles. A key benefit of this technology is that the methanol fueling time is very short (1-3 minutes) compared to the long charge of electric batteries. A key benefit of this technology is that it can leverage the liquid infrastructure, eliminate safety issues related to carrying hydrogen in a vehicle and lower the GHG emission footprint.

4. Ensure the protection of energy-intensive and trade-exposed sectors in GHG policies

Finally, and perhaps most importantly, we ask the government to exert caution regarding potential cost increases to methanol production due to any new regulatory framework. New GHG reducing requirements may create cost increases to methanol production. This could make production uneconomic in Canada which would lead to global emissions increase as methanol would continue to be produced in jurisdictions where coal is the predominant feedstock. An overly burdensome system would simply cause economic leakage outside the country, given the trade-exposed nature of our industry. We urge the committee to recommend that a careful cost-benefit analysis, that considers the impact on investment, be completed before any new low carbon fuel requirements are created. If the new carbon policy causes a meaningful increase in Canadian natural gas pricing, it could impact investment decisions on methanol projects in Canada as would be the case for our consideration of a potential new 1.8 million metric tonne methanol plant in Medicine Hat alongside the existing facility.

A concern on higher production costs is the effect of hydrogen packing (i.e., blending of hydrogen into natural gas pipelines). We have applauded the governmental decision to halt plans for hydrogen packing, as it can be challenging for petrochemicals that utilize natural gas as a feedstock. It can lead to (i) lower chemical production, (ii) more expensive feedstock, and (iii) increased capital investment to equipment and fuel gas piping to maintain safety. Hydrogen packing would be detrimental to the methanol industry and we urge the committee to recommend that it is not considered for industrial settings.

The potentially high carbon tax (up to C$170/MT in 2030) and the lack of regulatory certainty for future prices can also be damaging for operational costs and investment decisions. Although alignment on carbon tax between federal and provincial governments is expected, the federal government should also consider to explicitly propose mechanisms to avoid investment/manufacturing evasion, such as creating a ratcheting rate for existing and future operations.

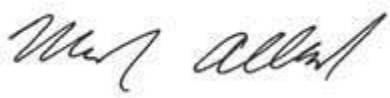
A Carbon Border Adjustment (**CBA**) will be an important tool to protect domestic companies from imports originating from less regulated jurisdictions. In addition, similar protections should be established for exporters to global markets. The Standing Committee on Natural Resources should promote the development of federal CBAs to make sure that they adequately protect Canadian companies from high trade exposure due to competition with jurisdictions that are out-of-sync on climate change regulations.

Conclusion

Government policy can support the development of many different fuel technologies, including Low-Carbon Methanol and fuel cells, providing consumers with the best options to reduce GHG emissions. We continue to urge the government to draft regulations that will be technology-neutral, fuel neutral and mode neutral in achieving the goal and focus on GHG emissions reductions. The CFR already has some attractive technology enablers and we believe that the additional explicit references described above would further enable environmental-friendly methanol market development in Canada that would support efforts to reduce our carbon footprint. We also believe that the CFR must not have unintended consequences for emission-intensive and trade-exposed industries such as methanol.

We welcome the opportunity to discuss this submission and the benefits of expanded methanol use in Canada at your earliest convenience. If you have any questions about this submission, please feel free to contact me or Renato Monteiro, Business Development Director, at rmonteiro@methanex.com.

Sincerely,



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Appendix - Symbiotic relationship between Methanol and Hydrogen

Methanol can support hydrogen by taking advantage of the existing 'Methanol Network'
Hydrogen can gain speed to market by taking advantage of the existing methanol network, reduce its logistics and storage challenges, and provide an economically viable low-carbon solution.

Methanol Network

- **Wide availability,** produced from fossil fuel and renewable sources
- **Global supply chain** already developed, providing reliable supply, leveraging liquid infrastructure

Methanol lower handling costs

- **Most efficient liquid hydrogen carrier** enabling efficient transportation between centers of renewable electricity (e.g., Canada) and renewable fuel consumption centers (e.g., Europe)
- **Liquid logistic** that is safe, more affordable and can take advantage of existing infrastructure
- **Higher volumetric energy content** providing better economics for applications where storage space is a challenge (e.g., marine)

Economically viable low-carbon business model

- **Zero-emissions solution available** if you combine hydrogen production from renewable methanol with carbon capture at a hydrogen production location
- **Low-carbon business model based on natural gas feedstock** that builds upon existing mature technology, abundance of shale gas and carbon capture, storage and utilization (**CCSU**)

Hydrogen can support methanol by taking advantage of the 'Hydrogen Momentum'
Methanol is a hydrogen carrier that enables hydrogen benefits and takes advantage of investments in electrolysis to improve technology and economics of renewable methanol production.

Hydrogen benefits as an energy source

- **Cleanest fuel from tank-to-wheel** due to no carbon emissions at the energy conversion system
- **High energy conversion rate** on the efficient use of fuel cells to produce electricity and from electricity to heat and mechanical energy
- **Broader use than only transportation,** including steel, iron, chemicals, where decarbonization can also play a role in the future, increasing economic incentives for growth

Hydrogen Momentum

- **Support from industry and governments** as an energy source, leading to incentives and favorable regulations, technology and network developments

Support for technology-driven business model

- **Synergistic manufacturing design with renewable methanol** as renewable hydrogen can be produced from electrolysis combined with carbon dioxide to produce renewable methanol.
- **Co-production potential** (larger front-end hydrogen production, smaller CO2-to-methanol synthesis back-end) to accommodate market demand from each product.