Committee on Environment and Public Works
United States Senate

Oversight Hearing on Domestic Renewable Fuels: From Ethanol to Advanced Biofuels

Written Testimony Submitted by

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The Biotechnology Industry Organization ("BIO") appreciates this opportunity to submit written comments on the U.S. Senate Committee on Environment and Public Works ("EPW") "Oversight Hearing on Domestic Renewable Fuels: From Ethanol to Advanced Biofuels." The importance of federal renewable fuels policy and its potential to reduce U.S. dependence on foreign sources of energy and greenhouse gas emissions cannot be overstated.

BIO is the world's largest biotechnology organization with more than 1,100 member companies worldwide. BIO represents leading technology companies in the production of conventional and advanced biofuels and other sustainable solutions to energy and climate change. BIO also represents the leaders in developing new crop technologies for food, feed, fiber, and fuel.

Background

In recent years, the federal government has codified its commitment to reducing U.S. dependence on foreign sources of energy and greenhouse gas emissions by establishing several federal policies and laws that further these goals. For instance, Congress created in the Energy Policy Act of 2005 ("EPAct") certain volume production and usage requirements for biofuels under the Renewable Fuel Standard ("RFS"), and went on to enhance the RFS ("RFS2") and its requirements for biofuels under the Energy Independence and Security Act of 2007 ("EISA").

The existence and implementation of the RFS and its biofuels usage targets have served to create strong market motivation for investment in biofuels—particularly advanced and cellulosic biofuels. It has been an essential market signal and is the principle reason why advanced and cellulosic biofuels have continued to develop.

Today there are over 29 pilot or demonstration cellulosic biofuels projects in operations or under development in the U.S [See Appendix I for a list and map]. However, since the economic downturn beginning in the fall of 2008, it has been (and continues to be) difficult to access essential capital to support construction of first-of-a-kind advanced and cellulosic commercial production facilities.

Today's headlines about high gasoline prices possibly derailing the U.S. economic recovery [See Appendix II] highlight the importance of commercializing advanced biofuels as rapidly as possible. To achieve this goal, federal policy must help unlock capital for commercial advanced and cellulosic biorefinery projects.

The Importance of the Renewable Fuel Standard

Attached to this testimony is a new study scheduled to appear in the May issue of Industrial Biotechnology Journal [See Appendix III]. The report concludes that the federal RFS provides considerable market motivation to drive investment in cellulosic and advanced biofuels. As mentioned above, the RFS forms the basis for U.S. low carbon fuels policy at the federal level by requiring the blending of up to 36 billion gallons of biofuels by 2022– more than twice current biofuel use. Recognizing that deployment of cellulosic and other advanced biofuels is essential to meeting the nation's energy security, economic development, and greenhouse gas reduction objectives, the RFS provides a transparent program to speed the deployment of these innovative products into U.S. fuel markets.

Renewable volume obligations ("RVOs") under the RFS ensure that all renewable fuels produced up to annually prescribed volumes will have a market. EPA has demonstrated in its 2010 and 2011 rulemaking its intention to fully enforce both advanced and overall volumes under the RFS. For cellulosic biofuels, EPA has adjusted cellulosic RVOs annually, as required, to reflect current market supply realities. In so doing, EPA does not dilute RFS obligations, but simply provides notice of the projected achievable volume of cellulosic biofuels – all of which must be blended into the fuel supply. This mechanism ensures that there will be a market for all cellulosic biofuels produced up to the volumes prescribed in statute.

To accommodate uncertainty in the timeline of deployment for cellulosic biofuels, the RFS provided obligated parties with flexibility in complying with cellulosic volume requirements. To satisfy their compliance obligations, obligated parties can either buy a gallon of cellulosic biofuel or purchase some combination of fuels—including advanced biofuels— and EPA waiver credits. The cellulosic waiver credit mechanism establishes a counter-cyclical compliance value for cellulosic biofuels that increases as petroleum price decreases, providing a significant degree of price certainty and, thus, considerable market motivation for investment in cellulosic biofuels. To the extent each option is dependent on the other, or can draw upon long-term pricing models for commercial fuels markets and supplies, the relative value and return on investment of physical gallons of cellulosic biofuels over the life of the RFS can be reasonably quantified.

The study concludes that the RFS is an effective mechanism in providing market motivation for investment in advanced and cellulosic biofuels, but calls for continued federal investment in the construction of first-of-a-kind commercial advanced and cellulosic biorefineries to overcome initial scale-up risk. It projects that once the first several commercial cellulosic and advanced biofuels facilities are operational, the RFS will rapidly accelerate deployment of advanced and cellulosic volumes, significantly reducing U.S. dependence on imported petroleum.

The Importance of Complementary and Consistent Federal Policy

Several complementary federal programs are currently playing a critical role in overcoming initial scale-up risk. The U.S. Department of Agriculture ("USDA") Biorefinery Assistance

Program, which recently issued its first loan guarantees to commercial cellulosic and advanced biorefinery projects, is helping unlock private capital. The U.S. Department of Energy ("DOE") Integrated Biorefinery Program at the Office of Biomass Programs, which provides grants to pilot and commercial demonstration biorefineries, is proving out technology and laying the foundation for the next wave of commercial projects. The USDA's Biomass Crop Assistance Program is (1) helping assist agricultural and forest land owners and operators with the collection, harvest, storage and transportation of eligible material for use in a biomass conversion facility; and, (2) supporting the establishment and production of eligible crops for conversion to bioenergy is also vital to developing sustainable biomass feedstock supplies and infrastructure.

BIO also wishes to stress the importance of a robust and durable suite of advanced biofuels tax incentives to complement existing policy. While existing programs at USDA and DOE are slowly helping to deploy advanced and cellulosic technologies at commercial scale, the combined challenges of rising gas prices, increasing insecurity of energy supply, and continued growth of greenhouse gas emissions call for additional federal policy for rapid commercialization. This federal support should include tax policy targeted at accelerating construction of next generation biorefineries and deployment of large volumes of advanced biofuels. BIO's recommendations for the structure of advanced biofuels tax incentives is attached [See Appendix IV].

Finally, we must also invest in deployment of renewable chemicals and biobased products to further improve the commercial viability of next generation biorefineries and to reduce our dependence on foreign oil. Doing so will help us find replacements for all the products that come from a barrel of oil so as to avoid dislocation in the marketplace as biofuels replace petroleum. Converting biomass into fuels, energy, and chemicals has the potential to generate upwards of $230 billion to the global economy by 2020, according to the World Economic Forum. In addition, the bio-based products industry employed more than 5,700 U.S. workers at 159 facilities in 2007, according to the U.S. International Trade Commission. This illustrates that the projected growth of biobased products could create or save tens of thousands of additional jobs in coming years.

