BIOFUELS POLICY

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LIST OF ACRONYMS

RFS	Renewable Fuel Standard
EPA	Environmental Protection Agency
LCFS	Low Carbon Fuel Standard
RVOs	Renewable Volume Obligations
RINs	Renewable Identification Numbers
GHG	greenhouse gas (emissions)
SJF	sustainable jet fuel
DOE	Department of Energy
BBD	biobased diesel

EXECUTIVE SUMMARY

In the development of a new industry like biofuels, stable long-term policy is a key factor to reach commercialization of alternative fuel production. In the United States, relatively stable and consistent policy is one factor that enabled ethanol[1] as the first-generation alternative fuel to grow "dramatically" from 175 million gallons by 1980, to nearly five billion gallons by 2006, and over 14 billion gallons in 2015 (Renewable Fuels Association). Today, however, ethanol's integration into the transportation fuel supply is said to be limited by the "blend wall"[2] (Verleger, 2014). At the same time, alternative second-generation biofuels have struggled to reach commercial-scale production largely because of uncertainty of future policies, high cost of production, the capital required to initiate a project, and a myriad of technical, environmental and social issues (Warner). The uncertainty is caused in part by the Renewable Fuel Standard's fluctuating biofuel production mandates set by the US Environmental Protection Agency (Lave, 2014). In particular, US law and policy for advanced biofuels has not provided adequate stimulus to foster predictable development and commercialization of the biofuel industry.

[1] As defined by the US Department of Energy, "Ethanol is a renewable, domestically produced alcohol fuel made from plant material, such as corn, sugar cane, or grasses." (US Department of Energy[a])

[2] The "blend wall" refers to the E10 transportation fuel limits for ethanol volumes in conventional vehicles.

INTRODUCTION

The production and use of "biofuels" evokes strong reactions across a broad range of audiences. On one end, the biofuel industry can "move the US toward greater energy independence and security [and…] increase the production of clean renewable fuels"[3]. The US Department of Energy (DOE) highlights the potential for alternative fuels to reduce US dependence on oil; environmental benefits, including reduced greenhouse gas emissions; and economic opportunities in hard-hit rural areas (US Department of Energy[b]). On the other end, commentators decry the use of biofuels, saying that it is "a [t]ime to close the books on US biofuels policy" (Klippen & Gibeson, 2014). The 2014 US National Climate Assessment Report notes that while "[t]ax credits for biodiesel and advanced biofuel production, alternative fuel infrastructure, and purchase of electric vehicles" are under discussion, there are also environmental concerns. For example, "the water resource implications of increased production of biofuels are substantial in some regions of the US" and "may result in negative impacts on ecosystems, power production, or residential water supply" (US Global Change Research Program). In addition, there are potential impacts to areas such as air and biodiversity. On the other side, industry has "challenged the obligation under RFS [Renewable Fuels Standards] to use cellulosic biofuels that do not exist in sufficient amounts in commercial markets or pay a fee" (National Academy of Sciences, 2011; Schnepf & Yacobucci, 2013). These views reflect the ever-changing set of laws and policies that challenge a relatively new industry in the United States and elsewhere.

Analyzing US biofuel law and policy development, this task reviews how both federal and state governments have affected the biofuel industry in the United States and explores the demand for advanced biofuels from the US military and for commercial aviation. Given the uncertainty under the federal RFS standards, state and regional approaches may offer more predictable law and policy motivations on the supply side. In addition, market demand for biofuels in the military and commercial aviation sectors may help move the industry forward.

[3] Energy Independence and Security Act of 2007, Pub L. 110–140; 42 U.S.C. 7545(o)(2)(2013)

BIOFUELS POLICY

OBJECTIVE

The objective was to investigate the interplay of policy on the development of biofuels and to identify whether sustainable jet fuel could be a successful avenue to realization of commercial biofuels. Parameters investigated included policies that affect development across the supply chain from feedstock to production and policy effectiveness on federal, state, and regional levels.

