Federal Clean Fuel Standard Regulations Comments

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Request for Comments

The proposed *Clean Fuel Regulations* were published in the December 19th version of *Canada Gazette*, Part I:
http://www.gazette.gc.ca/rp-pr/p1/2020/2020-12-19/html/reg2-eng.html

The proposed Regulations will reduce the lifecycle carbon intensity (the amount of GHGs per unit of energy) of liquid fuels used in Canada, and will support the production of cleaner fuels in Canada, including cleaner fossil fuels and lower carbon intensity biofuels. The Clean Fuel Standard is an important part of exceeding Canada's 2030 climate target, and specifically to see the type of economic and environmental transformation required to meaningfully reduce emissions in the oil and gas and transportation sectors.

The proposed Regulations will require liquid fossil fuel primary suppliers (producers and importers) to reduce the carbon intensity of their fuels used in Canada from 2016 levels by 2.4 gCO_2e/MJ in 2022 increasing to a 12 gCO_2e/MJ reduction in 2030. This represents a decrease of about 13% below 2016 levels in the carbon intensity of liquid fuels used in Canada by 2030. To drive innovation at the lowest cost, the proposed Regulations establish a market-based credit system. Regulated parties must create or buy credits to come into compliance with the annual reduction requirements. Parties with an excess of credits can bank them for use in later years or sell them. The proposed Regulations also provide opportunities for non-regulated parties to create credits.

The proposed Regulations provides three ways to create credits:

1. *Compliance Category 1: undertaking projects that reduce the lifecycle carbon intensity of fossil fuels (e.g., carbon capture and storage, on-site renewable electricity, co-processing).*
2. *Compliance Category 2: supplying customers with low carbon intensity fuels (e.g., ethanol, bio-diesel).*
3. *Compliance Category 3: investing in advanced vehicle technologies (e.g., electric or hydrogen fuel cell vehicles).*

The proposed Regulations are subject to a 75-day comment period, which ends on March 4, 2021. Any person may, within 75 days after this publication, file with the Minister of the Environment written comments on the proposed Regulations.

In addition to the proposed Regulations, the following documents have been published (and are subject to the 75-day comment period (canada.ca/clean-fuel-standard):

- *Regulatory Analysis Impact Statement*
- *Fuel LCA Model Methodology*
- *Quantification Method Development Guidance Document*
- *Quantification Method for Low Carbon Intensity Electricity Integration*
- *Quantification Method for CO_2 Capture and Permanent Storage*
- *Method for Validation, Verification and Certification*

Please submit comments in writing to ec.cfsncp.ec@canada.ca addressed to:

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In accordance with section 313 of the Canadian Environmental Protection Act, 1999, any person who provides information in response to this notice may submit with the information a request that it be treated as confidential.

Hydrofuel Comments

Hydrofuel believes that the federal governments approach to mitigating climate change though the Clean Fuel Regulations (CFR) is fundamentally flawed for the following reasons. Canada's commitment is achieving GHG reduction; the CFR, as of 2021-01-11, is intended to reduce GHG emissions from [only] liquid fuels by 13% [1], of 605 Mt of **all** Canadian fossil fuel emissions. The ECCC is imposing a "how-to-do" as opposed to a "what-to-achieve" requirement on Canadian oil industry (world-class) professionals to accomplish its national commitments.

1) This *CFR draft* report communicates a fundamentally flawed approach in the endeavour to **reduce** Canada's contribution to global, deleterious CO_2 emissions **by 13%**.
Canada's new 2020 Climate Plan (**CCP**) [2] errs in its "Modeling and Analysis Annex" (Table 1 & 3) [3] inferred accomplishment of a **92 M**illion **t**onne reduction in the **729** Mt CO_2 target of Canada's National Inventory Reports – 2020 Edition **(NIR)** Part 1 & Part 3 [4].

2) This quantification error is confirmed by *Canada Energy* Regulator [5], emissions imputed from 11,877 PJ of end-use 2018 energy consumption totalling 675 Mt of CO_2, not the 596 or 598 as reported in the above NIR. Canada's CO_2 reduction commitment target now totals at least **810 Mt of CO_2**. *See Appendix 2 (Energy and Carbon Estimate).*

3) The scope of Canada's" CFR regulation" project is incomplete, inaccurate in scope of work to be accomplished, and without demonstrable establishment of the fundamental quantification or rationale to preclude concerns imperiling s.6(1) of the *Impact Assessment Act* [6] [7].

4) Other apparent NIR omissions such as non-marketed fuel consumption, asphalt, agriculture buildings, and LCA (Life Cycle Analyses) carbon intensity increases could further impact Canada's omissions target, by as much as 25% (**see** *ECCC's LCA-Model paper* [8]). Moreover, the CCME [9] Pan-Canadian Greenhouse Gas Offsets Framework exhortation to avoid double counting should ensure that Impact **A**ssessment **A**ct (**IAA**) "quantification" will function as a management tool rather than a social report of outcomes.