With this continued near-term policy commitment to commercialization, the RFS should rapidly accelerate deployment of advanced and cellulosic volumes, significantly reducing U.S. dependence on imported petroleum within the next decade.

Conclusion

The technology is ready for significant and short-term expansion of domestic cellulosic and advanced biofuels commercialization and production to meet the volume requirements under the RFS. Although the economy has recovered somewhat, access to capital remains the biggest challenge for the development of the nascent advanced biofuels industry. The RFS administered by the EPA works hand-in-hand with other important federal programs administered by the USDA and DOE to provide the industry, its investors and obligated parties necessary federal support. This federal support must continue so that the advanced biofuels industry can reach its potential commercial production levels. Doing so will help this country go a long way toward reducing its dependence on foreign sources of petroleum and greenhouse gas emissions.

Appendix I: Current and Projected Production

BIO has tracked cellulosic ethanol projects since 2007 and made the results public through the Biofuels and Climate Change blog: http://biofuelsandclimate.wordpress.com/about/. Proposed projects have been added to and removed from the list on a regular basis as information about their status has been updated. Inclusion in the list requires that the project demonstrate a funding and/or feedstock procurement agreement in place; many of the funding agreements are in the form of state or federal support for the project.

A. Operating Biorefineries

Name	Location	Fuel	Capacity (mgpy):	Start Year
Abengoa Bioenergy	York, Neb.	Corn Ethanol/Cellulosic Ethanol	0.021	2007
AE Biofuels	Butte, Mont.	Cellulosic Ethanol	0.15	2008
Coskata	Madison, Pa.	SynGas/Ethanol	0.04	2009
DuPont Danisco Cellulosic Ethanol LLC	Vonore, Tenn.	Cellulosic Ethanol	0.25	2009
Enerkem	Westbury, QC	Syngas Methanol/Ethanol	1.3	2009
Fiberight, LLC	Blairstown, Iowa	Cellulosic Ethanol	5.6	2010
Gulf Coast Energy	Livingston, Ala.	FT Diesel/Ethanol	0.4	2009
Iogen	Ottawa, Ont.	Cellulosic Ethanol	0.2	2004
KL Energy Corp.	Upton, Wyo.	Cellulosic Ethanol	1.5	2008
Mascoma	Rome, N.Y.	Cellulosic Ethanol	0.2	2009
POET	Scotland, S.D.	Cellulosic Ethanol	0.02	2009
Terrabon	Bryan, Texas	Ketones/ Green Gasoline	0.1	2010
Verenium	Jennings, La.	Sugarcane Ethanol/Cellulosic Ethanol	1.4	2009

B. Biorefineries Expected to Begin Production in 2011

Name	Location	Fuel	Capacity (mgpy):	Start Year
ClearFuels Technology	Commerce City, Colo.	FT Diesel	1.5	2011
GeoSynFuels	Golden, Colo.	Cellulosic Ethanol	.25	2011
ZeaChem	Boardman, Ore.	Cellulosic Ethyl Acetate/Ethanol	0.25	2011

C. Biorefineries Expected to Begin Production After 2011

Name	Location	Fuel	Capacity (mgpy):	Start Year
Abengoa Bioenergy	Hugoton, Kan.	Cellulosic Ethanol	11.4	2013
AE Advanced Fuels	Keyes, Calif.	Cellulosic Ethanol	14	2011
Agresti Biofuels	Pike County, Ky.,	Syngas Ethanol	20	2012
Alltech Ecofin LLC	Washington Co., Ky.	Cellulosic Ethanol	1	2011
American Energy Enterprises, Inc.	New Milford, Conn.	Cellulosic Ethanol	15	2012
BlueFire Ethanol	Lancaster, Calif.	Syngas Ethanol	3.9	
BlueFire Mecca LLC	Fulton, Miss.	Syngas Ethanol	18	
Citrus Energy, LLC	Boca Raton, Fla.	Ethanol	4	
ClearFuels Technology	Collinwood, Tenn.	FT Diesel	20	2014
Clemson University Restoration Institute	Charleston, S.C.	Cellulosic Ethanol	1	2011
Coskata, Inc.	Boligee, Alabama	Syngas Ethanol	55	2014
DuPont Danisco Cellulosic Ethanol	Midwest, U.S.	Cellulosic Ethanol	25	2013
DuPont Danisco Cellulosic Ethanol	Tenn.	Cellulosic Ethanol	25	2014
Enerkem, Inc.	Pontotoc, Miss.	Syngas Ethanol	20	2012
Enerkem, Inc.	Edmonton, AB	Syngas Ethanol	9.5	2012
Flambeau River Biofuels LLC	Park Falls, Wisc.	Renewable Diesel	6	2013
Frontier Renewable Resources	Kinross, Mich.	Cellulosic Ethanol	40	2013
Fulcrum BioEnergy/Sierra Biofuels	Reno, Nev.	Syngas Ethanol	10.5	2012
Genahol/Powers Energy	Lake County, Ind.	Syngas Ethanol	32	2011
Gulf Coast Energy	Cleveland, Tenn.	FT Diesel/Ethanol	25	2011
ICM Inc.	St. Joseph, Mo.	Cellulosic Ethanol	1.5	2011
Ineos Bio	Vero Beach, Fla.	Cellulosic Ethanol	8	2012
Iogen	Prince Albert, Sask.	Cellulosic Ethanol	18	2012
Lignol	Burnaby, BC	Cellulosic Ethanol	0.26	
Logos/EdenIQ	Visalia, Calif.	Cellulosic Ethanol	10	
Pan Gen Global Plc	Colusa, Calif.	Cellulosic Ethanol	12.5	
POET	Emmetsburg, Iowa	Corn/Cellulosic Ethanol	25	2011

PureVision Technology	Fort Lupton, Colo.	Biomass Sugars/ Ethanol/Butanol	2	2011
Qteros	Chicopee, Mass.	Cellulosic Ethanol		2013
Vercipia	Highland Co., Fla.	Cellulosic Ethanol	36	2012
West Biofuels	Yolo Co., Calif.	Cellulosic Ethanol	0.182	2014
Woodland Biofuels	Mississauga, Ont.	Syngas Ethanol		2012