RESULTS

POLICY DEVELOPMENTS

- In response to the 1973 energy crisis, the US began exploring ways to develop its domestic energy industry.
- First-generation biofuels are produced from food-based feedstocks: sugars, grains and starches.
- From 1978 to 2004, US policy focused on the development of first-generation biofuels, which included corn-grain ethanol and biodiesel from soybean or vegetable oil.
- Following the robust development of the US corn-grain ethanol-based biofuel industry, Congress began enacting laws in 2005 to diversify the sources of biofuel feedstock, address the "food versus fuel" debate, and foster the "second generation" of biofuels. Although meant to support the diversification of the biofuel industry, the inconsistent application of these laws has also hindered the biofuels industry.
- Second- and third-generation (or "advanced") biofuels are produced from non-food-based feedstocks, including lignocellulosic feedstock, cellulosic biofuels, algae-based fuels, and biomass-based diesel (biodiesel).

AVIATION

The potential use of biofuels for commercial and military aviation has driven biofuel technology innovation and industry support. Because of aviation's specific demands – a high-performance, liquid, high-energy density fuel, which operates safely in a wide range of conditions –"drop-in" sustainable jet fuel (SJF) is the only option currently available. The need to develop SJFs is driven by a number of issues such as uncertainty in fuel costs, energy security, and concern over CO_2 emissions, especially given the global reach of aviation, as well as foster significant regional rural economic development. Incorporating biofuels into aviation as opposed to the general transportation sector will require fewer entry points for the relatively few "filling stations" for aviation fuels.

- This is the only option available because airplane engines are not able to operate under other sources of energy, including solar or wind. (Sustainable Aviation Fuels Northwest, 2011)
- As a liquid transportation fuel, SJF must pass a rigorous American Society of Testing and Materials (ASTM) International certification process.
- Another challenge is ensuring pricing parity with conventional petroleum-based aviation fuels, which is especially difficult given recent oil price volatility.
- High feedstock costs, capital requirements, and policy uncertainty, particu larly due to the RFS, are major impediments to competitive prices for SJF.

THE RENEWABLE FUEL STANDARD

The 2005 *Energy Policy Act* (RFS1) established the first Renewable Fuel Standard (RFS) to encourage diversification of the biofuels industry and to address a number of challenges, including rising oil prices, greenhouse gas emissions, energy security, and rural economic development. Just two years later, Congress passed the 2007 Energy Independence and Security Act (RFS2) to expand the requirements and replace a more significant fraction of U.S. petroleum-based transportation fuel with biofuels. Implementation of the RFS2 requirements is through a fairly complex system. Ideally, the RFS program provides a mandatory market for qualifying biofuels where fuel blenders must include minimum annual biofuel volumes in their transportation fuel sales (Table BP-1; Table BP-2). RVOs (Renewable Volume Obligations) are calculated by dividing each RFS target by the total estimated supply of non-renewable gasoline and diesel fuel in each year. There are four separate RVOs for the four different RFS targets.

Table BP-1. Fuel volumes used to determine percentages and final percentage standards.

Volumes used to determine % standards	Cellulosic Biofuel	Biomass-based diesel	Advanced biofuel	Renewable fuel
2011	6.6 mgal 0.003%	0.80 bgal 0.69%	1.35 bgal 0.78%	13.95 bgal 8.01%
2012	8.65 mgal 0.006%	1.0 bgal 0.91%	1.3–1.5 bgal 1.21%	14.5–14.7 bgal 9.23%
2013	810,785 gal 0.0005%	1.28 bgal 1.13%	2.75 bgal 1.62%	16.55 bgal 9.74%
2014	33 mgal 0.019%	1.63 bgal 1.41%	2.67 bgal 1.51%	16.28 bgal 9.19%

Table BP-2. Final volumetric standards used to determine the proposed percentage standards for 2014–17 *[Note: All values are ethanol-equivalent on an energy content basis, except for BBD which is biodiesel-equivalent]. Source: http://www.epa.gov/renewable-fuel-standard-program/final-renewable-fuel-standards-2014-2015-and-2016-and-biomass-based.*