5) Canada's 2030 emissions commitment (**achievement of ~211 Mt /30% CO_2 reduction**) and 2050 (**achievement of net-zero CO_2 emission**) commitment **are not ambiguous.** Knowing that 1 gigajoule of energy (work) from a carbonaceous fuel energy is always the "same", and likewise knowing that solid, liquid, or gaseous forms of carbon fuel has a unique carbon content, proper reliable management of GHG oxides is achieved by measuring the respective fuel in terms of its specific work capability which imputes a corresponding (natural science) CO_2 emission impact upon end-use consumption.

6) The apparent social science behind the restricting of this fuel regulation to liquids will not alter long proven realities of established natural science. "Liquid petroleum" fossil fuels are well known (globally) to produce 30% more carbon dioxide per gigajoule than "natural gaseous" fossil fuels, and liquid petroleum is well proven to produce 30% less carbon

dioxide per gigajoule than "solid" fossil fuels. The most direct form of achieving carbon dioxide emissions reduction is by switching from solid to liquid fossil fuel or by switching from liquid fossil fuel to gaseous fossil fuel.

7) Respectfully, the intended, proposed Regulations supplant a flexible, performance-based policy tool that respects the natural carbon intensity (CI) of fossil fuels harvested, processed, refined and imported in Canada. These regulations must ensure harmony with global end-use consumption emissions quantification practices [10] that have assured fossil fuel consistency [11] in the management of upstream, midstream, and downstream activities. This is why renewable fuels (biogas, biodiesels, wood chips are emitters of carbon dioxide) have been successfully blended with harvested fossil fuels.

8) These same (natural science) management principles accommodate infusing pure hydrogen, or co-firing pure hydrogen, or ammonia, with a solid, liquid or gaseous fossil fuel in such manner that end-use energy (work) performed **renders affective GHG reduction** per gigajoule; given adherence to end-user safety needs, accurate reliable risk limits are easily confirmed/established for the insurance underwriting community.

9) The foregoing characterizes focal points that permit realistically advancing from potential to **possible action needed** to achieve Canada's energy-switching, GHG-reducing, goal. Critical is continual mindfulness of the regenerative physio-chemical nature of (fossil fuel) energy constantly changing its form, not its CI. GHG reduction infers reduced (**total**) intensity of carbon emissions **which is what Canada has committed to achieve**; these draft regulations have been erroneously structured on reducing the carbon intensity of (**individual**) emissions (hence enhancing *Sisyphus* results).

10) Executing/achieving a GHG reduction plan across Canada's 13 ecosystems' goals necessitates "mass-balanced" management configuration that respects the idiosyncrasies of each ecosystem within the whole of the national achievement goal. A "mass-balance" approach facilitates the optimizing of positive environmental affects, the mitigating of negative environmental effects within each ecosystem, and, more easily exposing goal achievement (**hindrance or help**) likelihood.

11) For example, western provinces have access to ample natural gas and Carbon Capture and Sequestration (CCS) resources for blue hydrogen, central provinces (MB, ON, QC) are blessed with ample hydro/nuclear resources for green hydrogen, and eastern province have deficient resource access for hydrogen deployment, as do the northern territories. Accordingly, assigning a higher proportion of the national 2 billion tree planting program to enhance GHG reduction (carbon sink) capacity may benefit ecosystems where forestry activity is of lower national proportion, thereby inducing more opportunity for synthesizing hydrogen or more mitigation of resource lacks.

12) The reality of energy switching is "incremental"– everything will only happen on the *macro/micro* level one step at a time. Benefit from current "*power to gas*" hydrogen storage schemes will depend upon reliable security of supply, pricing, consumer safety and timely (**SEA**) Strategic Environmental Assessment. The energy *density of Ammonia **(4.32 kWh/liter)** exceeds the energy density of Liquid Hydrogen (**2.54 kWh/liter).*** To offset likely "ripple effect" delays with pure hydrogen, alternative CARBON-FREE hydrogen-energy carriers such as anhydrous ammonia must be deployed to enhance improved timeliness in achieving national GHG reduction goals.

13) Deployment of "*energyhub-microgrid*" thinking is *the epitome of the laws of energy*, more so when expanded with a GHG reduction perspective. Hydrogen roadmap activities will have to mirror "mass balance" attributes in ecosystems (e.g., melting Arctic) where abundant methane hydrate escape and abundant water vapour is likely to increase planetary surface temperatures. Imperative will be capacity for self-evident/efficient definition of foreseeable impacts and resolution of respective (*horse before the cart*) response needs to achieve national goals - synthetic fuels that best mimic natural science and enhance the ESG aspects of resiliency.

