

January 4, 2018

Ministry of Energy, Mines and Petroleum Resources

Via email: [lcfr@gov.bc.ca](mailto:lcfr@bc.ca)

Re: British Columbia (BC) Low Carbon Fuels Compliance Pathway Assessment

Dear Ministry Staff:

We have noted your request to submit comments on the BC Low Carbon Fuels Compliance Pathway Assessment that was released on December 1, 2017. We have carefully reviewed the document and attach our comments to this letter.

In carrying out our assessment we note that there has been considerable push back by the existing fuel industry as to their ability to meet the existing regulations and the potential for further progress after 2020. On the other hand our own lack of progress can be attributed to that very same industry being unwilling to consider off take of a supply of gasoline that fully meets those and future standards. Blue Fuel Energy has carried out GHGenius studies on our proposed project and determined that the carbon intensity of the gasoline product will be in the range of 15 - 20% below that of existing gasoline and so would make a considerable contribution to BC's carbon reduction program. All of this can be achieved with conventional technology, which is well proven at the scale we envisage.

We believe that the market place reluctance has to do with the belief by the industry that if they do nothing then nothing will happen and their existing business plan will go on unchanged. We are convinced that this is simply a tactic of self-preservation by the industry whose outcome will be slow, if any, progress towards the goals.

We also note that similar impediments to change in California are even more strenuous with a range of lawsuits and other actions being launched by the industry against the LCFS in that jurisdiction. Please see:

(<http://www.sfgate.com/business/article/Judge-upholds-California-s-low-carbon-fuel-11234257.php>)

This is just one of the current rounds of litigation. We understand the immense pressure that your Ministry will be under to continue to insist on compliance with the regulations, but we have great hope

that your efforts will continue. There are conventional remedies, such as ours, that will pave the way for longer-term solutions such as fuel cell vehicles and electric cars.

In our own case we offer a solution that would immediately reach the regulatory requirement for 2020 for up to 40% of BC's current gasoline requirements at current economic values. This can be a game changer.

We hope that our comments will be of value to you in your deliberations.

Sincerely,

A handwritten signature in blue ink, appearing to read "Ron Britton". The signature is fluid and cursive, with a large initial "R" and "B".

Dr. Ron Britton  
Chief Technology Officer

## **Response to the discussion paper: British Columbia Low Carbon Fuels Compliance Pathway Assessment**

Blue Fuel Energy applauds the efforts of the Government of BC to enter into consultation with all stakeholders in the ongoing evolution of the Low Carbon Fuel Standards (LCFS) for BC. Nobody thought this would be an easy process and there are going to be bumps and misfires along the way. It is critically important that Government sets the standards of performance that will ultimately lead to a much lower emissions future. Doing this will contribute to an investment environment where lenders and investors know there is a long-term plan. Any signs of weakness at this important juncture will ensure failure to make real or sustainable progress.

The major difficulty in this regard is that the owners of the current fuels infrastructure, to a large part, are totally dependent on the continuing exploitation of fossil oil resources to sustain their business model and ensure the value of their enterprises to their shareholders. It is interesting that more and more we are seeing shareholder rights groups starting to insist on seeing the plans that companies have to sustain their current value in the face of global climate change concerns generally, and related governmental initiatives specifically. They are also requiring roadmaps to the future that will continue to attract long-term investment. In this regard the move by the Norwegian Sovereign Wealth Fund (Reference 1) to consider the process of withdrawal from investments in fossil fuel companies is particularly noteworthy.

For our existing fuels industry, the prospect of lower carbon fuels has several costly manifestations. First and foremost it is the beginning of a decline in the use of oil and its derivatives. This has an impact on short-term financial results as well as the book value of reserves which, to a large extent, underpin the market valuation of these companies. Secondly, it will force a redistribution of forecourt space at the distribution end as some of the new fuel alternatives will require different equipment and storage tanks in already crowded geographies. Additionally, market demand for their existing products shifts as a result of consumer attitudes and regulations. This has the unintended consequence of shifting the balance in refinery operating parameters leading to over or undersupply of certain products that are major components of the current mix. For example, a large increase in “renewable diesel” could mean there is no ready home for fossil diesel but the same amount of gasoline is required. The imbalance will have at least short-term consequences to refinery performance and financial performance, and may necessitate capital expenditure to retool refineries to rebalance their product slates to meet changing market demand.