		2014	2015	2016	2017
Cellulosic biofuel	Original Mandate	1.75 bgal	3.0 bgal	4.25 bgal	5.5 bgal
	Final Rule	33 mgal	123 mgal	230 mgal	N/A
Biomass-based diesel	Original Mandate	≥1.0	≥1.0	≥1.0	TBD
	Final Rule	1.63 bgal	1.73 bgal	1.9 bgal	2.0 bgal
Advanced biofuel	Original Mandate	3.75 bgal	5.5 bgal	7.25 bgal	9.0 bgal
	Final Rule	2.67 bgal	2.88 bgal	3.61 bgal	N/A
Renewable fuel	Original Mandate	18.15 bgal	20.5 bgal	22.25 bgal	24.0 bgal
	Final Rule	16.28 bgal	16.93 bgal	18.11 bgal	N/A

RFS2, RVOs, and RINs

The EPA ensures obligated parties meet specific RVOs each year through Renewable Identification Numbers (RINs), which are 38-character identification numbers attached to each gallon of renewable fuel produced or imported. Renewable fuel producers generate RINs by producing fuels from qualifying feedstock that meets RFS2's established definition of renewable biomass. RINs must be acquired by fuel blenders to prove compliance with RFS2 mandated volumes. These RINs may be traded according to local market conditions. RIN values are complicated by growing volumes of mandated renewable fuels, the four nested and overlapping renewable fuel categories, and the two-year lifespan of RINs. According to one commentator, "[u]nderstanding the RIN market is key to understanding the role of the RFS mandates in biofuel and feedstock markets" (Burke & Tyner, 2011; Thompson, Meyer & Westhoff, 2011; Lihongm, Westcott, & Lutman, 2011).

STATE OF CALIFORNIA'S LCFS

California has taken the lead in developing a different approach by adopting low carbon fuel standards (LCFS). The goal of such standards is to "establish average carbon intensity values for various fuels such as gasoline, diesel, biofuels, natural gas, and electricity. Carbon intensity values are calculated using a life-cycle analysis, which accounts for all greenhouse gas emissions associated with a fuel's production, distribution and use—as opposed to a simple measure of carbon emissions when a fuel is burned" (Glass, 2014). In addition to California, such standards are being explored elsewhere, including in the Pacific Northwest (Oregon Department of Environmental Quality, 2011) and in the eastern US, where 11 states signed a 2009 Memorandum of Understanding to adopt a "Clean Fuels Standard"[4].

The effort by California represents a significant experiment that has taken years to play out; implementation of this may offer interesting insights to others. In addition, such individual state efforts are also taking place in more regional contexts. If California, Oregon and Washington all effectuate LCFS, there is the potential for significant impact: these states together provide approximately 20% of the US economy and 13% of US gasoline consumption, thus reinforcing the strength and effect of regional alliances.

WHERE ARE WE TODAY?

Policy on the supply side:

- Agriculture: Agriculture Risk Protection Act of 2000, Farm Security and Rural Investment Act of 2002, Energy Policy Act of 2002, Farm Bills
- Forestry/Timber: US Forest Service research and development projects, Bio fuels Research and Development Enhancement Act

Policy on the demand side:

- Transportation: alternate transportation fuel programs, Clean Cities Program
- Aviation: Federal Aviation Administration, coordinated government effort
- Military: Defense Production Act Tit. III, Energy, Agriculture, and Navy Memoranda of Understanding

CONCLUSION

The law and policy surrounding alternative fuel in the United States began with early policy related to the development of corn-grain-based ethanol and now includes efforts to diversify feedstock and encourage the scale-up of the advanced biofuels industry. The original policy was designed as a response to the 1973 US energy crisis and as a way to develop domestic energy sources. As societal needs changed, US biofuel policy evolved in the 2000s to address not only energy prices and security, but also GHG emissions and rural economic development. Today, US energy policy is implemented through a relatively complex system designed to diversify feedstock; however, one result has been that special interests are often in conflict over market share. The combination of federal policy with state and regional policy has created an interesting set of experiments that is playing out in real time. There is little doubt that this ever-changing set of incentives, both on the supply and the demand side, will continue to evolve at a rapid pace. At the same time, fluctuations in law and policy at a federal level make development of a stable industry more difficult. In light of recent and dramatic drops in gas prices during 2014 and 2015, the advanced biofuel industry in the United States will likely face continued development challenges.

[4] Memorandum of Understanding, 2009, signed by Governors of Maine, Maryland, New Jersey, New York, Pennsylvania, Rhode Island and Vermont, accessed through Northeast States for Coordinated Air Use Management (NESCAUM), available at http://www.nescaum.org/topics/clean-fuels-standard.

