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Michael Waugh
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Katrina Sideco
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Sent via email to ksideco@arb.ca.gov

Subject: Comments regarding the restructuring and re-adoption of the Low Carbon Fuel Standard

Dear Mr. Waugh and Ms. Sideco:

Syngenta appreciates the opportunity to provide comment on the restructuring and re-adoption of the Low Carbon Fuel Standard (LCFS). Syngenta is committed to leading the quest for affordable and sustainable renewable fuels. We are one of the leading agricultural product companies in the world with 27,000 employees in some 90 countries. Our purpose: Bringing plant potential to life to increase crop productivity, protect the environment and improve health and quality of life. Our broad portfolio of crop protection products helps farmers improve crop yield potential and plant health in all stages of development. Through modern plant breeding and biotechnology, Syngenta has developed high quality seed varieties that reduce loss from insect pressure and increase tolerance to drought, further boosting crop yield potential.

This same expertise was employed to develop corn containing the Enogen® corn trait, a revolutionary technology specifically developed to enhance the productivity and efficiency of converting starch to biofuel. The development and commercialization of Enogen® corn exemplifies the innovation and technological advancement stimulated by the LCFS. Not only is the production of ethanol significantly enhanced but the sustainability of grain production, farmer income and the local communities in which they reside are all improved as well.

Therefore, Syngenta's comments will focus on:

1) The impact technology has on the overall sustainability of biofuel production from farm to fuel and
2) Such improvements should be recognized in the full life cycle of the biofuel produced and its subsequent carbon intensity (CI)
3) Urging CARB to remove the Indirect Land Use Change (ILUC) penalty for corn ethanol until indirect effects for all fuels can be fully vetted and improved upon by the academic, professional and governmental institutions working on this controversial subject. Otherwise it has the effect of discouraging investment in new technologies that can further improve the sustainability of biofuels.

Syngenta's Commitment to Innovation and Development of Sustainable Biofuels

Syngenta has more than 5,000 people at 180 R&D centers and field stations worldwide, and we continually invest in the development of our people, technical capabilities, and partnerships. R&D investment in 2012 alone was more than $1.4 billion, reinforcing and advancing our industry-leading position. Syngenta scientists are committed to meeting growers' needs by using innovative technological developments to sustainably increase crop yields and quality. These technologies are focused in the areas of seed trait development, seed care, and crop protection, and enabled by our deep understanding of plant physiology, genetics, traits, and chemistry. This combination allows Syngenta to work with partners to further strengthen the development of novel technologies and agronomic solutions that help achieve the goals of the LCFS.

Enogen® Corn

Syngenta invested more than $150 million dollars in the development and commercialization of Enogen® - the first biotech corn output trait for ethanol production. Enogen® corn was developed by genetically engineering corn to express alpha amylase enzyme – the primary enzyme used in dry grind corn ethanol production – directly in the corn kernel. With Enogen grain, ethanol plants can:

- Drastically reduce slurry viscosity to increase solids loading in liquefaction and fermentation tanks
- Create process flexibility to improve throughput and yield based on market conditions
- Reduce natural gas, electricity and water use (Table 2)
- Reduce liquid enzyme and chemical costs, including pH modifications and maintenance chemicals
- Add economic value to their community by sourcing quality grain from local farmers (Table 1)

Since deregulation by the USDA in 2011, Enogen® (USDA 2011) is being used commercially by seven ethanol plants and trials are on-going with six additional plants. By 2016, Syngenta expects 25 ethanol plants to be using Enogen® grain. At an average of 60 million gallons per plant, approximately 1.5 billion gallons of Enogen ethanol would be produced, or 10% of the 15 billion gallons of corn starch ethanol required by the Renewable Fuel Standard. If Enogen is adapted by 25 ethanol plants, this technology alone come be responsible for a reduction in CO2e emission at the ethanol plant from using Enogen® grain exceeding 1,480,000 MT, nearly 0.1 MT per gallon or the equivalent of taking 309,000 cars off the road each year (EPA 2014). This reduction in carbon emissions would have a societal cost of $17,760,000.

