FERTILIZER CANADA
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May 28, 2021

Fuel Diversification Division and Clean Fuels Branch
Natural Resources Canada
580 Booth St, Ottawa, ON K1A 0E4

Via email: nrcan.cleanfuelsfund-fondsdecarburantspropres.rncan@canada.ca

RE: Clean Fuel Fund Program

On behalf of Fertilizer Canada, and our member companies, we welcome the opportunity to provide input to help inform the Clean Fuel Fund Program. That being said, we are concerned about the extremely short timeline for this consultation and the lack of representation from our sector during the industry stakeholder session. While we have prepared these preliminary comments to meet the submission deadline, we hope to continue this dialogue with Natural Resources Canada over the coming months to provide comprehensive input on the Clean Fuel Fund Program, which offers a significant opportunity on our industry.

Fertilizer Canada represents manufacturers, wholesale, and retail distributors of nitrogen, phosphate, potash, and sulphur fertilizers. Responsible for 50 per cent of global food production, fertilizer is crucial in meeting the food, fuel, and fibre needs of the growing world population, and Canadian fertilizer accounts for 12 per cent of the global fertilizer supply. Our industry contributes approximately $24 billion annually to Canada's economic activity, supporting the employment of over 76,000 individuals throughout the supply chain. However, as an energy-intensive, trade-exposed (EITE) industry, our members are highly vulnerable to carbon leakage and global competitiveness impacts. The Canadian fertilizer industry is well positioned to significantly contribute to our hydrogen economy with nitrogen fertilizer production being identified as an established hydrogen production supply chain[1].

Recommendations

As previously stated, Fertilizer Canada would like additional time to provide a thorough assessment of the opportunities for our industry as it relates to the proposed Clean Fuel Fund Program. However, as a preliminary response, Fertilizer Canada recommends that the Government of Canada take the following actions:

1. **Fertilizer Canada asks that Natural Resources Canada commit to a comprehensive review of our Technology Roadmap to endorse the accuracy of the proposed roadmap and help inform government programming such as the Clean Fuel Fund.** To better understand the current challenges or opportunities associated with low-carbon technologies for our sector, our member companies have proactively launched the development of a Technology Roadmap for the Canadian fertilizer industry. We are currently in the final stages of completing

[1] Hydrogen Strategy for Canada.

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our Technology Roadmap which we believe will help inform the types of projects that could be supported by the fund. The roadmap will 1) explain current manufacturing processes, 2) evaluate new or emerging technologies against its emission reduction potential, commercial scalability, economic viability, and regional considerations, and 3) provide technology and policy recommendations based on this evaluation. Fertilizer Canada will be presenting a specific proposal to Natural Resources Canada in the near future. We ask that the department prioritize review of our roadmap and work collaboratively with us to ensure its benefit for both government and industry.

2. **Based upon its ability to transport hydrogen or be used as a fuel itself, Fertilizer Canada recommends "blue" and "green" ammonia be classified as an approved "clean fuel" within the proposed funding program.** Anhydrous ammonia (NH_3) is made of a single nitrogen atom and three hydrogen atoms and with a higher boiling point can be stored and transported as a warm liquid. Industrial customers use ammonia in emission control systems or other industrial processes; however, the majority of this product is used as a nitrogen source for crop production. As a readily used fertilizer, ammonia is already safely stored and transported in large volumes via pipelines, railways, trucks, and ports in Canada, and globally. Canada's industry sets exceptionally high standards for product handling and stewardship, through world-class codes of practice, advanced tank car design and robust regulation. The Canadian fertilizer industry offers a unique opportunity to safely produce, store and transport hydrogen as ammonia through existing production and transportation infrastructure. After storage and transportation of ammonia, hydrogen can be separated from the nitrogen atom and used as fuel or feedstock. Additionally, ammonia can also be used as a carbon-free fuel without the need to extract hydrogen from the molecule. Since ammonia carries three hydrogen atoms for every nitrogen atom, it has a very high hydrogen density which allows it to be used as a fuel through combustion or with solid oxide fuel cells.

3. **Canada is in the early stages of developing ammonia as a fuel for export and, therefore, production projects in this category would be focused on non-repayable feasibility/feed studies. Without an existing market for ammonia as a fuel, these types of projects should not include offtake agreements within their project criteria. Further, we recommend that the offtake agreement term length be reduced since a minimum of five years may be challenging for many applicant and limit potential projects.** An international export market for ammonia as a fuel is being supported by global investments but is still in early stages of development. For example, Japan is currently investigating ammonia as a fuel for power generation and by the International Marine Organization is looking to hydrogen and ammonia as low-carbon, alternative fuel sources. Removing offtake agreements as a criterion for non-repayable feasibility/feed products specifically and reducing the agreement minimum below five years generally will allow applicants to participate in these project types. Otherwise, highly qualified, high-impact projects may be excluded simply because they cannot meet these criteria.