However, we would caution that none of this is the burden of the Government, rather, it is a natural process in all markets where existing supply is superseded by new supply with either



better performance or lower cost or both. The difference here is the extent to which just a few large, integrated oil companies dominate the current fuel supply industry. This is most pronounced at the retail end where customers are familiar with this branding configuration.

In the final analysis, customers will make the determination (within the regulatory framework overseen by Government and choices available in the market). On average, we as customers, are driven by our perceptions of cost and reliability to a very large extent; and increasingly, by perceptions of environmental performance. In a market where customers are used to volatility in pump prices, those resisting change will cite the cost to consumers of any change as wealth destruction to that same consumer (Reference 2). This is regardless of the fact that today consumers have no impact on the price of oil other than through their collective buying habits and thus already accept significant volatility in fuel purchase price as a consequence.

At the same time customers cannot be left out of the thinking. An example is the apparent rapid acceleration in sales of electric cars as an alternative to conventional gasoline vehicles. At present with provincial incentives to purchase electric cars (\$5,000 – \$6,000 at point of sale) and the rapid expansion of purchasing choices and the dramatic fall in battery costs, some futurists are now predicting massive switches to battery based technologies as early as 2020 (Reference 3). It does not seem that there is a corresponding pricing strategy for the electricity these vehicles will consume and for many today, the electricity is being provided free of charge at local recharging stations etc. Faced with these obvious economic incentives and falling vehicle prices it is little wonder that consumers are starting to turn in this direction. We feel that this is a good outcome as long as sufficient supplies of low carbon intensity electricity are available, but it certainly underscores the uncertainty in the near term future for a fuel supplier (at least on a marginal basis in mature economies during the early years of electric vehicle adoption).

The main point is that Government must do the heavy lifting. Although a majority of Canadians believe that something must be done about climate change, this opinion often changes dramatically for many when they realize that it is they who will have to pay. For this reason, it is our strong opinion that the change must be accompanied by careful consideration of the cost of change and the simplicity of change that is required. Most Canadians would not feel as strongly about a \$0.05 / litre increase in fuel cost as they would about a \$0.50 / litre increase. Similarly, they would not feel as strongly about a change that did not force them to adopt to changes in the refueling system as they would to one which required new safety procedures or an extension of their refueling time or geographic availability (Reference 4).

For these reasons we chose to develop our project to produce Blue Fuel Gasoline employing as much renewable electricity and the minimum requirement for natural gas so as to produce a fuel identical with conventional gasoline with up to 20% lower carbon intensity. Because it is fungible, such a fuel can be 'accounted' for thus eliminating major distribution costs that blends



introduce. At the same time its production costs are in line with conventional fuels and its pricing should reflect its value in reducing GHG emissions, with little impact on the consumer.

Our first plant would provide roughly 20 % of BC's total gasoline requirements and up to 40% of its short-term GHG reduction targets for the gasoline segment. Augmentation of the process with even more renewable content can provide a steady stream of gasoline with decreasing carbon intensity as rule making and market dynamics dictate.

What's wrong with this model? It represents an increase in supply of gasoline at a time when no new capacity is required. In short, it will force some part of the existing industry to change its production plans to accommodate the new supply; so they do not want to see it introduced to the market. This is not a malevolent response; it is just self-preservation. To date it would appear that the industry is using all of its efforts to persuade Government that they cannot meet the requirements of the regulations so they need a longer time or a less onerous target.