14) These draft **regulations fail** to convey demonstrable achievement (recovery/attainment) measures of **meaningful GHG reduction** that leads to ultimate overall net-zero emissions. Globally, it is estimated that 1800 Billion tonnes of CO_2 have now (2020) been emitted by anthropogenic activity since 1960.

Discussion

Carbon Pricing

The government announced on 2020-12-11 [12] an increase of the carbon tax [13] which would reach a $170 / tonne CO_2 level by 2030. This followed up on a prior (three weeks before) announcement of tabling new legislation (Bill C-12) [14] that would force current and future federal governments to set binding climate targets to get Canada to net-zero carbon emissions by 2050. This new bill did not set out exactly how the federal government should go about reducing emissions; it simply stipulated setting a goal, and working to achieve it through measures that are deemed effective.

BNN reported a pledge of $15 billion in new spending over 10 years, some of which will be funneled through green initiatives funded by the retooled Canada Infrastructure Bank [15]. At the same time, ECCC released "***A Healthy Environment and a Healthy Economy is Canada's plan to build a better future***" [2] – a plan that includes 64 new measures and $15 billion in investments in addition to the Canada Infrastructure Bank's $6 billion for clean infrastructure announced this fall as part of its growth plan. This 79-page plan, with 13 listed annexes, has been found to contain some serious flaws/shortcomings.

On page 63, was a depiction of distribution of projected 2030 emissions target reductions by sector. On page 62, a graph had depicted projections of exceeding Canada's 2030 emissions target (directing the reader to refer to their ***Modelling and Analysis*** annex [3]). However, on page 2 of this annex, and again on page 6, projected and historical emissions data from Canada's National Inventory Report (NIR) 2020 was charted. These reports indicated that (716-612=)104 **Mt** of CO_2 emissions had been **eliminated** between **2018 and 2020**.

The government report (dated 2019-10-10) of "***Clean Canada: protecting the environment and growing our economy***" [16] depicted these 2030 targets differently; included had been **unmodelled** measures of 79 **Mt and unidentified** measures of 13 **Mt.** These differences fully distort the ability to ascertain likely ratios (free cash flow) of investment **$$** to aspired **Mt** of CO_2 reduction. For different reasons, concerns [17] (e.g., stable transitions for certain supply chains) also exist.

Further aggravating this finding was the *Pricing Carbon Pollution* annex [18] did not explain how the $170/tonne of CO_2 was reached in its above "***Healthy Plan***" (pages 7-10 & 25-30) then induced the reviewing Canada's Social Cost of Greenhouse Gas [19] and its 2019 carbon pollution pricing systems [20] which had (pg 4,Table1) demonstrated some differences with the federal carbon pricing backstop structure [21]. Of the five (5) fossil fuels listed, only the "Marketable Natural Gas" unit pricing was consistent with the backstop.

This kind of inconsistency can be resolved by the CER or NRCan establishing Canadian emissions standards for measurement purposes of each type of fossil fuel that is to be subject to

regulatory control – kg CO_2/***G**iga**J**oule*, as is similarly distinguished [10] for other pertinent pollutants like NOx, CH_4, etc. More so, this type of standardization allows for consistency in planning, forecasting, etc, and appropriate equilibrating between private and public entities. Natural science "baseline" terminology communicates reliably and easily to social (understanding) preferences while maintaining clarity.

Consistency

Canada's climate plan [22] structure does not utilize its resources [23] to easily facilitate **national consistency** between its jurisdictions or public/private entities in a manner that harmonizes. A lot of their data can be considered reliable simply due tax levy structure on fuels [24]. Accordingly, end-use consumption can easily impute GHG emissions at point-of-sale transaction which can also designate commercial sector [5] (macro indicator = end-use demand) purpose by jurisdiction.

It can ease potential confusion prompted over sectors with a category like buildings. For example, "buildings" in urban Canada are regularly categorized consistent with municipal property taxation purposes. However, in rural Canada the majority of "buildings" are agricultural-, aquaculture-, or food processing- purposed that consume tremendous amounts of energy and emit voluminous (GHG) gases, liquid (contaminant) waste streams, and water. Everything that has an organic content involved in an activity or enterprise is already measured /measurable because energy (work) is naturally imputed/imputable by natural science laws.

For reasons unknown, omitted were simplified explanations of relationship between energy and anergy [25], and emergy [26] which could have facilitated comprehension of capacity of energy available for useful work, disorganized energy not available for useful work, and unused disorganized energy that can be combined/regenerated to provide useful work in other natural or synthetic systems as a "renewed" useful energy , i.e., a **renewable energy**. (e.g., ammonia, methanol)

As part of Canada's foreseen energy future, a "Generation Energy Council" was mandated to advise on how Canada can transition to a reliable, affordable, low-carbon economy in the future. This council issued its report in June 2018 [27]. It identified four main pathways - all of which must be pursued for Canada to reach its low-carbon future – and five principles to guide the transition.

