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October 7, 2009

Mr. John Courtis
Manager, Alternative Fuels Section
California Air Resources Board
VIA Electronic Mail

RE: Comments on Potential Pathways for Brazilian Sugarcane Ethanol Dehydrated In Caribbean Basin Initiative Countries

Dear Mr. Courtis:

Canopy Prospecting, Inc. (Canopy) and Trinidad Dehydration Company Limited (TDCL) are pleased to write to you with our initial comments on the necessity to create a methodology to assess pathways through Caribbean Basin Initiative (CBI) ethanol dehydration plants for Brazilian sugarcane-based ethanol in connection with California's proposed Low Carbon Fuel Standard. More specifically, this letter focuses on a proposed pathway utilizing natural gas to dehydrate ethanol in the Caribbean which originates from Brazilian sugar mills that are linked to electric co-product generation capability. The potential methodology described below is based primarily on information published by the California Air Resources Board's (CARB) preliminary draft California-GREET lifecycle calculations for Brazilian sugarcane based ethanol version 2.3 dated September 23, 2009 (hereafter referred to as CARB923).

As background, Canopy is a Pennsylvania corporation and is majority owner of TDCL. TDCL is a company incorporated in the Republic of Trinidad and Tobago. TDCL plans to build a state of the art ethanol dehydration facility and terminal at its leasehold at Brighton Point, Trinidad. This ongoing substantial investment is in response to the Caribbean Basin Economic Recovery Act (CBI) and the perceived need to supply low greenhouse gas (GHG) blendstock to the motor fuel industry particularly in regard to the advanced biofuels requirements of emerging national policy (including LCFS). This TDCL facility is fully permitted. The ethanol dehydration plant will use proven, efficient molecular sieve technology and will be fueled by natural gas produced in Trinidad. The TDCL project was started in 2001 in anticipation of increased risk associated with blending MTBE in gasoline and a need for a substitute oxygenate. The company team selected Trinidad, in part, because of the abundant availability of relatively low carbon natural gas and in anticipation of future regulation of GHG emissions. Overall, our goal is to apply oil company logistics, scale, and economics to the renewable fuels industry. We will send CARB confidential information in another letter detailing TDCL's planned facility.

The ongoing TDCL effort to provide a cost effective product, or in this case a motor fuel blendstock product, follows in the path of the entrepreneurial efforts of early oil explorers, their investors, and other pioneers of the energy industry. The current emergence of ethanol as a positive motor fuel additive after its elimination by an industry that promoted anti-knock lead and much later MTBE is only fair. The proof that cane ethanol's role as a transitional GHG reducing fuel has been achieved is shown in Brazil (i.e. the Alcool program) during the last 30 years.

CARB923 currently assesses anhydrous ethanol dehydrated from hydrous ethanol at the point of production in Brazil, the sugar mill and shipped directly to California, as noted on page 11. Although CARB does not mention it in CARB923, it is important to note that Brazilian anhydrous ethanol imported through the direct pathway is currently subject to two tariffs. The first tariff is a 2.5% ad valorem tariff based on the value of the product. The second tariff is a 54 cent per gallon (CPG) tariff, which prevents U.S. subsidies of Brazilian ethanol production due to the Volumetric Ethanol Excise Tax Credit (VEETC).

In contrast to the purported direct route, the process for CBI dehydrated ethanol differs from the pathways described in CARB923 in three key ways. First, instead of dehydrating the hydrous ethanol at the mill, the hydrous ethanol is transported to a CBI eligible location and dehydrated. The manufacturing process for anhydrous ethanol, which is approximately 198 proof or 99% alcohol by volume, generally consists of five functions: 1) feedstock preparation; 2) fermentation; 3) distillation; 4) drying (dehydration); and 5) storage. The dehydration step is necessary because ethanol can only be distilled to approximately 190 proof, or 95% alcohol by volume. This is referred to as hydrous ethanol. Second, instead of shipping the ethanol directly from Brazil to the United States, the ethanol is shipped to an ethanol dehydration plant in the Caribbean, dehydrated, and then shipped to the United States. And third, under the CBI, hydrous ethanol, dehydrated and transformed into anhydrous ethanol in a CBI eligible country is treated as if it had been produced in that country and is not subject to these tariffs. The total amount of CBI dehydrated ethanol allowed to enter the U.S. duty free annually is seven percent of the United States' previous years' consumption of ethanol. Additional volumes are not subject to U.S. tariffs so long as they have been blended with certain percentages of domestically produced CBI ethanol (i.e. cane ethanol actually grown and produced in that country).

Pathways for Brazilian cane-based ethanol through CBI ethanol dehydration facilities are far more economically viable than the pathway for ethanol shipped via a direct route for anhydrous ethanol from Brazil to California. As noted by US EPA in their proposed RFS 2 rules, "the most likely route [for Brazilian cane-based ethanol is] through the Caribbean Basin Initiative (CBI)"[1] because the ethanol would not be subject to the 54 CPG and 2.5% ad valorem tariffs described above. Indeed, since a duty drawback loophole ended in September 2008, direct Brazil to U.S. ethanol shipments have largely dropped off. Between January and July 2009, only 18,738 gallons of Brazilian anhydrous ethanol were directly imported into the U.S (this is about 0.017% of motor fuel ethanol imports for that period excluding Canada, according to the U.S. International Trade Commission). **Since CBI dehydration plants will be the most economically efficient pathways for sugarcane ethanol from Brazil to reach California, we urge CARB to include**

[1] 74 Federal Register 24998

pathways under Method I (carbon intensity look up table). Failing to do so could create significant confusion since direct imports are economically disadvantaged and impractical.