Our assessment is that the current fuel providers are unlikely to be able to meet reduced carbon intensity fuels requirements for at least gasoline (and likely also diesel) in their refineries, and so to supply compliant fuels will require further blending of non-refinery products downstream of the refinery and thus reduced crude throughput. Moreover, the recent economics of refining to supply BC markets suggests the value uplift across the refinery (i.e. the "crack spread") exceeds the proposed penalties for non-compliance, which provides economic motivation to do nothing even if the proposed regulations are maintained.

This incumbent resistance is to be expected and we believe the Government has an obligation to continue to push for full attainment and a progression to steeper reduction in the future. California has recently decided in this way and pushed back at industry, which had been lobbying strongly for relaxation.

The following is a point by point commentary on the discussion paper:

1) **Section 2.1. - 2014 Consultation Summary**

Our comment on this section is that there is an underlying assumption that the industry will cooperate to achieve the targets. What is the regulatory action if this does not take place? Integrated fuel suppliers have told us that paying the penalty is "cheaper for them than constraining production from their own facilities". There is a strong element of truth to this assertion since the margin forgone by not distilling a barrel of oil is the sum of component margins back to the cash cost of oil production. If that total margin is say \$50 / bbl then the penalty for not achieving a 10% reduction (the current \$200 / tonne of CO<sub>2</sub> for non-attainment) is roughly \$7.50 / barrel vs loss of \$50 on that same incremental barrel. The math is meant to be directional and not exact. But this would imply that the penalty for non-achievement would



need to be about 7 times higher or roughly \$1500 / tonne of non-achieved CO2 reduction in order to back out the refinery capacity. This is impractical at this time.

2) **Section 2.2. - Warranty Statements**

We agree with the conclusions in the text but would caution that to the average consumer misperception of warranty issues could still be a big barrier. This is perhaps an area Government may wish to take some leadership to ensure that the warranty issue does not become a barrier.

3) **Section 2.1. - Misfueling**

Our response to this is that the industry has gone through this kind of change in the past with the elimination of lead as an additive in gasoline. However the more important issue might be availability of space for more fuel choices in the station forecourt and secondarily the cost of installation for little used spots. In a free choice world where several ethanol blends as well as CNG and hydrogen just to name a few must be supplied but the majority of the car fleet is still regular gasoline consuming vehicles the question becomes one of "Who is going to pay"? Or alternatively, only those fuels that have sufficient demand would be supplied, and thus the market will ultimately dictate fuel choices.

4) **Section 2.2. - Fuel Delivery Infrastructure**

We agree with the conclusion but can see that a plethora of choices can make for different circumstances to those in the past. Today broadly we have three grades of gasoline and some diesel availability at most pumps. Broadly interchanging these gasoline choices will not make much difference to vehicle performance and probably happens more often than we think. The very large price differential between grades is the main choice differentiator for many customers. When we get to blends, which are not compatible with older vehicles, this is not so apparent.

The particular issue of E-85 is interesting in that for the branded oil-major supplier there is no incentive to offer a product they have little ownership of, and so the auto manufacturer gets credit for a low emission vehicle that they know will probably never be used with its intended fuel. Here making the choice flexible for the consumer ensures the product is not available. There will also be the issue of price. Inspection of wholesale ethanol prices back over the past decade and comparing them with gasoline wholesale prices suggests a sort of volumetric parity, yet we know that E-85 as it is presently offered will only provide about 70% of the equivalent gasoline heat value (i.e. miles driven per gallon). A consumer might be fooled once or twice but it won't take long before they realize that they are paying about one third more for their fuel as measured by not going as far between refuelings.

It might also be instructive to look at the availability of ethanol with low carbon intensity as it would appear that carbon intensity standards may result in stratification of supply by price. While this is inherently a good thing for regulators it is not necessarily a good thing for ethanol



producers. As the world turns more and more to ethanol with low carbon intensity as the desired route, the unintended consequence will be a bidding war for extremely low carbon intensity product, increasing its scarcity. There can be no assurance that BC will be able to attract or capture the lowest carbon intensity ethanol.