The government has a handle on its "climate" commitments (*it knows things are worse than reported and it must "buy time" until the SCC has rendered its decision on carbon tax and until the pandemic-consequences start improving*). *The truth of the matter is that Canada's emissions are likely closer to 1000 Mt of CO_2, not the 700 Mt being talked about.*

Canada's LCA "carbon intensity" calculation appears to be a "justification" to mask the 92 Mt quantitative error (see *paragraph 1 above*) in their published emissions target*. ECCC staff were also deemed to know better when they sanctioned the federal share in a **$68 million** Summerside, PEI solar project to deliver 600,000 **kWh /year** of electricity**).***

Canada **agreed** with the IPCC that the **objective is not to predict** the extent of global GHG emissions, the **objective is** for each country **to achieve** substantive GHG emissions **reduction.** Canada's share of the global reduction objective amounts to **2%** of the global need – less than 1000 Mt (**million tonnes**).

Canada, like many others, has difficulty in assuring the application of common sense. Biogenic methanes, sealed (**in abundance**) throughout Canada's northern region, appear to have been purposely excluded from ECCC's fastidious effort in preparing its 501-page calculation of LCA emission "CTCG" factors – like those simply "deemed" within BC's legislation (which permits LCA "contestability").

When the "confirmed" total of **605 Mt of CO_2 from fossil fuels** in the "Pan Canadian Framework" is compared with the inferred total of **721 Mt (million tonnes) of CO_2 emissions** in the Canada Energy Regulator 2018 energy end-use consumption of ~11,877 PJ (*which excluded non-marketed fuel consumption emissions*) [5], one can conclude the ***Table 1*** represents a potential baseline for an LCA guideline – a guideline that contributes little to achieving the IPCC objective. *Note that ECCC's LCA-Model paper* [8] *does NOT appear to account for the reality associated with non-marketed fuel consumption.*

Table 1 (Carbon Intensities for Fossil Fuels)

The full carbon intensities from cradle-to-consumer-gate(CTCG) and cradle-to-combustion(CTC) are presented in Table 44. The same sources of modelling variability noted above drive the differences in the CTCG comparison between the results and GHGenius.

Table 44: Carbon intensities for fossil fuels (gCO_2e/MJ HHV)

	Study Results		GHGenius (5.0c)	
Product	CTCG	CTC	CTCG	% Difference
Blended Gasoline	24	95	22	8%
Aviation Fuel	19	88	19	1%
Kerosene	19	87	19	0%
Diesel	24	96	22	9%
Light Fuel Oil	24	95	15	39%
Stove Oil	24	92	15	39%
Pet-coke	22	104	13	41%
Heavy Fuel Oil	22	97	15	33%

Compare the (CTC - CTCG) in ***Table 1 (Carbon Intensities for Fossil Fuels)*** with the corresponding "carbon intensity" factors of the US EPA [10]. These fuels have the same end-

use chemistry (*and emission factors*) everywhere in the world – s*ave for minor variants involving harvesting and gathering tasks*.

Science vs Expediency

For ECCC to impose on a Canadian producer (importer) a low-carbon-intensity fuels (LCIF) demonstrates Canada's substantial ignorance (*consequences*) of the matter. Any fossil fuel that does not comply with a typical (international) end-use specification is denied acceptance by the end-user and returned. The **chemistry** (***not convenience***) of an "end-use" fossil fuel product is what **determines GHG emission factors** (*and legal consequences*).

The LCA modelling mechanism, the clean fuel standard, the December 12-2020 climate plan, and other like regulatory analyses all clearly demonstrate, a) lack of collaboration within the relevant Canadian ministries; b), incompetence or carelessness; and c), apparent contempt for Canada's formal commitments to the world. *The modelling appears to very much mirror "cart-before-the-horse" thinking in the LCA report* [8].

Our sense is that the evidenced lack of mass balancing and the observed carelessness in charts/tables (*in Canada's latest climate plan*) mirrors profound bureaucratic weakness that must be ameliorated – immediately.

Just as Canada has a Chief Medical Officer overseeing the pathway of its national health needs, it also needs a Chief Science Officer to oversee the pathway to reducing deleterious GHG emissions.

A plan is not a plan because "plan" appears in the document title or because increased carbon tax rates are announced. Many people appear to know not of global practices/requirements within the fossil fuel industry. *Stylized facts* and assumptions remonstrate proven science.