D. Algae Biorefineries

Name	Location	Fuel	Capacity (mgpy):	Start Year
Algae2Omega	Ft. Lauderdale, Fla.	Biodiesel	0.5	
Algenol	Ft. Myers, Fla.	Ethanol	0.1	2012
Aurora Biofuels	Coastal Florida	Diesel	0.001	Aug. 2007
Cape Cod Algae Biorefinery	Massachusetts Military Reservation, Bourne, Mass.	Biodiesel	1	2010
Cellana	Kona Pilot Facility (KPF), Kona, Hi.	Biodiesel		2010
Green Plains	Shenandoah, Iowa	Ethanol		2010
HR BioPetroleum, Inc.	Ma'alaea, Maui, Hi.	Biodiesel		
Inventure	Seattle, Wash.	Ethanol		
Joule Unlimited	Leander, Texas	Ethanol		2010
LiveFuels, Inc.	Brownsville, Texas	Fuel oil		2009
Phycal	Honolulu, Hawaii	Renewable Diesel, Jet Fuel		2010
Sapphire Energy	Columbus, N.M.	Renewable Gasoline	1	
Solazyme	Danville, Pa.	Jet Fuel, Renewable Diesel		
Solix Biofuel	Coyote Gulch Demonstration Facility Durango, Colo.	Biodiesel	0.006	2009
US Biofuels	Fresno, Calif.	Jet Fuel	4	2010

E. Advanced Biofuel Biorefineries

Amyris	Emeryville, Calif.	Sugarcane Diesel		2008
Dynamic Fuels	Geismar, La.	Animal fats Biodiesel	75	2010
GeoSynFuels	Golden, Colo.	Beetle-killed forest		2010

		Ethanol		
Gevo	St. Joseph, Mo.	Corn Biobutanol	1	2009
Gevo	Luverne, Minn.	Corn Biobutanol	22	2012
Kior	Houston, Texas	Wood chips Renewable Crude	0.23	2010
LS9	Okeechobee, Fla.	Sugars Diesel	0.05 - 0.1	2011
Sun Drop Fuels	Broomfield, Colo.	Solar gasification of biomass		2009
Virent	Madison, Wisc.	Sugar beet Green gasoline	0.01	2010

Existing and Planned Cellulosic Biofuel Biorefineries

Green icons indicate commercial-scale facilities. Blue icons indicate pilot or pre-commercial facilities. Red icons indicate facilities currently in operation.

APPENDIX II

The Washington Post

$4-a-gallon gas fueling fears for recovery

By Michael A. Fletcher and Ylan Q. Mui, Tuesday, April 12, 9:12 PM

Gasoline prices are soaring toward $4 a gallon, a threshold that some analysts say will damage the fragile economic recovery and crimp consumer spending just as families are planning their summer vacations.

Higher prices saddle businesses with higher transportation costs, causing them to either swallow them or pass them along to already strapped customers. As gasoline costs go up, consumers are left with less money to spend elsewhere. And there is evidence that the hike at the pump is beginning to push drivers off the road.

Gasoline prices, which are approaching record levels, "are going to have a very profound effect on the economy," said Peter Morici, an economist at the University of Maryland.

D.C. resident Amber Sutton, who drives 25 miles each way to her job in Woodbridge, said rising gasoline prices have caused her to cut back on restaurants and other entertainment.

"I already was spending a ton on gas," she said. "But now it's absolutely ridiculous."

The average price for a gallon of regular gasoline Monday was $3.79 — up more than a dime from the previous week and 93 cents from a year earlier, according the Energy Information Administration. In California, the average is now $4.16, and prices are above $4 a gallon at some stations in the District and elsewhere.

Prices have risen so high, so fast that some market analysts predicted a sell-off in the short term. That sentiment sent crude oil prices tumbling Tuesday for the second consecutive day, dragging stock markets down about 1 percent, as evidence grew that escalating prices are beginning to threaten the global economic recovery.

But Morici and other economists say the pullback may only provide temporary relief at the pump and that higher prices could be here to stay.

Gasoline prices peaked in July 2008, when a gallon of regular sold for an average of $4.11 nationally. Some analysts fear prices could again approach that level in the near future, since demand for gasoline generally rises in the warm-weather months.

Nearly three-quarters of Americans says higher prices could slow their spending in other areas in the months ahead, according to a Deloitte survey of consumers' spending intentions.

APPENDIX II

"We have an au pair from France, and she recently filled up our minivan and gave me a bill for $70," said Melanie Janin, a mother of three from Bethesda. "I was like, 'Oh, my God.' "

Already, motorists are cutting back on driving because of the increasing prices. "We are seeing some deterioration in U.S. motor gasoline demand . . . as pump prices near $3.75 a gallon," which is when demand got soft in 2008, said David Greely, an analyst at Goldman Sachs. "As the market moves to higher prices, the likelihood that you're going to weaken demand increases."

Bill Simon, chief executive of Wal-Mart U.S., said recently that the retailer sees fewer customers when gas prices begin to rise, because its mammoth stores are typically farther away than local grocery and convenience stores.

But as the spike continues, customers begin consolidating shopping trips and are more likely to visit just Wal-Mart instead of a handful of smaller retailers, Simon said. "We know that gas prices are going to continue to challenge people."

New reports from Goldman Sachs and the International Energy Agency were the triggers for Tuesday's $3.67-a-barrel drop in the price on the New York Mercantile Exchange, where a barrel of the U.S. benchmark West Texas Intermediate closed at $106.25.

Oil prices above $100 will hurt the recovery, the IEA report said. "Economic impacts from high prices are never instantaneous, and often take months to materialize, but preliminary data for early 2011 already show signs of oil demand slowdown," the IEA report said. "Unfortunately, the surest remedy for high prices may ultimately prove to be high prices themselves."

Fears of continued Middle East unrest and the possibility that supply disruptions could spread beyond Libya have driven up the price of Brent crude, another key oil benchmark that is used by about two-thirds of the world, from $100 a barrel in mid-February to $125 a barrel last Friday, a level not seen since May of the record-setting 2008. Yet inventories and spare production capacity are bigger this year than they were then, Goldman noted.

Goldman Sachs analysts did not change their target prices, which are $105 a barrel for Brent much of this year with a rise to $120 a barrel by the end of 2012. Brent prices closed at $120.66 a barrel Tuesday, down $3.32, after reaching $2^1 / _2$-year highs Monday.

Recent oil price hikes increasingly look like the result of speculation. Saudi oil ministry officials, worried that prices are so high that they might lower consumption, have contacted major oil companies offering additional supplies. But the firms responded that they have ample supplies.

"I think you are starting to see that the market might have overextended on prices," said Frank A. Verrastro, senior vice president at the Center for Strategic and International Studies.

But even though crude prices are retreating, there is no telling how low they will go, or when the price decreases will show up at the pump, he said.

APPENDIX II

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Appendix III

The Value Proposition for Cellulosic and Advanced Biofuels Under the Federal Renewable Fuel Standard

Executive Summary

This paper demonstrates that the federal Renewable Fuel Standard ("RFS")—established under the Energy Policy Act of 2005, enhanced pursuant to the Energy Independence and Security Act of 2007 ("EISA"), and enforced by the Environmental Protection Agency ("EPA")— provides considerable market motivation to drive investment in cellulosic and advanced biofuels.