E-10/15 and E85 were not chosen by whimsy but rather as a response to the difficulty of engineering vehicle parts that are able to withstand intermediate mixtures. While it may be true that E-85 and E-15 may be compatible with the materials of construction for a flex fuel vehicle it is by no means certain that an E-50 will be benign.

Having said all of this we agree totally that the market will establish its own value for carbon intensity based on a number of factors as we get to a more balanced approach.

5) **Section 2.5. - Market Control**

We cannot disagree with the data but it would be interesting to see the volumes sold by Integrated Refiner Marketers vs. Non Refiner Marketers as, intuitively, the Integrated would seem to have a much larger say.

6) **Section 2.6. - Concerns Regarding Availability of Fuel**

In a perfect world the Government has already created a new market, which should be attractive to new suppliers and technologies. This market is the market for low carbon intensity fuels. In practice, however, in order to be significant as a new supplier, scale is critically important. This means very large investments and consequent risks. Proponents with otherwise viable technology entries do not have the balance sheet capacity or ability to overcome market entry barriers that have been erected by incumbents to undertake such investments and are therefore inherently unattractive to investors whether for debt or equity. If the existing industry shuns support for these developments then who will undertake such investments? In our own case for example we feel very strongly that if we can achieve a contingent off take agreement then the funding will be available. We have no technology risk and we can derisk raw material costs substantially, and we can derisk market exposure significantly if we have known off takers. But in their absence there is a sense that if the people that need the product are not interested then where is it going to be sold? In this chicken and egg scenario only the government holds the big stick and it is our view that current suppliers feel if enough push back can be developed by the incumbents, then ultimately Government will cave in to the wishes of the industry. We would point out that the development of an ethanol industry took the combined lobbying efforts of all the corn states and a lobbying organization prepared to spend almost as much as the fuel industry to get the renewable fuel standard imposed in the US. This also happened at a time when there was a nationalistic and economic imperative in the US to reduce dependency on OPEC for oil.



Unfortunately, the political will of the people has not yet coalesced around global warming as an issue where individual sacrifice (e.g. paying higher fuel prices in developed economies) is required. At best it can be said that the majority of the population has accepted that global warming is an issue but not to the extent that they are willing to endure some personal hardship to combat it. This is because there is a strong voice of denial that will continually affirm that the price of taking mitigating actions is too high.

We would add that the, "unique deployment constraint", in our own case is strictly access to capital. The project has strong social license, a large contracted site, and access to rail transportation and electricity supply from BC Hydro's main transmission line. It is also situated in the prolific Montney Gas formation with a number of interested long term supply partners. First Nation support has been agreed with both of the neighboring nations.

#### **7) Section 3. - Compliance Scenario**

In general the compliance scenario has been well thought out. It seems as though a lot of improvement in carbon intensity for ethanol is assumed with little evidence that new low carbon ethanol supplies are on the horizon. To the contrary, our insight is that the much sought after cellulosic ethanol pathway is turning out to be much more difficult and much higher cost than forecast. (See the attached report from BiofuelsDigest on the current status of cellulosic ethanol Reference 5). The other downside risk is that the low carbon intensity ethanol which is available will be in high demand in all regions of Canada and the US and the BC market will have to attract it through price incentives. This would seem to put into question the forecast doubling of supply at the same time as reducing the CI to 14%.

On the positive side electric car populations may increase at a much higher rate than forecast and offset some of the aforementioned pessimism in the ethanol outlook.

We think that some penetration by our own natural gas to gasoline project could be included in the pathway as we foresee producing 20% of BC's requirements for gasoline at about a 20% CI reduction.

#### **8) Section 4. - Hydrogen**

Whilst the hydrogen fuel cell vehicle seems to have been just around the corner for a long time there are signs that all the major car manufacturers are much more confident about the future at this point. A large market potential has opened up with the failure of electric cars to demonstrate the range needed to entice families to invest. It would seem that a scenario where electric cars represent the majority of so called "town cars" and the fuel cell car will penetrate the touring car market. The challenge for fuel cell vehicles will be to solve the chicken and egg of refueling as hydrogen stations will require very high capital investment with only slowly developing utilization.