Consider the following:

A) The CER chart [5] in ***Table 2*** infers that 725 Mt of CO_2 emissions from fossil fuels in 2018, 727 Mt of CO_2 emissions in 2019, and 677 Mt of CO_2 emissions in 2020 (**thanks to COVID**). *If life cycle (LCA) emission rates would be applied, the inferable Canadian total CO_2 fossil fuel emissions would be 25% higher (906 Mt in 2018, 909 Mt in 2019, and 846 Mt in 2020).*

Table 2: End-Use Demand

End - Use Demand

Select Report Version: Canada's Energy Future 2016: Update | Select Appendices: End - Use Demand | Select Case: Reference | Select Region: Canada

Export to Excel

Reference Case: Canada

Total End-Use Sector - Petajoules

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Total End-Use	10,863.47	11,040.59	11,290.60	11,499.01	11,436.46	11,548.44	11,747.12	11,876.63	11,977.38	12,054.26	12,132.74
Electric	1,890.47	1,890.87	1,934.49	1,976.50	1,959.83	1,999.68	1,977.55	1,993.11	2,018.51	2,031.66	2,045.96
Natural Gas	3,458.33	3,541.54	3,784.52	3,944.77	3,984.92	4,001.67	4,191.63	4,250.32	4,287.39	4,307.77	4,336.13
RPP	4,722.46	4,836.08	4,773.31	4,713.01	4,675.13	4,729.85	4,770.25	4,823.39	4,860.16	4,902.21	4,938.08
Biofuels & Emerging Energy	577.72	572.97	618.42	632.26	645.73	645.09	639.85	642.23	644.30	646.98	647.79
Other	214.49	199.14	179.86	232.48	170.86	172.15	167.84	167.59	167.02	165.65	164.77

B) The following **Tables 3-6 (Canada's Climate Plan, Annex 1, Tables 1,2,3)** [3] [22] portray a different perception about CO_2 emissions in Canada. Table 1 indicates CO_2 emission projections being reduced by 92 -104 Mt (Million tonnes) between 2018 and 2020, increasing by 37-45 Mt by 2030 to an overall total of 657-674 Mt of projected CO_2 emissions. Yet in Table 3, the "*magic in the plan"* provides for a further reduction to the desired level of emissions.

"Insult to injury" is seen on page 3 of the annex titled CARBON PRICING. It is very difficult to ascertain from the information in these tables how this new climate plan justifies ***increases*** to the carbon price ***from 2022 to 2030 of $15/tonne per year*** where in 2030 it reaches **$170/tonne or more later.** (*Until the SCC decision is rendered, further comment would be futile?*)

Tables 3-6 (Canada's Climate Plan, Annex 1, Tables 1, 2, 3)

Table 1: 2020 Reference Case Emission Projections by Economic Sector from 2005 to 2030 (Mt CO_2 eq) (Including LULUCF Accounting Contribution)

	Historical				Projected		Change 2005 to 2030
	2005	2010	2015	2018	2020	2030	
Oil and Gas	158	159	191	193	177	194	36
Electricity	119	96	81	64	38	21	-98
Transportation	161	168	172	186	155	178	17
Heavy Industry	87	75	79	78	65	82	-5
Buildings	86	82	86	92	90	82	-5
Agriculture	72	68	71	73	73	77	5
Waste & Others	46	42	41	42	39	41	-5
LULUCF[2]	n.a.	11	-8	-13	-25	-17	-17
Total (excl. LULUCF)	730	691	720	729	637	674	-56
Total (incl. LULUCF)	730	702	712	716	612	657	-73

Note: Numbers may not sum to the total due to rounding. Historical emissions data comes from Canada's National Inventory Report (NIR) 2020.

[2] By design, the LULUCF accounting contribution for 2005 is zero. The LULUCF accounting contribution for the historical and projected periods cannot be compared directly, because the scope of available data differs between historical years and projections.

Table 2: Expected Emission Reductions of the Plan in 2030

	Projected Emissions in 2030 (MT)
2020 Reference Case	674
Sectoral Measures, post-2022 carbon price and CFS (liquid only)	144
LULUCF accounting contribution	17
Nature-Based Solutions and agriculture measures	10
Total Projected Emissions from the Plan	503
Canada's 2030 Target	511

Table 3: Expected Emission Reductions of the Plan in 2030 by Sector

	Historical				Projected		Change 2005 to 2030
	2005	2010	2015	2018	2020	2030	
Oil and Gas	158	159	191	193	177	138	-20
Electricity	119	96	81	64	38	11	-108
Transportation	161	168	172	186	155	151	-10
Heavy Industry	87	75	79	78	65	61	-26
Buildings	86	82	86	92	90	65	-21
Agriculture	72	68	71	73	73	74	2
Waste & Others	46	42	41	42	39	31	-15
LULUCF, NBS and agriculture measures	n.a.	11	-8	-13	-25	-27	-27
Total (incl. LULUCF)	730	702	712	716	612	503	-227

Note: Numbers may not sum to the total due to rounding. Historical emissions data comes from NIR 2020.