The RFS forms the basis for U.S. low carbon fuels policy at the federal level, requiring the blending of up to 36 billion gallons of biofuels by 2022– more than twice current biofuel use. Recognizing that deployment of cellulosic and other advanced biofuels is essential to meeting the nation's energy security, economic development, and greenhouse gas reduction objectives, the RFS provides a transparent program to speed the deployment of these innovative products into U.S. fuel markets.

Renewable volume obligations ("RVOs") under the RFS ensure that all renewable fuels produced up to annually prescribed volumes will have a market. EPA has demonstrated in its 2010 and 2011 rulemaking its intention to fully enforce both advanced and overall volumes under the RFS. For cellulosic biofuels, EPA has adjusted cellulosic RVOs annually, as required, to reflect current market supply realities. In so doing, EPA does not dilute RFS obligations, but simply provides notice of the projected achievable volume of cellulosic biofuels – all of which must be blended into the fuel supply. This mechanism ensures that there will be a market for all cellulosic biofuel produced up to the volumes prescribed in statute.

To accommodate uncertainty in the timeline of deployment for cellulosic biofuels, the RFS provided obligated parties with flexibility in complying with cellulosic volume requirements. To satisfy their compliance obligations, obligated parties can either buy a gallon of cellulosic biofuel or purchase some combination of fuels—including advanced biofuels— and EPA waiver credits. The cellulosic waiver credit mechanism establishes a counter-cyclical compliance value for cellulosic biofuels that increases as petroleum price decreases, providing a significant degree of price certainty and, thus, considerable market motivation for investment in cellulosic biofuels. To the extent each option is dependent on the other, or can draw upon long-term pricing models for commercial fuels markets and supplies, the relative value and return on investment of physical gallons of cellulosic biofuels over the life of the RFS can be reasonably quantified.

This paper finds the RFS to be an effective mechanism in providing market motivation for investment in advanced and cellulosic biofuels. Continued federal investment in the construction of first-of-a-kind commercial advanced and cellulosic biorefineries is needed to overcome initial scale-up risk. Thereafter, the RFS will rapidly accelerate deployment of advanced and cellulosic volumes, significantly reducing U.S. dependence on imported petroleum.

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The Value Proposition for Cellulosic and Advanced Biofuels Under the Federal Renewable Fuel Standard

The enactment of the Renewable Fuel Standard ("RFS") in 2005 and its extension in 2007 ("RFS2") are critical elements in the demand for biofuels and play an important role in determining the value of renewable fuels. The value of cellulosic and advanced biofuels under the RFS2 is determined by both the price of the commodity fuel and its value in meeting the RFS2 requirements for obligated parties. This paper discusses the compliance mechanisms under RFS2 and their impact in determining the value of—and thus future demand for—cellulosic and advanced biofuels.

RFS Compliance Value

For the first time in U.S. history, the RFS created a federal program requiring the use of 7.5 billion gallons of biofuels by 2012. In 2007, Congress passed the Energy Independence and Security Act (EISA), which extended and increased the RFS requirement to 36 billion gallons by 2022, and included specific, nested requirements for cellulosic and advanced biofuels. Given uncertainty around the availability of cellulosic biofuels, Congress required EPA annually to adjust volume targets for cellulosic biofuels to reflect achievable production. The law also set a pricing mechanism for compliance with the cellulosic biofuels requirement. In 2010, EPA released its final administrative rules for implementation of the RFS2 program ("EPA's final rules"), which defined eligible renewable fuels and compliance values based on greenhouse gas ("GHG") emissions. It further clarified the treatment of the nested requirements. Figures 1 and 2 below outline the specific volume requirements in the RFS2 as well as qualifying fuels.

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Figure 1 – RFS2 Volume Requirements

Total Renewable Fuel = Total Advanced + Conventional Renewable Fuels

Total Advanced = Cellulosic + Biomass-based Diesel + Other Advanced

Year	Total Renewable Fuel	Advanced biofuel nested standards				Conventional biofuel (maximum)
		Advanced biofuel	Cellulosic biofuel	Biomass-based diesel	Other advanced	
2009	11.1	0.6	0	0.5	0.1	10.5
2010	12.95	0.95	0.1	0.65	0.2	12
2011	13.95	1.35	0.25	0.8	0.3	12.6
2012	15.2	2	0.5	1	0.5	13.2
2013	16.55	2.75	1	1	0.75	13.8
2014	18.15	3.75	1.75	1	1	14.4
2015	20.5	5.5	3	1	1.5	15
2016	22.25	7.25	4.25	1	2	15
2017	24	9	5.5	1	2.5	15
2018	26	11	7	1	3	15
2019	28	13	8.5	1	3.5	15
2020	30	15	10.5	1	3.5	15
2021	33	18	13.5	1	3.5	15
2022	36	21	16	1	4	15

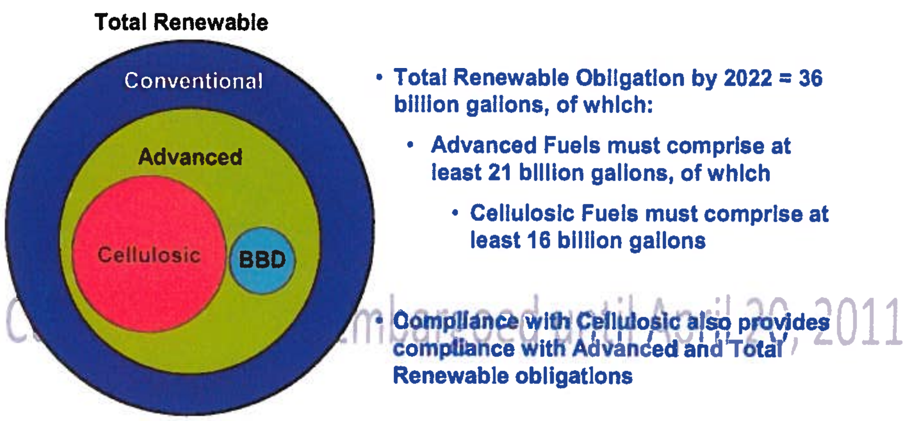
Figure 2 – Eligible Biofuels for RFS2

RFS2 designation	GHG reduction	Qualifying renewable fuel
Advanced	50%	Any renewable biofuel, other than corn starch ethanol, that meets 50% GHG reduction (includes sugarcane-based ethanol)
Cellulosic	60%	Biofuel, including diesel, derived from cellulosic biomass
Biomass-based Diesel	50%	Fatty methyl ester or hydrogenated biodiesel from any fat or oil, including algal oils
Conventional	20%*	Corn starch based ethanol

*Facilities where construction began before Dec. 2007 and is completed by June 2011 do not have to meet this GHG reduction threshold.