NARA OUTPUTS

PEER REVIEWED PUBLICATIONS

Dahmann, K. K.S., L.B. Fowler, P.M. Smith. 2016. United States Law and Policy and the Biofuel Industry, included in Volume One: *The Law and Policy of Biofuels* co-editors, Yves Le Bouthillier, Annette Cowie, Paul Martin and Heather McLeod-Kilmurray, IUCN Academy of Environmental Law Series. May, 400pp. Hardback. 978 1 78254 454 8. Edward Elgar Pub., Inc., Northampton, MA. Pp. 102-140.

PRESENTATIONS

Dahmann, K.S., P.M. Smith, and L.B. Fowler. 2014. *U.S. Biofuel Law & Policy: An Unsteady Past and an Uncertain Future For Second Generation and Third Generation Biofuels and Beyond*. Presentation at the TAPPI International Bioenergy & Bioproducts Conference 2014, Session on Impacts of Policies and Incentives, Sept. 17-19, Seattle, WA.

Smith, P.M., P. Adeniran, A. Chatterjee, C. Grassi, A. Kulkarni, J. Quezada, A. Hawkins, and J. Scheib. 2012. *Strategic Marketing Plan for Biofuels in the NARA Region*. Presented at the Western Montana Corridor NARA Community Roadmap Development Meeting. University of Montana, Missoula, MT. 13 June.

POSTERS

Dahmann, K.S. L. B. Fowler, and Paul M. Smith. 2016. U.S. BIOFUEL - LAW AND POLICY: First, Second and Third Generation biofuels. Poster presentation at the NARA 2nd Northwest Wood-Based Biofuels + Co-Products Conference. May 3–4 in Seattle, WA.

Dahmann, K.S., P.M. Smith, and L.B. Fowler. 2014. U.S. BIOFUEL - LAW AND POLICY: An Unsteady Past and an Uncertain Future for 2nd & 3rd Generation Biofuels. Poster presentation at TAPPI International Bioenergy & Bioproducts Conference 2014, Session on Impacts of Policies and Incentives, Sept. 17-19, Seattle, WA.

Dahmann, K.S. L. B. Fowler, and Paul M. Smith. 2014. AVIATION AND ALTERNATIVE FUELS: The Law and Policy of First, Second, and Third Generation Biofuels. Poster presentation at the NARA Annual Meeting. Sept. 15-17 in Seattle, WA.

Wertz, S., P.M. Smith, and M.P. Wolcott. 2013. Aviation Biofuels Market Opportunities and Policy Considerations. Poster presentation at the 56th International Convention of the Society of Wood Science & Technology, June 9, Austin, TX.

Wertz, S.M. and P.M. Smith. 2013. US Biofuels Policy: Understanding RFS2. Poster presentation at the Year 2, NARA Annual Meeting, Corvallis, OR. Sept. 10.

Wertz, S.M., P.M. Smith, and M.P. Wolcott. 2013. Biojet Market Prospects and US Regulatory Considerations. Poster presentation at the Year 2, NARA Annual Meeting, Corvallis, OR. Sept. 10.

NARA OUTCOMES AND FUTURE DEVELOPMENTS

The law and policy surrounding alternative fuel in the United States began with early policy related to the development of corn-grain-based ethanol and now includes efforts to diversify feedstock and encourage the scale-up of the advanced biofuels industry. The original policy was designed as a response to the 1973 US energy crisis and as a way to develop domestic energy sources. As societal needs changed, US biofuel policy evolved in the 2000s to address not only energy prices and security, but also GHG emissions and rural economic development. Today, US energy policy is implemented through a relatively complex system designed to diversify feedstock; however, one result has been that special interests are often in conflict over market share. The combination of federal policy with state and regional policy has created an interesting set of experiments that is playing out in real time. There is little doubt that this ever-changing set of incentives, both on the supply and the demand side, will continue to evolve at a rapid pace. At the same time, fluctuations in law and policy at a federal level make development of a stable industry more difficult. In light of recent and dramatic drops in gas prices during 2014 and 2015, the advanced biofuel industry in the United States will likely face continued development challenges.

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