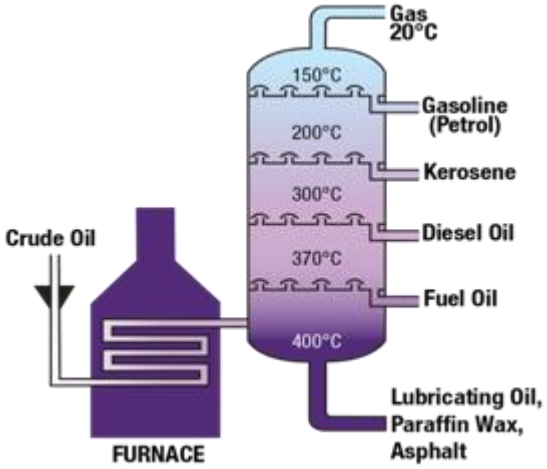
Ethanol and Other Renewables

"To drive innovation at the lowest cost, the proposed Regulations establish a market-based credit system. Regulated parties must create or buy credits to come into compliance with the annual reduction requirements. Parties with an excess of credits can bank them for use in later years or sell them. The proposed Regulations also provide opportunities for non-regulated parties to create credits."

The CFS focuses on fossil fuels but then exempted ethanol and biofuels from their "life cycle analyses" (e.g., land use). In addition, it classified these renewables as low carbon and thereby can increase the minimum blend-mandate from 5-10% to 15% basically by stealth. The EU no longer classifies these as "green fuels" effective 2021, and has proposed rules to reduce these levels to 3.8 percent in 2030 and 7 percent in 2021. [28]

Why is Asphalt Ignored?

Asphalt [29] is a key output in refinery operations, then later subjected to further "preparation" operations that are already subject to ECCC regulations (*Asphalt Code of Practice*) [30]. Asphalt also appears to left out of the NIR, CFS, etc. Even though asphalt is not a liquid transportation fuel, because it is a substantial liquid petroleum product, asphalt MUST be considered in the ECCC's efforts to reduce CO_2 emissions.



See Petroleum Products Facts [31]*, Note: outputs + capacity (2020-10-06 update)*

Intentions vs Actions

Our sense is the tending to focus more on the prioritizing of "Carbon Credit Compliance" rather than prioritizing the mitigation pathways to achieving GHG reduction. In the vernacular, our concern is that horse must be provided with sufficient strength/vision to get the cart to arrive at the agreed upon destination.

Our view is that the "carbon increase" corresponds to the amount of "oxygen decrease" – chemistry cannot be simpler. 1700 billion tonnes of CO_2 emissions were made from 1200 billion tonnes of atmospheric oxygen; this is the imbalance induced by anthropogenic activity. Appendix A of the CFS [32] identifies a schedule for reporting on "credit creation" yet absents the amount of "carbon reduction" in the Validation, Verification and Certification pathway to be followed.

It seems that Canada's GHG reduction plan is going in the wrong direction (*in fact, and on paper too*). Where is the overall master plan for this climate GHG reduction program?

Carbon Pricing Inflation

The government is still returning carbon tax to people in the provinces that are now fighting the government in the Supreme Court. With a SCC decision in 2021, it will still take another year before the carbon tax would start flowing into the intended purpose. Regardless, the climate problem is worse in scope and Canada's north is melting faster so more money will obviously be needed to overcome the impact.

The proposed Regulations set a maximum price for credits acquired, purchased or transferred in the credit clearance mechanism (CCM) at $300 in 2022 (CPI adjusted) per compliance credit [33]. However, throughout the *Clean Fuel Regulations*, the price of a compliance credit is $350 each. The "**Regulatory analysis**" section then indicates that the "**Compliance credits created from certain activities that reduce emissions throughout the lifecycle of *gaseous and solid* fuels may also be used for up to 10% of the annual reduction requirement**." *Are gaseous and solid fossil fuels now included, by inference, in the CFS?*

Each compliance credit (*supposedly*) equates to 1 tonne of CO_2. Liquid fossil fuels, on average, emit about 72 kg of CO_2 per GJ implying that a tonne of CO_2 emissions is the equivalent of 14 GJ of RPP consumption (or approximately 375 liters of Refined Petroleum Product).

Essentially, that which is being imposed on a producer, or importer, is the equivalent of $1.00 per liter of product – a cost which will be imposed upon the consumer who, pursuant to Canada's new climate plan (carbon tax) rate of $170 per tonne of CO_2, will be subsequently exposed to $0.50 per liter more for consuming clean liquid fuel.

The bottom line is that these new regulations add $1.50 per liter of liquid fuel in place of the $0.13 per liter Canadians have been exposed to under the current Carbon Tax scheme.