Table 1. Economic value to Enogen® feedstock producer and biofuel facility in producing 1.5 billion gallons of Enogen® ethanol

Gallons of Enogen® ethanol produced by 2015	1,500,000,000
Gallons of ethanol produced per bushel of corn	2.8
Premium per Enogen® bushel of grain produced	$0.40
Bushels of grain needed to produce 1.5 billion gallons of ethanol	535,714,286
Bushels of Enogen® grain to produce 1.5 billion gallons of ethanol (15 percent of total grain)	80,357,143
Bushels of non-Enogen® grain needed to produce 1.5 billion gallons of ethanol	455,357,143
Grower premium paid to produce Enogen® grain	$32,142,857.14
Energy, chemical and other savings per gallon Enogen® ethanol produced	$0.10
Savings at ethanol plant using Enogen®	$150,000,000
Direct economic value created in producing 1.5 billion gallons of Enogen® ethanol (Ethanol plant savings – grower premium paid)	**$117,857,143**

Cellerate™

Building on our investment in Enogen, Syngenta has collaborated with Cellulosic Ethanol Technologies, LLC, to successfully produce commercial-scale quantities of cellulosic ethanol derived from corn kernel fiber (EPA 2013) – the first cellulosic gallons in Iowa – at the Quad County Corn Processors (QCCP) ethanol plant in Galva, Iowa. Cellerate™ is a revolutionary process technology to produce cellulosic ethanol from corn kernel fiber. QCCP expects to produce one million gallons of cellulosic ethanol in 2014 and two million gallons in 2015. Cellerate™, in conjunction with Enogen® trait technology, this innovative process can deliver significant benefits to ethanol plants:

- Raise ethanol yield per bushel up to 6% (when C5 yeast are available up to 10%)
- Boost throughput up to 15%
- Reduce energy use up to 20%
- Increase corn oil availability up to 1.6 lb/bu
- Increase the protein content of dried distillers grains (DDGs) up to 40%

Ethanol plants can easily integrate Cellerate™ process technology into their existing production process. It holds the potential to produce more than 1 billion gallons of cellulosic ethanol at existing dry-grind plants.

Agrisure Artesian®

In addition, Syngenta has also spent $213 million dollars and over 10 years to develop corn hybrids with Agrisure Artesian® technology that allows plants to function more normally during gaps in rainfall, reducing plant stress and protecting against yield loss. In developing Agrisure Artesian® technology, Syngenta researchers used a unique method to identify and select multiple genes with distinctive modes of action to protect against moisture stress at all stages of plant development. Once identified and validated, these genes were introduced through traditional plant breeding techniques into elite Syngenta germplasm to produce the broad-based response to moisture stress that this technology provides.

The effectiveness of these hybrids was demonstrated in 2012 in more than 1,100 in-field trials during one of the worst droughts in decades (Syngenta, unpublished data). In good growing conditions of moderate drought stress, hybrids with Agrisure Artesian® technology matched or exceeded the yields of comparable hybrids. However, in severe and extreme drought conditions, hybrids with Agrisure Artesian® technology produced 16.8% and 48.4% higher yields (Syngenta, unpublished data), respectively, than the plot average (for this research, Syngenta defines a yield environment of 50-99 bu/A as “severe” and fewer than 50 bu/A as “extreme”). For ethanol plants located in both irrigated and non-irrigated areas, with good agricultural practice, Agrisure Artesian® hybrids combined with Enogen® and/or other technology that helps protect the roots and above ground portions of the plant from insect feeding and disease, enable a more consistent supply of high quality feedstock under water stress or normal conditions.

Water+™ Intelligent Irrigation Platform

In collaboration with Lindsay Corporation, Syngenta introduced the Water+™ Intelligent Irrigation Platform in 2013. This integrated agronomic solution, initially designed to help corn growers realize the full potential of their irrigated acres but also adaptable to other crops in their rotation, has been in development for several years in collaboration with corn growers, universities, industry partners, and Lindsay Corporation. Based on field trials supported by millions of data points collected through combine yield monitors across the western Corn Belt, growers have been able to maintain or increase yield with 25 percent less water than required by employing conventional practices (Syngenta, unpublished data). The total savings can be substantial as even a two-acre inch reduction can reduce irrigated water use by 7 million gallons on a 130 acre pivot (27,154 gallons per acre inch x 2 acre inches x 130 acres per pivot). In addition, the energy and cost required to pump the water and concomitant greenhouse gas emissions (GHG) are significantly reduced. Nebraska, Kansas, and parts of Iowa and South Dakota are important markets for the Water+™ Intelligent Irrigation Platform. These states are also important ethanol producers representing nearly 50% of total US capacity

(RFA 2014). Consequently, when combined with the advancements in converting starch to ethanol at the biofuel plant provided by Enogen® corn, the farm to fuel life cycle impacts of producing ethanol can be greatly reduced (Table 2).