Figure 3 below depicts the nested nature of the RFS2 requirements. Compliance with the Cellulosic requirement also provides compliance with the Advanced and the Total requirements. Similarly, compliance with the Biomass-Based Diesel requirement also provides compliance with the Advanced and Total requirements. These categories therefore will have the highest value from a compliance standpoint. In fact, cellulosic diesel, which can qualify for either the Cellulosic or the Biomass-Based Diesel ("BBD") requirements, should have the highest compliance value since it satisfies all requirements.

Figure 3 – RFS2 Nested Requirements



The following are defined terms under EPA's final rules clarifying key elements in the process to achieve compliance with the renewable fuel volume requirements under the RFS:

- <u>Obligated Parties</u> – Gasoline and diesel fuel producers and importers in the United States.
- <u>Renewable Volume Obligation</u> ("RVO") - Annually defined as the number of Renewable Identification Numbers each Obligated Party must possess to meet the volumetric requirements of RFS (calculated as percentages of conventional and advanced renewable fuels required to be included in each Obligated Party's sales).
- <u>Renewable Identification Number</u> ("RIN") – EPA tracking mechanism for RVO compliance.
    - The RIN is created and attached to each gallon of renewable fuel produced. It follows the gallon through blending, unless separated prior to blending by an Obligated Party.
    - RINs are reported to EPA annually for compliance and can be tracked daily through the EPA Moderated Tracking System (EMTS).
    - To help Obligated Parties achieve their RVOs, RINs may be separated from physical gallons and sold after blending (or by Obligated Parties prior to blending).

- Cellulosic Waiver Credit (CWC) – Credits available for purchase from the EPA to satisfy a shortfall in RINs needed for the cellulosic RVO.
    - The CWC price is set annually at the higher of $3.00 less the average wholesale price of gasoline for the preceding 12 months or $0.25 per gallon adjusted for inflation (2008 base per EISA).
    - Can only be used to satisfy current year cellulosic RVO; cannot be banked for future use, cannot satisfy compliance obligation carried over from previous year, cannot be sold or transferred.
    - Number of credits issued by EPA for the marketplace is equal to total cellulosic RVOs for current year.
- Equivalence Values (EVs) – Adjustments to account for differing energy content and efficiency of different biofuels; determines number of RINs per gallon of production.
    - Ethanol = 1
    - Butanol = 1.3
    - Biodiesel = 1.5 or 1.7 (depending on production method).

Cellulosic Requirement

The cellulosic compliance mechanism in RFS2 constitutes a true and enforceable requirement on Obligated Parties to blend all available cellulosic biofuels, up to the volumes prescribed in Figure 1 above. As required by EISA's cellulosic waiver mechanism, EPA annually has adjusted prospective year cellulosic volumes to the projected production level, determined by surveying producers prior to each compliance year. In so doing, EPA does not dilute RFS2 obligations. It simply provides notice to Obligated Parties of the projected achievable volume of cellulosic biofuels – all of which **must** be blended into the fuel supply. **This volume requirement ensures that there will be a market for all cellulosic biofuel produced up to the prescribed volumes.**

EPA Enforcement Is Key

EPA's continued enforcement of the RFS2 is crucial to compliance with the volume requirements. While EISA obliges EPA to waive the cellulosic requirement to achievable production levels, *EPA does not have a waiver obligation for the advanced or total renewable fuel requirements.* EPA has asserted that it has the authority to waive the advanced and overall requirements by the same amount as the waiver of the cellulosic portion, but will not do so as long as it envisions sufficient supply of advanced biofuels. Furthermore, since 2005 EPA has been consistent in its commitment to enforcing the renewable fuels requirements set by Congress.

EPA has continued that tradition in its rule making. In setting annual volumes, EPA has explicitly stated its intention to provide an incentive for industry growth. In EPA's final rules for the 2011 RFS2 volumes, the Agency specifically noted:

> "We believe that the cellulosic biofuel standard should provide an incentive for the industry to grow according to the goals that Congress established through EISA. However, we also believe that the cellulosic biofuel standard that we set should be within the range of what can be attained based on projected domestic production and import potential. Any estimate we use to set the cellulosic biofuel standard for 2011 will have some uncertainty in terms of actual attainment, and the level of such uncertainty generally rises with the volume mandate. Our intention is to balance such uncertainty with the objective of providing an incentive for growth in the industry."[1]

In addition to EPA's commitment to enforcement, the effectiveness of the cellulosic and advanced requirements is further reinforced by several important considerations:

- The cellulosic requirement EPA sets is unlikely to fall below actual production levels for two main reasons: (1) Cellulosic producers will report their expected production volumes; and, (2) EPA thus far has taken great care to fully account for all potentially available cellulosic volumes and has signaled its intent to provide a market incentive. Furthermore, given that cellulosic biorefineries have long construction schedules, it is highly unlikely that any unanticipated production will come online in any given compliance year. So, even if EPA does adjust the cellulosic requirement, cellulosic biofuels are more likely to be in short supply than oversupply.

- EPA is unlikely to waive the advanced or total RFS2 requirements for at least the next few years. Sufficient biodiesel, sugarcane ethanol and other advanced biofuels are likely to remain available to satisfy the advanced volumes in the RFS2 schedule for the next several years given existing capacity in those industries. EPA has demonstrated in its 2010 and 2011 rulemakings that it is committed to enforcing these volumes. This means the total and advanced EISA volumetric requirements are likely to be maintained at congressionally directed levels. **Under this scenario, waived cellulosic volumes are re-designated into the "other advanced" category, expanding the requirement and opportunity for "other advanced" biofuels.**

- EPA will allow the purchase of a CWC to be used only for compliance with the current year's cellulosic requirement. This means a purchased CWC does not eliminate the obligation to blend a gallon of advanced biofuel, or purchase an advanced biofuel RIN (A-RIN).

- EPA will calculate the CWC price under a clear, statutory formula and will announce the price prior to each compliance year. This EPA CWC pricing structure provides for RIN market certainty and transparency for a cellulosic premium.

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[1] EPA, Preamble to 2011 Final Rule, November 23, 2010, page 13

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- EPA has added transparency and efficiency to the various ways in which an Obligated Party may comply with the RFS ("compliance mechanisms") by instituting the EMTS (defined above), an electronic reporting system, to provide real-time information and tracking. This information and tracking thus provides Obligated Parties—and all industry participants—real-time views into the RIN supply/demand situation in the compliance markets.