Recommended Proactive Remedy

Using the ***Appendix 2 – Energy and Carbon Estimate*** as a guidance tool, the CER end-use energy consumption for the Transportation Sector implies that 843 PJ of diesel will emit 60 Mt of CO_2, and that 1369 PJ of motor gasoline will emit 98 Mt of CO_2.

Given that this CFS regulation is intended to reduce 13% (or 20 Mt) of transportation emissions, Canada's GHG reduction goal is achievable by replacing truck diesel with CNG that emits 25% less CO_2, and consequently render a reduction of approximately 12 Mt CO_2 – which is 60% of the CFS goal.

Likewise, converting vehicles to electricity from motor gasoline would then require a reduction of 8 Mt CO_2 - which is 40% of the CFS goal. Converting 8% of Canada's 25 million vehicles to electricity infers a need of 2 million EVs or FCEVs over a 10-year period. Respecting skepticism about likely success induces a mitigation option of modifying existing vehicles to operate on propane – which emits 10% less CO_2 than gasoline; or alternatively modifying existing gasoline vehicles to operate with ammonia that has no carbon emissions.

CN Rail used 462.7 million gallons of diesel fuel in 2018 [34], which generated 4.72 Mt of CO_2. Another option to reduce CO_2 emissions would be to retrofit CN's locomotives with a diesel-NH_3 dual fuel system. Using green NH_3 with an 80% substitution rate would render reduction of 3.78 Mt of CO_2 emissions [10], which is 19% of the CFS goal. Similarly, it would only require substituting 34% of the transportation industry's diesel fuel use with green NH_3 to render the CFS reduction goal of 20 Mt of CO_2. [35] [36]

> *Hydrogen-fueled internal combustion engines, using ammonia as the carrier, are an immediate, viable way to convert to a carbon emission free. Ammonia can provide a cost- and environmentally effective transient to hydrogen economy. (see Appendix 3). [37]*

This fuel switching strategy would be further mitigated by planting some of those 2 billion trees promised, achieving the needed GHG reduction can be seen by Canadians. Remember, the technology exists today, and is proven.

Canada's goal is clear: reduce CO_2 emissions for the benefit of the people who can also be pleasantly surprised to realize that CNG, propane, and ammonia fuels are much less costly.

Summary

Sadly, it would appear that ECCC has paid little attention to the accuracy and content of its reports. For Canada to succeed in its climate change mitigation effort, ECCC must be attentive to the accuracy and content of its reporting tools.

Hydrofuel Inc and Ontario Tech University recommend that the terms of reference on which this draft Clean Fuel Standard is based should be fully reviewed from the perspective of achieving Canada's GHG reduction commitment.

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Appendix 1 – Acronyms

CH_4 – Methane
CO_2 – Carbon Dioxide
NH_3 – Ammonia
NOx – Nitrogen Oxides, especially Nitric Oxide (NO) and Nitrogen Dioxide (NO_2)

BNN – Business News Network (Bloomberg)
CCM – credit clearance mechanism
CCME – Canadian Council of Ministers of the Environment
CCS – Carbon Capture and Sequestration
CER – Canada Energy Regulator
CFR – Clean Fuel Regulations
CFS – Clean Fuel Standard
CI – carbon intensity
CPI – Consumer Price Index
CTC – Cradle to Combustion
CTCG – Cradle to Consumer Gate
ECCC – Environment and Climate Change Canada
ESG – Environmental, Social, and Governance
EU – European Union
GHG – Greenhouse Gas
GHGenius – a free to download lifecycle analysis (LCA) model of transportation fuels in Canada
IAA – Impact Assessment Act ()
IPCC – Intergovernmental Panel on Climate Change
LCA – (Life Cycle Analyses
LCIF – low-carbon-intensity fuels ()
NIR – National Inventory Reports – 2020 Edition ()
NRCan – Natural Resources Canada
RPP – Refined Petroleum Product
SCC – Supreme Court of Canada
SEA – Strategic Environmental Assessment
US EPA – United States Environmental Protection Agency