By analyzing the differences in the direct Brazil to U.S. pathway outlined in CARB923 and its differences with CBI dehydration pathways, one can begin to create a framework to assess the lifecycle emissions of CBI dehydrated anhydrous ethanol by isolating the dehydration process and ocean transport of ethanol.

Molecular sieve technology is well established, popular, and thought by some to be the industry standard for Brazil and the Caribbean to convert hydrous ethanol into anhydrous ethanol.[2] Various companies construct these systems, including Praj of India, Delta-T of Williamsburg, Virginia, and Dedini of Brazil. The process is described in Appendix A.

The dehydration process requires steam energy to heat and cool the ethanol as described in Appendix A. As noted on page 12 CARB923, this energy is typically generated from burning waste bagasse and is not counted in the Life Cycle Analysis of Brazilian anhydrous sugarcane ethanol. In the Caribbean, however, the energy to create steam is generated by burning fossil fuels, which vary by plant. These fuels range from natural gas, which is primarily used in Trinidad because of its abundant availability (Trinidad is so rich in natural gas production that it is a major exporter of liquefied natural gas to the U.S. and other destinations), to #2 distillate (diesel fuel) and #6 oil (bunker). Diesel fuel and bunker are primarily used in dehydration plants located outside of Trinidad. **We urge CARB to differentiate in the Method I look-up charts between the various CBI ethanol dehydration facilities based on the type of fuel that they burn.**

We also encourage CARB to reduce its proposed 5 gCO_2e/MJ substantiality requirement to modify a pathway as provided in Method 2A, at least insofar as CBI ethanol dehydration plants are concerned. The current 5 gCO_2e/MJ sets a bar impossibly high to provide incentives to ethanol dehydration facilities to reduce their carbon footprints (the entire transportation leg from Brazil to the U.S. is only 1.81 5 gCO_2e/MJ[3]). <u>CBI ethanol dehydration plants may differ from one another in many more ways than the type of fuel they burn</u>. These plants are of varying age, size, and efficiency. Some, such as TDCL, are or will be state of the art using the newest technology. Others may be older facilities cobbled together with a focus on minimizing capital expenditure. Some plants are in refineries and may use common utilities. Some are relatively small with only 40 million gallons a year of reported capacity, while others will be capable of dehydrating hundreds

[2] Molecular sieve technology is regarded as the standard technology to dehydrate ethanol in the United States. Other technologies are available to dehydrate ethanol using azeotropic distillation. These processes use benzene or cyclohexane. While we understand that molecular sieve technology is popular to dehydrate ethanol in Brazil, cyclohexane azetropic distillation dehydrators are commercially advertised and available in that country (see www.dedini.com.br for an example). Experimental technology using nanotechnology is also available, but may still be in the experimental stage.

[3] The current substantiality requirement would also preclude recognizing carbon savings for more efficient ocean shipping. Ethanol is currently shipped in 20,000 DWT chemical carriers. Savings could be achieved by using larger ships. We hope that CARB would encourage this by providing a framework that recognizes such savings.

of millions of gallons a year of ethanol, thus creating operational economies of scale. Individual plants may devise other innovations for GHG emission reductions, including wind, solar, geo-thermal, and/or hydro. **CARB can create an intense atmosphere of competition for GHG reduction in the CBI by establishing a lower substantiality requirement (perhaps .25 gCO_2e/MJ) while not creating a workload nightmare for itself since there are only 11 projected CBI dehydration plants either operating or may be operating in the near future**.[4]

When determining the initial carbon footprint(s) of ethanol dehydration plants in Trinidad that are fueled by natural gas, CARB should make note that natural gas produced in Trinidad may have a lower life-cycle carbon footprint than natural gas in the United States. First, Trinidad uses the latest in production technology. Given Trinidad's natural gas driven economy and its status as a leading exporter of LNG, it has significant incentive and funding for some of the most efficient technology available. Second, the natural gas pipelines are relatively new and well maintained, using predictive and preventive maintenance regimes. This further reduces fugitive emissions. Third, natural gas in Trinidad travels less than 50 miles from the natural gas processing plant to the dehydration facilities, further reducing the opportunity for fugitive emissions while being transported. For comparison, Los Angeles County, California is more than twice as large as the combined area in square miles of both Trinidad and Tobago.

