THE BIOFUEL DEBATE:

FUEL, FOOD, AND THE FUTURE OF THE PLANET

BY: BRYN MAYES

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I. Introduction

When "biofuels" became a buzzword, hopes were high that a panacea for high-priced oil and environmental problems had arrived. Politicians, farmers, consumers and environmentalists are learning now that the situation is far more complicated. While the picture of pure plant energy could not be a greener one, the fossil fuel necessary to clear land, plant, fertilize, transport and process the plant material for alternative fuel purposes smears this picture. Additionally, although biofuels originated in part as a way to help consumers struggling with high oil prices, the large-scale production of biofuels may actually have resulted in high food prices. While many soy and corn farmers are profiting from the biofuels industry, the meat industry and consumers in general are hurting. Grain prices have soared as increasing amounts of corn and soy and sugarcane are diverted to the energy sector instead of the livestock and food sector.[1] When the amount of fossil fuel needed to produce biofuels, the effect of deforestation, the release of greenhouse gases, and the resulting rise in the cost of food are added to the equation, the disadvantages of biofuels appear at first glance almost to outweigh the benefits.

There is reason to pursue biofuels, however; even if current biofuels production models are not working, there are more sustainable and more efficient biofuels options on the horizon. Grasses, algae, husks, and waste products are the touted fuel sources of the future. The problem is that the lack of technology and the expense needed to process these materials makes current mass-production impossible. The relevant question for today is how to utilize biofuels without

[1] *See* The State of Food and Agriculture 2008, Biofuels: Prospects, Risks and Opportunities at 3, UN Food and Agriculture Organization, *available at* ftp://ftp.fao.org/docrep/fao/011 /i0100e/i0100e.pdf (last visited April 20, 2009) [hereinafter The State of Food and Agriculture].

hurting consumers or the environment. Legislation should be reflective of the current and future realities of the biofuels industry.

After a description of the historic development of various types of biofuels, this paper will discuss the benefits and detriments of current and possible future biofuels. It will explain the political significance of biofuels, and the various laws that have resulted from debate over biomass-generated energy. An analysis of the advantages and disadvantages of biofuels will follow this explanation. Next, this paper will analyze existing legislation. Finally, this paper will conclude with a summary of the impact of provisions of law dealing with biofuels and will offer a qualified declaration of support for biofuels. Following the conclusion, two tables and a diagram are offered to provide a visual illustration of biofuels trends and processes.

II. The History of Biofuels

Despite cutting-edge connotations of the term "biofuel," plant-fuel has been around for more than a century.[2] In the late 19th century, Rudolph Diesel used peanut oil to power compression engines.[3] Henry Ford was also an early proponent of biofuels.[4] Ford predicted, "The fuel of the future . . . is going to come from fruit like that sumac out by the road, or from apples, weeds, sawdust – almost anything. There is fuel in every bit of vegetable matter that can be fermented."[5] In fact, Ford built a factory that began making biofuels, but oil soon became the mainstream fuel of choice. Some historians attribute this to petroleum marketing and low

[2]History of Biodiesel, Biodiesel, http://www.biodieselathome.net/History_of_Biodiesel.html (last visited Feb. 25, 2009).

[3] *Id.*

[4] *Ford Predicts Fuel from Vegetation*, N.Y. TIMES, Sept. 20, 1925, at 24.

[5] Henry Ford, cited by *Ford Predicts Fuel from Vegetation*, N.Y. TIMES, Sept. 20, 1925, at 24.

petroleum prices.[6] While the national fuel economy has relied on fossil fuels for most of the twentieth century, interest in biofuels has increased in response to environmental and economical difficulties around the turn of the century.

III. Types of Biofuels

As Ford predicted so long ago, fuel can be created using numerous different organic materials. Biofuels may be in the form of ethanol or biodiesel. While ethanol is made from fermented sugars, biodiesel is made from the oils of certain plants.[7] Examples of biofuels include corn-derived ethanol,[8,9] sugarcane-derived ethanol,[10] cellulosic ethanol, and various waste products.

