Appendix D

Compliance with the Revised LCFS Program and Associated Economic Impacts

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CARB's proposed changes in the LCFS regulation call for a reduction in the carbon intensity (CI) of gasoline relative to the baseline level of 99.18 by 2 percent in 2016, 5 percent in 2018, and 10 percent in 2020.[1] In theory, the strategies to achieve those reductions could include 1) displacing gasoline usage with other types of fuel with lower CI values (*e.g.*, electricity); 2) changing the current limit on the percentage of ethanol that can be blended into California gasoline below the E85 level (which is E10); 3) reducing the average CI of renewable fuel blended with gasoline under the E10 limit; and 4) deployment of credits generated from the use of renewable fuels prior to 2016 and the use of renewable fuels in diesel after 2016. CARB projects that compliance with the LCFS will rely significantly on the third method through at least 2020.[2] This Appendix to Growth Energy's comments identifies the circumstances under which the LCFS program will shift the supply of ethanol for the California market from the United States to Brazil, as a result of strategies to reduce the average CI of renewable fuels blended into gasoline under the E10 limit.

Through 2020, CARB has projected that compliance with the LCFS could be reached primarily through a shift from corn ethanol, now largely sourced from the Midwest[3] with an average CI value of about 82, to cane ethanol from Brazil, which currently has an average CI value of about 72.[4] CARB developed an "illustrative compliance scenario" which projects a reduction in corn ethanol use in California gasoline from the current (2014) level of 1,250 million gallons per year to 700 million gallons per year in 2020, with an increase in consumption of cane ethanol equal to about 64 percent of that reduction. Thus, CARB's scenario would

[1] CARB, *Staff Report: Initial Statement of Reasons for Proposed Rulemaking*, December 2014 ("ISOR"), p. ES-3.
[2] ISOR, p. B-39.
[3] The Renewable Fuels Association (RFA) lists three operating corn ethanol plants in California, with total capacity of 175 million gallons per year, representing about one percent of total U.S. ethanol production and about 14 percent of consumption in California. [RFA website at www.ethanolrfa.org/bio-refinery-locations]
[4] ISOR, p. B-39.

involve a reduction in consumption of Midwest-sourced corn ethanol of about 550 million gallons per year as of 2020, relative to today, equivalent to the entire output of about seven typical-sized ethanol plants.[5]

CARB presents the foregoing scenario as an example of how compliance could be achieved. CARB bases its analysis of the economic impacts of the LCFS on an assumption that credit prices would equal $100 from 2016 through 2020.[6] CARB also evaluates economic-impact scenarios based on assumed credit prices of $25, the current value as of January 2015, and $57, the average value from 2012 to 2013.[7]

To determine whether credit prices at those levels would, in fact, cause fuel marketers in California to switch from Midwest-based corn ethanol to Brazilian cane ethanol, Edgeworth Economics prepared an analysis of the total, delivered cost of both fuels under various assumptions about the CI for each type. Our analysis uses the following data:

- A CI range for Midwest-based corn ethanol of 81.4 to 92.4, representing a range of ratings for ethanol refineries located in the Iowa/South Dakota/Minnesota area that currently ship product to California, based on CARB's list of "Approved Physical Pathways" and information provided by Growth Energy members.
- A CI range for Brazilian cane ethanol of 72.5 (current) to 40 (as of 2016), as reported in the ISOR at p. B-39.
- Ethanol spot prices at Chicago, IL and Santos, Brazil—2014 average [source: Platts] and 2016 forecast [source: OECD-FAO, *Agricultural Outlook 2014-2023*].
- Rail freight rates from Midwest refinery locations to California, provided by Growth Energy members.
- Maritime freight rates from Brazil to California, including tariff and terminal charge [source: Odin Marine Group, *Ethanol Report*, January 2015 and Growth Energy members].

[5] The average output of operating ethanol facilities is about 76 million gallons of ethanol per year. [RFA website at www.ethanolrfa.org/pages/statistics]
[6] ISOR, p. VII-1.
[7] ISOR, pp. VII-1-2 and "Monthly LCFS Credit Transfer Activity Report for January 2015" [CARB website at www.arb.ca.gov/fuels/lcfs/credit/20150210_jancreditreport.pdf]

- D5 and D6 Renewable Identification Number (RIN) prices—2014 average [source: OPIS].

Because the delivered cost of Brazilian ethanol in California is substantially higher than the cost of Midwest corn ethanol at present, with LCFS credit levels around $25, relatively little cane ethanol is imported into California[8], while Midwest facilities with CI ratings in the low 90s continue to deliver product. At the average ethanol and RIN prices experienced in 2014, the value of an LCFS credit would need to rise to $156 in order to incentivize a switch from the highest-CI-rated Midwest sources to Brazil. The spread between prices for conventional (D6) RINs and advanced biofuel (D5) RINs has recently expanded, which provides additional incentive to import cane ethanol from Brazil. Based on the average spread in January 2015, an LCFS credit price of $105 would incentivize the same switch.