CARB923 provides a framework under which the increased GHG life cycle emissions from CBI dehydration fueled by natural gas may be completely offset with increased domestic distribution via the grid of co-product electricity from Brazilian ethanol production facilities. Pages 42 to 44 of CARB923 describe the process of accounting for co-product credit from electricity generation in Brazil. Since the same technology is used in Brazil and in CBI countries to dehydrate ethanol, the same amount of energy should be generally required to power the dehydration process in Brazil and the CBI. Under an electric tri-gen scenario, energy normally used at the Brazilian mill to convert hydrous ethanol into anhydrous ethanol would be used to generate additional electricity for distribution via the grid, thus creating additional GHG emission credits. These credits would be used to offset any potential GHG emissions from ethanol dehydration at a CBI ethanol dehydration plant burning natural gas. **Moreover, since these credits are derived by displacing electricity generated from natural gas in Brazil, hydrous ethanol transformed into anhydrous ethanol at a CBI ethanol dehydration plant using natural gas should have the same life cycle GHG emissions as anhydrous ethanol dehydrated at a mill in Brazil insofar as the dehydration process is concerned and so long as the Brazilian mill is equipped to distribute co-product electricity.[5]**

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[4] CARB may want to consider requiring each plant to substantiate its Carbon footprint upon implementation of enforcement of the LCFS and/or the beginning of commercial operations. At the very least, we encourage CARB to offer each CBI ethanol dehydration plant at least two opportunities to reduce its carbon footprint before meeting the 5 gCO_2e/MJ substantiality requirement. This would provide significant economic incentives to ethanol dehydration plant owners to continually improve their facilities.

[5] This calculation does not take into account the possibility that natural gas in Brazil may have a higher life cycle carbon footprint than natural gas in Trinidad. Natural gas in Brazil may be shipped hundreds and hundreds of miles and even imported from Bolivia in pipelines of various age and states of repair, thus

Additional GHG emissions as a result of dehydrating ethanol in the Caribbean instead of at the mill in Brazil may be derived as result of the increased distance that the ethanol must travel to and from the CBI dehydration plant away from the direct route. CARB923 lists on page 34 the energy intensity on a BTU/tonne-mile basis for ocean transportation. Additional miles from the base Brazil port direct to California would be calculated on this basis.

Our recommendation for multiple pathways through the CBI is in line with CARB's existing multiples pathway methodology detailed in CARB923. Indeed, differentiating between ethanol dehydrated at different dehydration facilities should be less difficult than differentiating ethanol from various pathways in Brazil at the Brazilian port. Brazilian ports are known to be congested and short on tank capacity, thus requiring product comingling in the tanks. In contrast, ethanol from different dehydration facilities will probably arrive to California in different ships. Even if shipped in the same vessel, we believe that it would be held in different tanks for quality and volume control purposes.

We look forward to additional iterations of CARB's lifecycle assessment of Brazilian sugarcane ethanol. Please do not hesitate to contact us with any questions.

Sincerely,

Canopy Prospecting, Inc.
Trinidad Dehydration Company Limited

by:
John Thomas, Ph.D
Science Consultant, [6]
Canopy Prospecting, Inc.

by:
Erik Johnson
Managing Director (ag),
Trinidad Dehydration Company Limited

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creating significant fugitive emissions. In contrast as noted above, Trinidad, the primary Caribbean producer of natural gas, transports its natural gas approximately 50 miles, at the most, from the natural gas processing plant to industrial consumers via new, state of the art pipelines that are subject to routine inspection and preventive and predictive maintenance.

[6] For identification purposes only, Dr. Thomas is a research professor at the Florida Institute of Technology.

Appendix A

Purifying the 190 proof hydrous ethanol (hydrous) into 198 proof anhydrous ethanol (anhydrous) is performed by pumping the hydrous liquid into the super heater that uses indirect steam in shell and tube heat exchanger to vaporize the liquid into a vapor at a temperature greater than 280˚F. This vapor will then flow into the top of one of the two or three molecular sieve beds that have been regenerated. When one sieve bed is in use and under pressure, the other is under vacuum and regenerating.

From the top of one of the molecular sieves the 280˚F vapor is pushed through the bed from the top to bottom with a pressure of approximately 50 PSI. The sieve bed contains zeolytes that have holes the size of 3Å (angstrom). The water molecule vapor has the size of 2.5Å while an ethanol molecule vapor has the size of 4.5Å. As the hydrous vapor is forced through the bed of beads, the water adheres to these small holes, but the ethanol flows around the zeolytes and passes to the bottom of the bed. At the bottom of the bed, most of the anhydrous vapor will flow to heat exchangers and be condensed back to a liquid while heating hydrous streams. The remaining anhydrous is sent through the other molecular sieve beds to dry out and thereby regenerate them.

Regenerating sieve beds have valves that are automatically switched for reverse flow through a bed. The pressure is reduced from approximately 50 PSI to a vacuum of 2 PSIA as anhydrous vapors pass through from the bottom. . The pressure drop with the anhydrous water clears the zeolytes of water, which passes out the top of the sieve bed. The sieve bed is now regenerated and ready to be put under pressure again when the other beds need to go through the regeneration process. Cycle times for sieve beds are around 8 minutes.

The back flushed vapors, which are now approximately 150 proof and 300˚F, pass through the condenser, cool to approximately ˚150F. The liquid is then distilled to 190 proof in a distillation column and flows into the hydrous ethanol feed.