Compliance Options

The compliance mechanisms available under the RFS2 afford Obligated Parties several options for compliance with the cellulosic requirement, as depicted in the example shown in Figure 4, below.

Figure 4 – Compliance Options for Cellulosic Requirement – Ethanol Example

	Advanced biofuel nested standards			Conventional biofuel	Alternative compliance from EPA
	Advanced biofuel	Cellulosic biofuel	Biomass-based diesel		
RIN type	A-RIN	C-RIN	B-RIN*	R-RIN	CWC
Compliance options:	Gallon purchased (✓); RINs obtained (X)				
1 - Buy cellulosic ethanol gallons		✓ X			
2 - Buy advanced ethanol gallons & CWC	✓ X				X
3 - Buy biodiesel gallons & CWC*			✓ X		X
4 - Buy corn ethanol gallon; sell R-RIN & buy A-RIN and buy a CWC	X			✓	X

* Per Equivalence Values, biodiesel is worth 1.5 or 1.7 RINs. An average of 1.6 is assumed. This implies only 0.6 gallons of biodiesel provide an ethanol equivalent RIN. It also implies that a B-RIN/gal=1.6 A-RINs/gal.

In the case of cellulosic ethanol, to comply with the cellulosic requirement under RFS2, an Obligated Party has four options:[2]

1. Buy cellulosic ethanol (CE) gallons, which provides the fuel and cellulosic biofuel RINs (C-RINs);
2. Buy advanced biofuel (AE) gallons (which provides the fuel and A-RINs) ***and*** purchase a CWC from EPA;

[2] Technically, an obligated party has a fifth option which is to carry over the obligation for one year. However, CWCs cannot be used to meet carry over obligations, only C-RINs. This would increase the demand and price of C-RINs in future years. Since this is a higher cost option, and is complicated by inter-temporal elements, it has been omitted from the above example.

3. Buy biodiesel (BD) gallons (which provides the fuel and biodiesel RINs [B-RINs]) over the Biomass-Based Diesel requirement ***and*** purchase a CWC from EPA; or
4. Buy conventional (RE) biofuel gallons (which provides the fuel and renewable fuel RINs [R-RINs]) ***and*** sell the R-RINs and purchase A-RINs ***and*** purchase a CWC from EPA.

Note that since a gallon of biodiesel includes 1.6 RINs (average of 1.5 and 1.7 equivalence values assumed), the value of a B-RIN per gallon must be 1.6 ethanol A-RINs per gallon, and therefore *a B-RIN per gallon will always be higher than an A-RIN per gallon*. This fact means that an Obligated Party could obtain the required RINs with fewer gallons of biodiesel. Other fuels such as butanol also receive more RINs than ethanol due to their higher energy content. *Butanol's compliance value per gallon will be similarly higher in value than ethanol.*

Obligated Parties will seek to minimize their cost of compliance. Producers may therefore set their price up to the level at which Obligated Parties are indifferent between purchasing cellulosic fuel and complying with a CWC. Thus, the purchase price of cellulosic ethanol (option 1) must be equal to the least-cost option from among options 2-4[3]. As a result:

C-RIN = A-RIN + CWC

This relationship between the compliance values is important because it (1) establishes a known compliance premium for cellulosic biofuels in the form of the CWC formula price, and (2) allows an estimation of the value of cellulosic biofuels inclusive of its C-RIN, by estimating the value of the marginal advanced biofuel equivalents. If we add the fuel value of ethanol to each side of this equation, for example, we come to a full value for cellulosic ethanol:

CE Value = AE Value + CWC

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[3] The price of each compliance option is outlined below:

Option 1: Cellulosic Ethanol (CE) = Naked Fuel (Fuel) + C-RIN
Option 2: Advanced Ethanol (AE) + CWC = Fuel + A-RIN + CWC
Option 3: Biodiesel (BD) + CWC = Fuel + B-RIN + CWC
Option 4: Renewable Ethanol (RE) + A-RIN – R-RIN + CWC = Fuel + R-RIN+A-RIN –R-RIN + CWC

Setting Option 1 to the minimum of options 2-4 leads to:

Fuel + C-RIN = Min (
Fuel + A-RIN + CWC
Fuel + B-RIN + CWC
Fuel + A-RIN +CWC)

Since B-RIN> A-RIN, and cancelling like terms from each side of the equation, we derive:

C-RIN = A-RIN + CWC

Adding fuel value ("Fuel") to each side of this equation we get:

Fuel + C-RIN = Fuel + A-RIN +CWC
CE = AE + CWC

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The key to valuing cellulosic ethanol is in understanding the value of advanced ethanol, since the CWC price will be determined by a stated formula, and it will be announced ahead of the compliance year. Similar methodology may be applied to other fuel molecules, such as biobutanol. For the purposes of the following discussion, we will consider ethanol as a case study.

Advanced Biofuel Value

As is typical of commodities, biofuel prices are bound by the consumer's substitution value and the marginal cost to producers. Within these bounds, *the price of ethanol at any given point in time is determined by ethanol's relative supply/demand balance*. If there is excess supply, the price will tend to be closer to the marginal cost. If there is excess demand, the price will tend to be closer to the substitution value. The difference between the substitution value and the marginal cost represents the total margin that can be distributed between producers and consumers.

Gasoline Blend Value

The substitution value of biofuel is the price at which a blender becomes indifferent to using biofuel and is referred to as the Gasoline Blend Value ("GBV"). Since ethanol can be a substitute for gasoline, the GBV is determined by the price of gasoline, adjusted for mileage and blending properties such as octane value, the incentives that blenders obtain for using ethanol and the compliance value for meeting the RFS.

Ethanol can currently be utilized in vehicles in either a 10 percent blend in regular vehicles ("E10"), 15 percent blend in newer vehicles ("E15")[4], or up to an 85 percent blend ("E85") in flex fuel vehicles ("FFVs"). At E10 and E15, there is effectively no distinguishable mileage loss (compared to using 100 percent gasoline) and no corresponding impact on price. However E85 blends suffer a 25 percent mileage loss in the final blended fuel in typical flex fuel vehicles available today.[5] *An outlook on the prevailing blend of ethanol is important in determining the GBV*. Other biofuels, such as butanol, can be blended at higher percentages without a mileage loss.