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4. **Given that the project application process is competitive and exceptionally onerous, Fertilizer Canada asks that the request for proposal (RFP) timeframe for production projects be expanded from 75 to 90 days to align with timelines for other project types.** With a Fall 2021 review of Stream 1 production projects, delay of the RFP deadline for these projects should not impact the proposed timelines for the Clean Fuel Fund Program but will offer applicants more time to propose highly qualified, high-impact projects to produce clean fuel in Canada.

5. **Considering the timing of the proposed Clean Fuel Standard, we recommend that the commission date be delayed to March 31, 2028. Further, production projects must align and reflect industry commercial scale adoption of clean fuel technologies.** The Clean Fuel Standard assumes that by 2028 “banked credits, credits from mature technologies, and fund contributions would no longer be sufficient to fulfill the credit requirement”. Adoption of clean technologies at a commercial scale often requires upwards of five years for implementation and, therefore, the proposed funding program should account and align with these industrial timelines. For example, a project that will be fully commissioned in 2025 or Q1 2026 likely will not be able to provide the proposed mandatory documentation (i.e. business plans, offtake agreements, etc) during the application process in Q2/Q3 2021.

6. **Fertilizer Canada asks that the Natural Resources Canada provide greater detail as to how the repayable contribution will be calculated and whether the repayable contribution will consider individual economic impacts for each company.** The proposed repayable requirements do not account for the specific economic hurdles that some companies may face internally. A detailed calculation of the repayable contribution should be available so project proponents can determine how these contributions will impact the financial status of their specific project.

Conclusions

Fertilizer Canada and our member companies stand ready to work with the Government of Canada to develop mechanisms that will encourage adoption of low-carbon technologies to produce clean fuels while protecting the competitiveness of our industry in a global market. As previously stated, these are preliminary comments, and we hope that Natural Resources Canada will take advantage of the opportunity to review our Technology Roadmap to further inform government policies and programs like the Clean Fuel Fund Program.

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Sincerely,

McKenzie Smith
Director, Stewardship & Regulatory Affairs
Fertilizer Canada

CC: Christine Hogan, Deputy Minister of Environment and Climate Change Canada

John Moffet, Assistant Deputy Minister of Environment and Climate Change Canada

Jean-François Tremblay, Deputy Minister of Natural Resources Canada

The Honourable Jason Nixon, Minister of Environment and Parks

The Honourable Dale Nally, Associate Minister of Natural Gas and Electricity

The Honourable Jeff Yurek, Minister of Environment, Conservation and Parks

The Honourable Warren Kaeding, Minister of Environment

The Honourable Sarah Guillemard, Minister of Conservation and Climate

The Honourable Bronwyn Eyre, Minister of Energy and Resources

Background Information

An Overview of Nitrogen Production

Nitrogen Fertilizer Manufacturing Process

Nitrogen is an essential nutrient required for plant growth however, until the discovery of the Haber-Bosch process in the early 1900s, nitrogen could not be chemically produced, jeopardizing global food security for a growing population. Large scale production of ammonia and ammonia-based products via the Haber-Bosch process continues to significantly contribute to crop production and is necessary to feed our population today. To date, there is no comparable process to produce nitrogen-based fertilizers at this scale.

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The Haber-Bosch process combines hydrogen with nitrogen in the air to produce ammonia. Hydrogen production is therefore the first step in this manufacturing process. Canada's nitrogen production facilities rely on natural gas as a feedstock which, through steam-methane reforming, produces hydrogen, carbon monoxide and small amount of CO_2. The hydrogen produced is then reacted with atmospheric nitrogen in the presence of a catalyst to produce ammonia.

Combustion versus Process Emissions

Natural gas is essential to the fertilizer sector – both as a fuel for heat production and as a feedstock. It is the primary input in nitrogen production with 70 to 90 per cent of a facility's input costs typically attributed to natural gas due to its role as a feedstock in ammonia production. It is also used as a fuel to provide the heat required in nitrogen and potash production.

Natural gas is delivered to nitrogen production facilities through a pipeline where it is used to heat the steam methane reformer and to provide the required methane for this reaction. The steam-methane reforming process is endothermic meaning it requires heat to produce the necessary pressure that can react methane with steam to produce the hydrogen required for the Haber-Bosch process. Natural gas is primarily composed of methane which provides the necessary reactant for this process – making natural gas both a feedstock and a fuel for ammonia production.

Ammonia is a nitrogen fertilizer product in its own right; however, it can also be converted to urea by reacting it with the CO_2 emissions produced during the steam methane reforming process. Displayed in the following reactions, you can see that for every molecule of hydrogen produced there is an equal amount of CO_2 produced which is referred to as process emissions. Therefore, a significant portion of process CO_2 emissions are fixed by chemistry and cannot be reduced by the nature of steam methane reforming process. A substantial amount of these process CO_2 emissions are captured and used by Canadian producers in the associated production of a solid urea fertilizer product.