Appendix 2 – Energy and Carbon Estimate

Canada's Energy Future 2016 : Update		https://apps.cer-rec.gc.ca/ftrppndc/dflt.aspx?GoCTemplateCulture=en-CA	
TOTAL End-Use Sector - Petajoules (**PJ**)	2018	CO2e kg/GJ	**Mt** CO2e
Total End-Use DEMAND	**11,876.64**		
Electric : via 7% **coal** + 11% **gas/oil** + 82% **non-fossil**	1,993.11	16	32
Natural Gas	4,250.32	56	238
RPP	4,823.39	72	347
Biofuels & Emerging Energy	642.23	72	46
Other	167.59	72	12
Residential Sector - Petajoules			
Total End-Use	**1499.16**		
Electric	546.63		
Natural Gas	698.45	**Hydrogen Blending ? => less GHG**	
RPP	81.27	**Ammonia Blending ? => less GHG**	
Biofuels & Emerging Energy	172.2		
Other	0.61		
Commercial Sector - Petajoules			
Total End-Use	**1,491.02**		
Electric	572.11		
Natural Gas	677.36	**Hydrogen Blending ? => less GHG**	
RPP	238.78	**Ammonia Blending ? => less GHG**	
Biofuels & Emerging Energy	0.77		
Other	2		
Industrial Sector - Petajoules			
Total End-Use	**6227.34**		
Electricity	870.02		
LPG & Petroleum Feedstocks	701.41		
Natural Gas	2,864.97		
RPP	709.93		
Solar and Geothermal	0		
Still Gas & Petroleum Coke	542.02		
Biomass	374.02		
Coal, Coke & Coke Oven Gas	150.03		
Other	14.94		
Transportation Sector - Petajoules			
Total End-Use	**2659.09**	**Road Asphalt ??**	
Electric	4.34		
LPG	7.09		
Natural Gas	9.54	**Hydrogen Blending ? => less GHG**	
Biofuels	95.24		
Aviation Fuel	275.17		
Diesel	842.61	**CNG ? Or NH3 ? Or both ?**	
Heavy Fuel Oil	54.92		
Lubricants	1.26		
Motor Gasoline	1,368.92	**CNG ? Or NH3 ? Or Both ?**	

CER explainer

End-use (or secondary) energy demand includes energy used in the residential, commercial, industrial and transportation sectors.

This includes includes non-energy use and producer consumption.

Non-energy use is the use of energy commodities for a purpose other than fuel.

Examples of this include energy commodities used as petrochemical feedstock, lubricants and asphalt.

Producer consumption accounts for the energy consumed by energy producers for their activity.

e.g., this includes the combustion of natural gas by natural gas producers to operate compressors and processing equipment.

Commercial sector energy use includes energy used by pipelines.

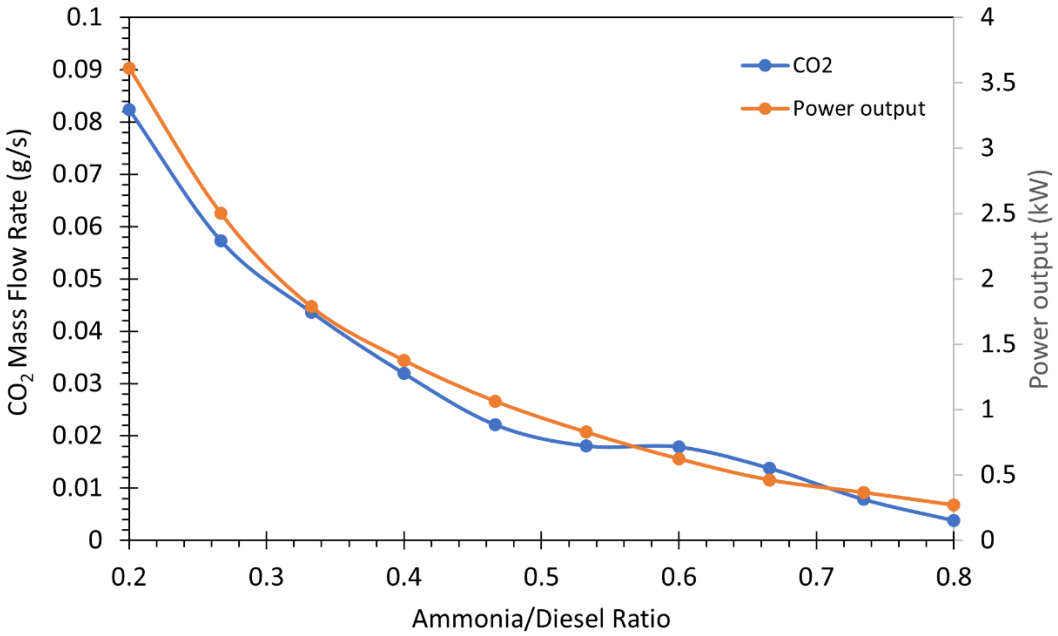
RPP includes asphalt, aviation fuel, diesel, gasoline, heavy fuel oil, kerosene, light fuel oil, liquified petrol gases (LPG), lubricants, naphtha specialties, oil, non-energy products, petroleum feedstocks, petroleum coke, still gas.

Biofuels and Emerging Energy includes biomass (wood), solar, geothermal, hydrogen, ethanol and biodiesel.

Other includes coal, coke, coke oven gas and steam, unless otherwise listed.

Industrial includes energy used for oil and gas production, processing and refining

Appendix 3 – Diesel-Ammonia Dual Fuel Engine Performance



Effect of the ammonia ratio in the diesel-ammonia mixture on the CO_2 emission and power output. (data from Ref. 37)

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