To put the potential savings in energy, water, carbon emissions and the social cost of carbon reduced from stacking technology for both production of the feedstock and ethanol into context, consider the following for a 100 million gallon ethanol plant located in Nebraska that sources its Enogen® and other grain from corn growers utilizing the Water+™ Intelligent Irrigation Platform (Table 2).

Table 2. Water, energy and CO2e reduced by producing the Enogen® and conventional corn grain needed to produce 100 million gallons of ethanol with the Water+™ Intelligent Irrigation Platform and converting the grain to ethanol using a mixture of 85% conventional : 15% Enogen.

Production of 100MM gallons of Enogen ethanol[a]	Water Savings (MM gallons)	Energy Savings	Energy Cost Savings	CO2e Reduced (MT)	Social Cost of CO2e[b]
Water+ Intelligent Irrigation Platform	10,484[c]	1,057,915 gal diesel[d]	3,598,709[e]	1,958[f]	23,496
Enogen[g]	68[h]	350 BBTUs NG[i]	1,573,803[j]	98,958[i]	1,187,496
Total Savings	**10,552**		**$5,149,555**	**100,916**	**1,210,992**

[a] 193,050 acres of corn = 100 million gallons of ethanol ÷ (2.8 gallons of ethanol per bushel X 185 bushels per acre)
[b] Assumes $12/MT CO2e http://www.whitehouse.gov/sites/default/files/omb/assets/inforeg/technical-update-social-cost-of-carbon-for-regulator-impact-analysis.pdf)
[c] Assumes water savings of 2 acre-inches per acre = 27,154 gallons per acre inch X 2 acre-inches X 193,050 acres of corn (http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs141p2_023891.pdf)
[d] 5.48 gallons of diesel required to pump 2 acre-inches of water per acre (http://water.unl.edu/web/cropswater/management)
[e] Off-road diesel = diesel price per gallon - taxes = $3.91 - ($3.91*13%) = $3.40 per gallon http://www.eia.gov/petroleum/gasdiesel/)
[f] CO2e emissions = gallons of diesel X 22.37 pounds of CO2e emitted per gallon (htp://www.eia.gov/oiaf/1605/coefficients.html)
[g] Enogen ethanol produced by processing 90% conventional corn blended with 10% Enogen corn
[h] Syngenta unpublished data
[I] Method 1.0 Application for Enogen System submitted to California Air Resource Board, November 8, 2013
[j] http://www.eia.gov/dnav/ng/ng_pri_sum_dcu_nus_m.htm

Syngenta's investments in the renewable fuels are making significant contributions to our nation's energy security and the overall environmental sustainability of ethanol production from farm to fuel. In addition, they help strengthen the economies of rural communities where the corn is grown and converted to ethanol by new business development. The LCFS was an important impetus behind the development of these innovations and products.

Conclusion

Syngenta appreciates the opportunity to comment on the restructuring and re-adoption of the LCFS. We encourage CARB to consider the impact technology has on the overall sustainability of biofuel production and that such improvements should be recognized in the full life cycle of the biofuel produced and its subsequent carbon intensity (CI). We strongly support ARB's proposal to maintain the original LCFS CI reduction at 10% by 2020. We further encourage the ARB to establish stronger compliance curves to continue progress beyond 2020.

Furthermore, Syngenta encourages CARB to postpone use of an Indirect Land Use Change (ILUC) CI penalty number until carbon modelling science reflects ***actual*** U.S. Agricultural trends in terms of acreage and yield and global land use change.

Thank you again for this opportunity to comment. We welcome any inquiries.

Sincerely,

David Witherspoon

Head of Renewable Fuels
Syngenta

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