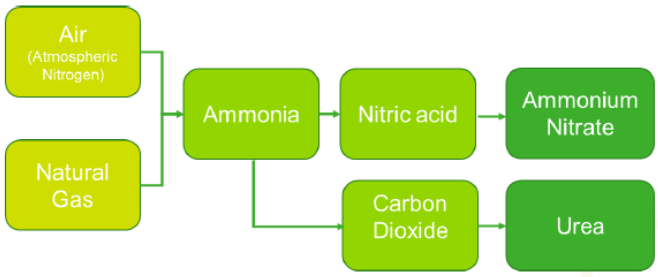

Figure 1: General outline of the nitrogen manufacturing process.

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$$CH_4 + H_2O \rightarrow CO + 3H_2$$

$$CO + H_2O \rightarrow CO_2 + H_2$$

Figure 2: Steam-methane reforming and water-gas shift reaction.

The Hydrogen Strategy for Canada states that Canada is one of the top ten global producers of hydrogen via steam-methane reformation of natural gas and is well positioned to transfer to clean pathways going forward. It is important to understand the different opportunities for emission reductions at a nitrogen production facility.

Nitrogen manufacturers have eliminated the "low hanging fruit" for further emissions reductions; a position not universally held by other manufacturing industries. The sector implements the best technology and practices available, and current production systems based on Haber-Bosch and Ostwald have been used for decades as the most efficient method to produce ammonia and nitric acid, respectively.

It is true that the fertilizer industry already captures a significant amount of process emissions through the production of urea, however, science limits the ability of the industry to make further reductions in greenhouse gas emission levels. A study sponsored by Natural Resources Canada concludes that the theoretical maximum reduction potential on combustion gas is minimal[2].

Ammonia: An Opportunity for Canada's Hydrogen Economy

Hydrogen Storage and Transport

Hydrogen has a large potential in Canada and around the world – as a fuel, for heat and as a feedstock for industrial processes. However, due to its chemical composition, hydrogen is very difficult to store and transport safely. Not only is hydrogen a combustible gas that requires high pressure tanks, but it also has a very low boiling point as a liquid which requires it be stored and transported at cryogenic temperatures.

[2] Canadian Ammonia Producers Benchmarking Energy Efficiency and Carbon Dioxide Emissions

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Anhydrous ammonia is made of a single nitrogen atom and three hydrogen atoms and with a higher boiling point can be stored and transported as a warm liquid. Industrial customers use ammonia in emission control systems or other industrial processes; however, As a readily used fertilizer, ammonia is already safely stored and transported in large volumes via pipelines, railways, trucks, and ports in Canada, and globally. Canada's industry sets exceptionally high standards for product handling and stewardship, through world-class codes of practice, advanced tank car design and robust regulation. The Canadian fertilizer industry offers a unique opportunity to safely produce, store and transport hydrogen as ammonia through existing production and transportation infrastructure.

A required increase in transportation infrastructure presents social and economic challenges for the efficient transportation of hydrogen. For example, railway transport introduces costly tariff agreements or constructing a pipeline to Pacific ports through British Columbia could be challenged by social or political concerns. These challenges will need to be addressed proactively if Canada hopes to export hydrogen as a global commodity. With its track record of safe and efficient transport of ammonia across Canada and globally, the Canadian fertilizer industry should be consulted to leverage existing infrastructure and knowledge.

Ammonia as a Fuel Source

After storage and transportation of ammonia, hydrogen can be separated from the nitrogen atom and used as fuel or feedstock. Additionally, ammonia can also be used as a carbon-free fuel without the need to extract hydrogen from the molecule. Since ammonia carries three hydrogen atoms for every nitrogen atom, it has a very high hydrogen density which allows it to be used as a fuel through combustion or with solid oxide fuel cells[3]. An international export market for ammonia as a fuel is being supported by global investments. Japan is currently investigating ammonia as a fuel for power generation[4] and by the International Marine Organization is looking to hydrogen and ammonia as low-carbon, alternative fuel sources[5].

Market Demand for Low-Carbon Fuel

As the world seeks to mitigate climate change and meet its net zero targets, the global demand for low-carbon fuels will continue to grow significantly. The Canadian fertilizer industry is uniquely positioned to meet this demand through experienced production of hydrogen and ammonia but requires significant investment opportunities to modify equipment and chemical processes.

[3] Science and technology of ammonia combustion
[4] Japan Ministry of Economy, Trade and Industry, International Resource Strategy
[5] Argus Media. Ammonia to lead shipping in decarbonization.

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Through the Haber-Bosch process outlined above, grey hydrogen is produced when manufacturing ammonia and other ammonia-based products. Most nitrogen production facilities in North America produce grey hydrogen, with a few producing blue hydrogen through implementation of CCS technologies. Green hydrogen, or carbon-free hydrogen, can be produced through electrolysis of water, but implementation of this technology has not yet been seen in Canada due to its technical and economic challenges.

The transition from grey to blue or green hydrogen will require investments, infrastructure adjustments, and access to alternative energy sources. Canada's nitrogen manufacturers already safely produce, store and transport hydrogen as ammonia. It is recommended that the Federal Hydrogen Roadmap create opportunities for existing hydrogen producers to achieve reductions in carbon intensity and work with Canada's existing ammonia production facilities to realize the potential of a low-carbon fuel economy.