At the same time large scale hydrogen production from low carbon sources will be required to give hope to the eventual reduction in cost that will be needed. Blue Fuel Energy is developing a project with a partner to produce hydrogen by electrolysis. The concept is to add the hydrogen to an existing natural gas stream so as to lower the CI of the delivered natural gas. Such processes are being advanced with good success in Europe as a way to decarbonize the fuel system and to balance out intermittent electricity supplies from wind and solar (Reference 6). We are however somewhat alarmed to see that the new default value for BC electricity is being set at 19 G CO<sub>2</sub>/Mj as this will significantly erode the value of hydrogen as a CI reduction pathway. Overall electricity efficiency is seldom more than about 75% before transportation to the market and before energy used to compress at the station to 600 bar. This suggests the proposal of hydrogen at 11 G CO<sub>2</sub>/Mj may be very optimistic.

**9) Section 5. - Propane**

We fully support the conclusions reached in the discussion document. Propane may be seen as a transition fuel but it is a transition to nowhere. There is no logical sequence to convince motorists that they should modify their vehicles knowing that in a few years their fuel will disappear from the market.

**10) Section 6. - Natural Gas**

We have no strong views on natural gas other than like propane it suffers from no end game. We believe that it will continue to be used by a number of fleet operators (like BC Ferries) who have the fuel compression and delivery systems to manage their own supply. It has very attractive economics but in the end is limited in how far it can go to solve the GHG emission problems.

We have recently looked at the potential for RNG but supply is extremely limited and is probably best used to reduce the impact of much larger natural gas applications where it can be added directly to pipeline supplies.

**11) Section 7. - Electricity**

In the case of electricity we believe the rate of penetration is too conservative. A recent review of the state of development of Lithium Ion batteries suggests a cost crossover point with internal combustion engines in about 2020 (Reference 3). With the massive reduction in fuel cost (electricity is as much as 10 times less expensive on a cost/mile basis as gasoline) many consumers will overlook the issue of recharging time and convenience and plan most of their usage so as to recharge at night at home.

Although there is enough electricity available at present in BC the devil will be in the detail as to how many homes are adequately serviced to manage the recharge load. A recharge of 70 Kwh over 8 hours at home represent a load of about 9 kwh/hr or on a conventional 100 amp service, 90% of the available feed to the home. This will quickly make off-peak time peak time!!

**12) Section 8. – Dimethyl Ether (DME)**

DME is seen by many to be the ideal diesel fuel offering high cetane value and no sulfur content in a liquid at very moderate pressure. The liquid point would be the same as propane. The conclusion in the document is valid as there is no one proposing DME engines in North America. Some significant success has been shown in Sweden where Volvo has run a trial for several years and has committed to manufacturing a DME fueled heavy-duty truck (Reference 7). We believe Japan has also successfully demonstrated DME. The issue is that despite its virtues, there is no infrastructure in place and other than for fleets there is no incentive in retail markets to provide such a fuel.

It should be mentioned that our project to produce low carbon gasoline will produce DME as an intermediate product and could be modified to provide commercial quantities if demand develops.

**13) Section 9. Renewable or Low Carbon Gasoline and Diesel Fuel**

We have carried out a simple analysis of the availability of Biomass from forest waste in BC and the outlook at first glance is not good. Of course we have forest waste and the residue of the Pine Beetle kill is still available and not good for much else than gasification or wood pellets for the European market as the trees are now over ten years old and those that are standing are brittle and starting to rot. There is also technology available now for the gasification process but gasification of wood waste is not very carbon efficient. For the average unit of cellulose, gasification will give about one half CO and Hydrogen and one half CO<sub>2</sub>. The ratio of CO to H<sub>2</sub> is low and some of the CO needs to be sacrificed to produce sufficient H<sub>2</sub> utilizing the water gas shift reaction. By the time this has been done the yield of useful syngas is about one quarter of what would be derived from natural gas under the same conditions. If the CO and H<sub>2</sub> is converted to something like methanol or Fischer-Tropsch diesel further losses are incurred and so the yield per tree is extremely low (15 – 20%) based on starting carbon. To develop a suitably sized plant is limited by the economic distance to haul the waste which is estimated at about a 250 Km radius (or less) (Reference 8). Estimation of the available wood waste in such a radius suggests that feed for only about 1,000 tonnes/day of product can be achieved. This is well under the economic scale for such plants. Given that the plant needs a reliable supply for at least 25 – 30 years, harvesting can only be carried out on a sustainable basis. In a 250 Km radius only about 3% of the area can be harvested in any given year since the re-planting and second growth will take upwards of 80 years.