Blenders of ethanol also receive the Volumetric Ethanol Excise Tax Credit ("VEETC")—also known as the "blender's credit"—established under the American Jobs Creation Act of 2004. This blender's credit replaced the Federal Ethanol Excise Tax Credit that had been in place since the 1970s and provides oil companies with an additional economic incentive to blend ethanol

[4] Note that this is not yet legal in commerce. Testing is done, approval for 2001 and newer light duty vehicles is authorized but commercial use is not legal until the fuel has passed EPA registration requirements and all conditions of the waiver have been met.
[5] The mileage loss is due to ethanol's lower energy content compared to gasoline. However, despite a 33 percent lower energy content, empirical mileage tests show average mileage for E85 vehicles to be only 20-25 percent lower than similar models with non-flex fuel engines.

with gasoline. As of January 1, 2009, the original blender's tax credit totaling 51 cents per gallon on pure ethanol was reduced to 45 cents per gallon pursuant to the Food, Conservation and Energy Act of 2008. VEETC is currently authorized through Dec. 31, 2011.

As discussed above, there is a compliance value that blenders also derive from using ethanol. In the past, when RFS volume requirements and demand for a replacement for methyl tertiary butyl ether ("MTBE") as an oxygenate exceeded industry production, a significant compliance premium was also associated for conventional ethanol. Given the corn ethanol industry's ability to quickly ramp up production, however, that compliance premium was short-lived. Today, conventional R-RINs are worth a few cents per gallon. In the case of advanced biofuels, the value of an A-RIN will be determined by similar market forces such that when advanced biofuels, including biodiesel, are plentiful A-RINs will have a lower value than when these fuels are scarce. If required volume demand is greater than available supply, then the A-RIN value will rise to incent additional supply of advanced biofuels. Since Brazilian sugarcane ethanol is also expected to earn compliance credits with California's Low Carbon Fuel Standard ("LCFS"), the A-RIN is likely to reflect the value of that compliance credit as well.

The value of advanced ethanol to a blender, or the GBV, therefore is the wholesale price of gasoline, adjusted for ethanol mileage loss, plus the blender's credit and A-RIN. This determines the expected ceiling for the advanced ethanol price.

Marginal Cost

The marginal cost ("MC") of ethanol is the cost of the marginal supplier, which for the advanced category is assumed to be imported sugarcane ethanol from Brazil. This cost will include production costs at expected exchange rates, reflective of prevailing sugar prices (which show correlation to crude oil prices), and an expectation for the cost of tariff and transport. This cost reflects the floor value for advanced ethanol prices.

Margin allocation

Historically, corn ethanol prices have fluctuated between the GBV and the MC depending on the relative supply and demand of ethanol. When the market is short ethanol, prices approach the GBV. When there is excess ethanol capacity—as there has been recently—prices approach the levels of the marginal producer's cash costs. The difference between the GBV ceiling and MC floor reflects the total margin pool available to producers and blenders. This margin pool will also cover broader supply chain costs and margins involved in the distribution of the product. The relative position of the spot price splits this margin between the blender and producer. Depending on the time period reviewed, this average margin split has fluctuated between as little as 20 percent blender share to as much as 90 percent blender share of the margin.

We expect that margins will continue to be split between blenders and producers in line with the expected supply/demand balance for ethanol. Given the growth of the advanced ethanol requirement per the RFS2, and assuming blend wall concerns are overcome by deployment of E85 infrastructure and/or market adoption of biobutanol and other infrastructure compatible fuel molecules, we expect the sugarcane ethanol market will be in short supply beginning in 2015. The U.S. Energy Information Administration projects that FFVs will make up more than 20 percent of U.S. auto sales by 2015 and maintain that market share through 2035, which will provide additional market for E85.[6] This additional market means that advanced ethanol is more likely to be valued closer to the GBV than the MC.

Mathematically then, the value of Advanced Ethanol is as follows:

AE value = GBV – (% Blender margin capture)*(GBV-MC)

Cellulosic Biofuel Value

Cellulosic ethanol prices can be projected by constructing a projection for Advanced Ethanol and adding to it the calculated CWC value. Advanced Ethanol prices can be projected by estimating the GBV and MC at expected oil prices per the formula discussed above, making assumptions about the relationship between crude oil, gasoline and sugar prices, as well as market factors such as blend levels and margin allocation. Similar methodology can be used for other cellulosic biofuels under development.

As discussed above, EPA will calculate the CWC based on the greater of $0.25 per gallon or $3 minus the average wholesale gasoline price for the previous 12 months, adjusted for inflation since 2008. For 2011, this CWC price was announced at $1.13/gallon.[7]

The CWC price in the future can also be projected based on an outlook for crude oil prices. A very important aspect of the CWC formula price is its inverse relationship to gasoline, and therefore crude oil prices. The figure below shows for a single year, 2014, the range of potential cellulosic ethanol values based on different crude oil prices. At low crude oil prices, the value of Advanced Ethanol is low since sugar and gasoline prices are low, however the value of the CWC approaches $3/gallon. Similarly, at high oil prices, the value of Advanced Ethanol is high, while the CWC provides a small additional premium to cellulosic ethanol. **This counter-cyclical compliance value provides a significant degree of price certainty for cellulosic ethanol and other cellulosic biofuels, substantially mitigating additional capital risk associated with commercialization of fuels from cellulosic feedstocks.**

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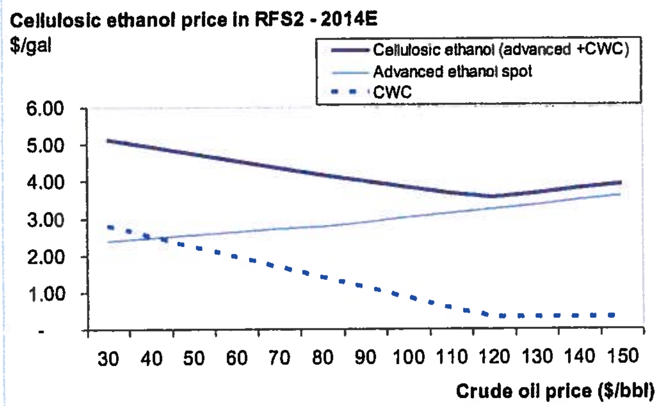
6 U.S. Energy Information Administration, "EIA projects rapid growth in unconventional vehicle sales," accessed Feb. 10, 2011. http://eia.gov/todayinenergy/detail.cfm?id=70.

7 Per the final rule, EPA will use the trailing 12 month US Total Gasoline Bulk Sales (Price) by All Sellers reported by EIA and the latest month CPI-U index reported by BLS that is available by September 30 of the year prior to compliance.