However, based on forecasts for ethanol prices in 2016, which show a narrowing of the price differential between U.S. and Brazilian ethanol, an LCFS credit price of about $36 (based on 2014 RIN spreads) would cause a switch from 92.4-CI corn ethanol to cane ethanol; and a credit price of only $77 would cause a switch from 81.4-CI corn ethanol to cane ethanol. These figures are well below CARB's estimate for LCFS credit prices of $100 in 2016.

If Brazilian cane ethanol can receive the CI ratings predicted by CARB, then the switch will occur at even lower credit prices. For example, CARB projects that Brazilian ethanol will have an average CI rating of 40.0 by 2016.[9] At that rating, LCFS credit prices as low as $14 would result in a switch away from the higher-rated facilities in the Midwest, and credit prices as low as $17 would result in a switch away from even the lower-rated Midwest facilities.[10] In this scenario, even Midwest facilities with CI ratings as low as 70, which CARB claims will be the average rating of the Midwest corn facilities still delivering product to California as of 2016[11], would be at risk. Credit prices as low as $23 would be sufficient to induce a switch to imported cane ethanol. CARB's scenario indicating a substantial decline in the use of Midwest corn ethanol in California and an increase in the use of imported cane ethanol is therefore not only

[8] CARB estimates 100 million gallons in 2014. [ISOR, p. B-39]
[9] ISOR, p. B-39.
[10] These figures are calculated using the 2016 forecast for ethanol prices and current RIN spreads.
[11] ISOR, p. B-39.

plausible, but probable if sufficient ethanol is available from Brazil, even at modest credit prices well below CARB's projected level of $100.[12]

The implications for Midwest ethanol producers in this scenario would be severe. Assuming that U.S.-wide demand for ethanol does not increase (the Energy Information Administration projects ethanol consumption will be flat through 2016[13]), then the increased imports of Brazilian ethanol would result in some combination of 1) lost production or shut-down of Midwest facilities—with total lost volumes equivalent to as many as approximately seven typical-sized plants by 2020, as noted above; or, at a minimum, 2) increased logistics costs associated with exporting corn ethanol to the nearest source of demand outside the U.S., which could be Brazil. Obviously, the latter outcome would not result in a decrease in world-wide carbon emissions.

The economic impact of reduced production levels or complete plant closures in the Midwest can be estimated based on the characteristics of typical ethanol refineries. On average, U.S. corn ethanol facilities employ approximately 0.8 employees per million gallons of ethanol produced, or about 61 employees for a typical plant.[14] A reduction in ethanol demand of 550 million gallons per year therefore would result in a direct loss of approximately 440 jobs at ethanol refineries. In addition to these direct effects, the regions that host ethanol production facilities would experience additional reductions in economic activity stemming from reduced purchases of locally-sourced inputs (the "indirect" impact) and reduced spending by facility employees and local vendors (the "induced" impact). These additional economic impacts are generated by the "multiplier" effect, which results from the recycling of business revenues and household income within the local region. Plausible estimates for the overall multiplier effect for employment applicable to the ethanol industry range from about 2 (indicating a total impact

[12] This result holds even if the price differential between U.S. and Brazilian ethanol remains closer to current levels, rather than declining as indicated in the forecast described above.
[13] U.S. Energy Information Administration, *Short-Term Energy Outlook*, February 10, 2015.
[14] Based on various sources, including: John Urbanchuk, "Contribution of the Ethanol Industry to the Economy of the United States," Cardno ENTRIX, prepared for the Renewable Fuels Association, February 2, 2012; David Swenson, "Understanding Biofuels Economic Impact Claims," Iowa State University, April 2007; and various public SEC filings.

on employment equal to two times the direct employment impact) to about 7.[15] Applying a figure of 4 to the direct employment impacts calculated above implies a loss of approximately 1,760 jobs in ethanol producing regions.

Even assuming that the facilities forced out of the California market could find customers outside the U.S., there would still be substantial costs to the industry. For example, transport of ethanol from the Midwest to Brazil would entail increased logistics costs of approximately 10 cents per gallon[16], or $55 million per year, assuming sufficient demand in Brazil for all 550 million gallons of displaced corn ethanol.

[15] See, for example, Urbanchuk, February 2, 2012, *op. cit.*; Swenson, April 2007, *op. cit.*; Susan Christopherson and Zachary Sivertsen, "Economic Policy Makers Beware: Estimating the Job Impact of Public Investment in Biofuel Plants," working paper, Cornell University, December 12, 2009; and Dave Swenson, "Input-Outrageous: The Economic Impacts of Modern Biofuels Production," Iowa State University, June 2006.

[16] Based on the sources described above.