Such an enterprise can only be considered if there is a willing forest product partner who can commit to at least 25 to 30 years of operation in the catchment area.



At any rate the technology is not the issue but rather the availability of wood and wood waste. Until all of these issues can be resolved the promise is more of a boutique operation with minimal impact on the fuel supply.

**14) Section 9.2.2. - “Biocrude” refinery co-processing**

As was mentioned earlier in this response paper, any significant move to upset refinery operations in a modern refinery has major consequences on the operation of the refinery. Removing one barrel of crude from the crude run and replacing it with “biocrude” will result in a sub-ideal mix for the refinery and the product slate. To some extent that is why the companies active in this area of development tend to be start up technology companies, whereas the logical developers would be the oil companies themselves.

The issue of “not recognizing” these as renewable fuels points out another illogical tendency in existing regulatory efforts. It seems to us that the regulatory effort is targeted at lowering the CI of fuels not promoting renewables above all other approaches. We need to make very certain that all of the work of the Renewable Fuels Association has not blinded regulators to more conventional and often more economical ways to achieve the same result.

We first ran into this at the beginning of Blue Fuel Energy when we were looking at capturing the CO<sub>2</sub> from natural gas treatment plants offgas. Such waste is not going to stop whether we capture it or not, but if that CO<sub>2</sub> can be reused chemically to produce a fuel then it will replace an equivalent amount of fossil based fuel. Why then does it not get credit as a renewable since the CO<sub>2</sub> would be going to the atmosphere in any event? We were informed that if we recovered the CO<sub>2</sub> from the atmosphere it would be treated as a renewable, but avoiding all of the entropy associated with mixing it with the atmosphere is somehow not right. These kinds of philosophical Gorgon’s Knots do not help us make progress.

**15) 9.2.4. - Natural Gas Based Gasoline**

We have already discussed this earlier but further to say since the original discussions with the ministry, we now have a flow sheet that should result in almost a 20% reduction in carbon intensity using BC-sourced natural gas and electricity. That is still not of interest to the fuel marketers!!

**16) 10. - Methanol**

We agree that in the absence of proponents there is not likely to be a major thrust to include methanol as a motor vehicle fuel in BC. This is sad in a way as methanol is in many ways the ideal fuel. There are engineering solutions to most of the drawbacks cited and the product and its distribution are already in place. Methanol is also one of the very few potential fuels that bridges the gap from today’s motor fuels to those needed tomorrow such as hydrogen. It is a global high volume commodity safely handled in almost all countries of the world with an extremely high octane value and potential as a higher pressure compression engine fuel. It can



be easily converted to DME should that be necessary in the future and is environmentally much safer than existing fuels due to its rapid bio degradation. We believe that if we lived in a different galaxy (say China for example) and scientists were sent to develop the perfect fuel, methanol would be the result. A recent announcement from the Indian government's premier policy making body underscores this thinking (Reference 9).