Figure 5 - Cellulosic Ethanol and Crude Oil Prices



Comment [HC1]: Insert new version of chart

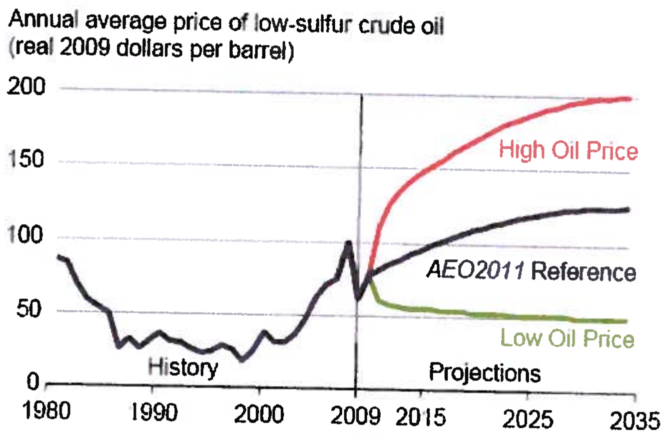
* Assumes 16 percent gasoline refining margin, A-RIN and blenders credit of $0.50/gal, a $0.54/gal tariff and 20% blender margin capture

Conclusion

The RFS2 requirement is a critical determinant of the demand for renewable fuels, providing both market assurance and value, particularly for cellulosic and advanced biofuels. For cellulosic biofuels, **the RFS2 requirements provide assurance that all cellulosic biofuel produced up to annually prescribed volumes will have a market.** The RFS2 compliance mechanisms promulgated by EPA also allow producers of innovative renewable fuels, such as advanced and cellulosic biofuels, to capture additional value for their products. **For cellulosic biofuels, RFS2 establishes a counter-cyclical compliance value that increases as petroleum price decreases, providing a significant degree of price certainty. The combination of market assurance and price certainty provides considerable market motivation for investment in cellulosic biofuels.**

Further, because of projected competition for tight supplies in worldwide oil markets, and given volatility in oil prices, cellulosic and advanced biofuels should be expected to offer a more certain return on investment. Crude oil prices are projected to continue an upward trajectory through 2035, according to the U.S. Energy Information Administration (EIA).
At the same time, progress in commercializing cellulosic and advanced biofuels and continued innovation in the industry will lead these fuels down the cost curve. Additionally, **because advanced biofuels will also be in a demand-driven market, they will also be well positioned to capture value between the high price of petroleum gasoline and low wholesale cost of conventional biofuels.**

Figure 6 – World Crude Oil Prices, 1980-2035



Source: Energy Information Administration, Annual Energy Outlook 2011 Early Release Overview, December 2010.

These findings indicate that the **RFS is an effective mechanism in providing market motivation for investment in advanced and cellulosic biofuels**. However, as the initial years of the RFS2 program have demonstrated, market requirements alone may not be sufficient to overcome initial scale-up risk associated with first-of-a-kind commercial facilities. **Continued federal investment in the construction of first-of-a-kind commercial advanced and cellulosic biorefineries is recommended to help overcome initial scale-up risk**. The U.S. Department of Energy ("DOE") Integrated Biorefinery Program at the Office of Biomass Programs, which provides grants to pilot and commercial demonstration biorefineries, and the U.S. Department of Agriculture ("USDA") Biorefinery Assistance Program, which provides loan guarantees to first-of-a-kind commercial biorefinery projects, will continue to play a critical role in overcoming initial scale-up risk. Thereafter, the RFS will rapidly accelerate deployment of advanced and cellulosic volumes, significantly reducing U.S. dependence on imported petroleum.

Further acceleration of commercial deployment of cellulosic biorefineries can be achieved through programs to speed grower adoption of purpose-grown energy crops. Continuation of establishment payments under the Biomass Crop Assistance Program is therefore also recommended.

The advanced biofuels industry, including many BIO members, is making progress in commercializing new cellulosic and advanced technologies. The RFS2 compliance options provide the type of long-term, market-based government policy mechanisms that will continue to drive innovation and cost reduction and ultimately enable the biofuels industry to achieve its promise of U.S. energy security, economic development and environmental sustainability.

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Appendix IV

Tax Code Should Promote Innovation and Commercialization of Advanced Biofuels, Renewable Chemicals and Biobased Products

Accelerate Commercialization of Advanced Biofuels to Reduce Petroleum Dependence and Enhance Energy Security

- Extend the Cellulosic Biofuel Production Tax Credit (IRC Section 40(a)) and the Cellulosic Bonus Depreciation Incentive (IRC Section 168(l)) through December 31, 2017

  As part of the 2008 Farm Bill, Congress enacted a tax credit for the production of cellulosic biofuels, and enhanced depreciation for these facilities, both of which are scheduled to expire on December 31, 2012. Extending the cellulosic biofuel credit and the enhanced depreciation treatment through 2017 will provide American businesses the certainty they need to make long-term investment decisions in new cellulosic facilities.

- Enact tax parity between algae-based biofuels and cellulosic biofuels to encourage this cutting-edge technology.

  Algae-based biofuels possess the same favorable characteristics as cellulosic biofuels in terms of feedstock sustainability, job creation, energy security, and environmental profile. But it is our understanding that they may not have been originally considered in the enactment of the cellulosic biofuel production tax credit due to limited awareness of algae's commercial potential. Congress should ensure that the cellulosic biofuel production tax credit and accelerated depreciation are extended to algae-based biofuels so as to provide a level playing field for these promising biofuel technologies.

- Provide an investment tax credit (ITC) for next generation biorefineries

  Capital costs for construction of next generation biorefineries, which utilize renewable biomass to produce next generation biofuels and biobased products, are a substantial barrier to commercialization. Congress should provide an investment tax credit to help accelerate construction of next generation biorefineries and speed deployment of next generation fuels, chemicals and products.

Encourage Domestic Production of Renewable Chemicals and Other Biobased Products to Revitalize U.S. Manufacturing

Biotechnology is enabling the production of a new generation of biobased products – chemicals and plastics produced from renewable biomass – that can supplement or substitute for traditional petroleum-based chemicals and products. The emergence of this technology represents a historic opportunity to reverse job losses in the U.S. chemicals and plastics sectors, increase energy security, and reduce greenhouse gas emissions. To help accelerate commercialization of this promising new generation of renewable materials, Congress should:

- Enact tax incentive to accelerate commercialization of the renewable chemicals and biobased products industry

  A tax credit for renewable chemicals and biobased products will promote investment and domestic production of innovative renewable chemicals, creating thousands of high quality U.S. jobs and reducing demand pressure on volatile petroleum prices.

- Revisit the Advanced Energy Project Credit (IRC Section 48C) and include renewable chemicals and bioproducts biorefineries

  The expired 48C advanced energy manufacturing credit provided much needed assistance to developers of a wide range of energy efficiency and renewable energy technologies, including biofuels projects, but failed to clearly recognize renewable chemicals manufacturing projects as eligible. Statutory language should be clarified to ensure that renewable chemicals and bioproducts manufacturing property is unambiguously eligible.