**17) 11. - Ethanol**

While there is significant merit in the discussion paper contents with regard to ethanol they do not cover the fuel vendors dilemma. While there may be technical ability to handle any mix of ethanol and gasoline in the future the fact remains that at present there is little or no incentive for the fuel vendor to install the capacity to market E-85 or indeed even lower levels of ethanol. Primarily this is because there is no incentive for the valuable real estate represented by fuel station forecourts to promote a fuel that has no supply chain economics for the oil company. It would be very interesting to see if the offering of E-85 was at a discount that represented the heat value loss represented by that fuel in the vehicle. In theory for existing vehicles the fuel ought to be available at roughly a 30 percent discount to account for the losses but at this level we are convinced the ethanol suppliers would not be able to sustain their business. On the other hand, at prices equal to or just slightly less than regular gasoline the consumer would notice the reduction in average mileage and quickly revert to regular gasoline. Talk of new engines which would take advantage of ethanol's higher octane is just that: talk. Changing engine design is a major undertaking even when the technology is understood in terms of warranty service etc.

Experience with the ill-fated methanol program which had both M-85 and M-100 showed that consumers rarely filled the vehicles with anything other than gasoline since they had the option with a "flex fuel vehicle". This was because of availability but also the knowledge that the fuel was lower performing in terms of average mileage even though it had the same high-octane attributes as ethanol. Consumers need a high degree of technical savvy to use high alcohol blends in the absence of significant price incentives. The price approach is also skewed by the uniform addition of the various taxes which obscures the reduction in price that might be there and to the consumer selling E-85 at say \$0.30 / gallon less than gasoline is not a big enough enticement to cover the performance dilution.

**18) Section 11.3. - Outlook for Carbon Intensity**

Our current views (Province of BC) of ethanol carbon intensity overlook the international discussion of ethanol's other penalty, which is the Indirect Land Use Change. Similar to the recent reevaluation of BC Hydro's electricity which found that methane emissions from reservoirs must be included in the CI of electricity, indirect land use changes are based on the same logic. For this reason many of the listed sources of ethanol in California for example have CI's that are even higher than gasoline. We understand there are similar concerns for some sources of biodiesel, especially that produced from palm oil. While this question remains



unresolved it would be dangerous to promote even more ethanol or biodiesel in the fuel pool if the result is that we end up with at best only a modest reduction in carbon emissions.

The province seems to expect that ethanol carbon intensities will be reduced by as much as 50% in the near future. There is a massive amount of ethanol capacity already in place (some 15 billion gallons/year in the US alone) which will not be forced to change to some new technology in its lifetime. As the whole country moves to lower carbon fuels as is indicated in Minister McKenna's press release of December 13 this year there will be even more competition for ethanol with low carbon intensity

#### **19) December 13 Press Release**

"The Clean Fuel Standard is the single largest emission-reduction policy in Canada's climate and clean-growth plan. The Clean Fuel Standard will be designed to reduce Canada's greenhouse gas emissions by 30 million tonnes a year, by 2030."

This plan, while laudable, will put even more pressure on the availability of low carbon ethanol supplies in Canada. There is also the question of "food vs. fuel" as more grain products are diverted from the food supply chain to the fuel chain.

At the same time ethanol is one of the only lower carbon fuels which actually competes roughly in price with oil based fuels at least at oil prices above \$50 – 60 US. As long as grain prices do not react to the increase in demand from biofuels requirements this is a helpful situation.

The discussion paper seems to recognize all of these factors in the statement on page 37, "It is unlikely that compliance will be possible in the longer term without supplying these blends in significant quantities. "

#### **20) Section 12. - Biodiesel**

We have little comment on the sections that deal with biodiesel blend possibilities and overall biodiesel would seem to have the characteristics required to make significant progress on CI improvement. However that being said the potential demand may create stresses on the supply side as competition for crops pushes farmers to replace normal food crops with canola in Alberta and Saskatchewan for example. Our understanding is that for reasons of soil nutrient deficiency canola can only be grown on the same land every four years. This means that roughly four times as much land needs to be dedicated to Canola growing even though other crops may be grown in the intervening years. We question the ability of Canadian farms to increase Canola plantings by a factor of ten to move from B2 to B20. And then what? We need to have a view of what comes after diesel as a heavy duty fuel. Maybe Tesla's approach with a battery powered heavy duty truck will be the answer for the longer term.

**21) Section 13. - Hydrogenation Derived Renewable Diesel (HDRD)**

This would seem to be the best route forward in the sense that the product is more or less fungible with regular diesel and has the additional benefit of being zero sulfur. It is also produced in the refinery and so remains in the control for the refiners. However, in this case once again the refinery balance is disturbed as HDRD (and Biodiesel) replaces barrels of otherwise balanced crude oil in the refinery run, and also backs-out crude oil production at the wellhead. We believe that some study is required over the longer term to gauge the extent to which refiners get into an operational bind when the effects of the significant changes in refinery run balances on both gasoline and diesel are taken into account. Also, increases in biodiesel and HDRD cannibalize the refinery in the sense that the refiner only makes some kind of margin on purchased Bio oils rather than the full throughput of the barrel of crude.

We must also remember that BC is not an isolated market and similar changes in the US and the rest of Canada will have a major impact on product availability and price in BC.

**22) Section 14. - Conclusions**

We agree totally with your suggestion that there should be a “differentiating between the carbon intensities of each ethanol, either through pricing according to carbon intensity or through market selection.” The devil however is in the detail. Today there is a massive market for ethanol, which is not differentiated by carbon intensity. That market is also a financial market and members of the Renewable Fuels Association and their lobbyists in Washington are unlikely to look fondly on a movement, which would differentiate their members by quality (carbon intensity) and price. The ethanol lobby has been successful through its cohesion.

One of the activities the Government could undertake would be to experiment with this new model for our belief is that until producers can be rewarded for taking the risks associated with creating lower carbon intensity in new fuels access to capital will continue to elude new suppliers. One of the routes could be the establishment of a carbon market which has a much higher value than the current \$30/tonne. This level of carbon tax is not sufficient to enable the new producer nor is it sufficient to dissuade the existing fuel producers. Our own analysis would suggest that prices for carbon on the order of \$200/tonne would be required to make fundamental changes to the fuel supply industry.



#### References:

- 1) The Guardian (2017, Nov. 16) "World's biggest sovereign wealth fund proposes ditching oil and gas holdings" [Online]. Available: [www.theguardian.com/business/sovereign-wealth-funds](http://www.theguardian.com/business/sovereign-wealth-funds)
- 2) This is just one of many references that could be cited to show how the press attempts to frighten the public about adopting Climate Change mitigation strategies. Greenpeace, [Online]. Available: [Renewable Energy Myths](#)
- 3) Tony Seba: Clean Disruption - Energy & Transportation, [Online]. Available: [Youtube: Tony Seba](#)
- 4) Stanford Social Innovation Review, "Cultivating the Green Consumer" [Online]. Available: [https://ssir.org/articles/entry/cultivating\\_the\\_green\\_consumer](https://ssir.org/articles/entry/cultivating_the_green_consumer)
- 5) DowDuPont to exit Cellulosic Ethanol Business, [Online]. Available: <http://www.biofuelsdigest.com/bdigest/2017/11/02/breaking-news-dowdupont-to-exit-cellulosic-ethanol-business/>
- 6) European Power to Gas, [Online]. Available: <http://www.europeanpowertogas.com/index>
- 7) Heavy Duty Trucking, Truckinginfo, "Successful Field Tests of DME in Europe Prompt Volvo to Consider the Alternative Fuel for the US.", <http://www.truckinginfo.com/channel/fuel-smarts/article/story/2012/08/successful-field-tests-of-dme-in-europe-prompt-volvo-to-consider-the-alternative-fuel-for-us.aspx>
- 8) Personal Communication from Nexterra Corporation. Website reference: <http://www.nexterra.ca/>
- 9) The Economic Times (2018, Jan. 1) "Niti Aayog's new methanol push could be bad news for Modi's electric vehicles mission" [Online]. Available: <https://economictimes.indiatimes.com/industry/auto/news/niti-aayogs-new-methanol-push-could-be-bad-news-for-modis-electric-vehicles-mission/articleshow/62323639.cms>