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[6] History of Biodiesel, *supra* note 2, at 2.

[7] *See* The State of Food and Agriculture, *supra* note 1, at 14. Biodiesel can be made from numerous non-petroleum oil sources, such as soybean oil, rapeseed oil, palm kernel oil, peanut oil and oil from sunflower seeds. The majority of biodiesel is produced by the European Union, while the majority of ethanol is produced by the United States and Brazil. This paper mentions biodiesel in some sections, but focuses primarily on ethanol biofuels.

[8] Ethanol usually is made from corn or sugar. For more information on how ethanol is made, see Enrique Rene de Vera, Comment, *Development: The WTO and Biofuels: The Possibility of Unilateral Sustainability Requirements*, 8 CHI. J. INT'L L. 661, 663 (2008)[hereinafter de Vera].

[9] In the United States, ethanol is primarily made from corn. In fact, a third of the corn produced in the 2008-2009 crop year in the United States was used for ethanol production. *See* Corn-Based Ethanol Expansion Expected to Slow, Agricultural Baseline Projections: U.S. Crops, 2009-2018, Briefing Rooms, USDA Economic Research Service, Feb. 12, 2009, *available at* http://www.ers.usda.gov/briefing/Baseline/crops.htm (last visited April 4, 2009)[hereinafter Corn-Based Ethanol Expansion Expected to Slow].

[10] While ethanol derived from sugarcane is a significant source of biofuels, globally speaking, this paper will not address it because the major biomass grown in the United States is corn, not sugarcane. The use of sugarcane in Latin America and South America in producing biofuels is another subject that merits novel research and analysis. For instance, it should be noted that Brazilian sugarcane is the only biomass capable of competing with fossil fuel without the crutch of subsidies. *See* The State of Food and Agriculture, *supra* note 1, at 7. Additionally, at least one study has shown that Brazil's sugarcane-derived ethanol produces approximately eight times as much energy as corn-derived ethanol. *See* L. Leon Geyer, Philip Chong, and Bill Hxue, *Ethanol, Biomass, Biofuels and Energy: A Profile and Overview*, 12 DRAKE J. AGRIC. L. 61, 73 (2007) [hereinafter *Ethanol, Biomass, Biofuels and Energy*]. Brazil plans to double its ethanol production by 2010. *See* de Vera, *supra* note 8, at 666.

Although corn-based ethanol is now the dominant biofuel in the United States, criticism over this type of ethanol is increasing. Cellulosic ethanol now promises to play a leading role in the future of biofuels. Waste products may involve more treatment and processing, but if this process were streamlined, there might be a sustainable supply of fuel to meet national energy needs. A variety of types of biofuels increases the number of available alternatives to fossil fuels.

A. Corn-derived ethanol

Corn-derived ethanol is the United State's current staple biofuel.[11] In recent years, production of corn[12] for ethanol has increased substantially. In 2003, the United States produced less than 3 billion gallons of ethanol.[13] By 2008, only five years later, that amount had tripled.[14] The corn-derived ethanol boom spilled over into politics; Obama enjoyed great political successes in Illinois and Iowa, two corn-growing states. The previous Bush administration also supported corn-derived ethanol development.[15] By November 2008, over 75% of federal subsidies for renewable fuels were going to supporting ethanol made from corn.[16]

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[11] Corn-derived ethanol is often simply referred to as "ethanol." This may be confusing because ethanol can be created from other plants as well. For purposes of clarity, this paper will refer to it as corn-derived ethanol.

[12] One bushel of corn makes approximately 2.8 gallons of ethanol. *See Ethanol, Biomass, Biofuels and Energy*, *supra* note 10, at 74.

[13] *See* Corn-Based Ethanol Expansion Expected to Slow, *supra* note 9.

[14] *See id.*

[15] The politicization of corn can be seen in the subsidies the crop enjoys. Corn producers received subsidies of approximately $51.2 billion between the years of 1995 and 2005. This is more than twice the amount of subsidies for wheat, which receives $20.9 billion. *See Ethanol, Biomass, Biofuels and Energy*, *supra* note 10, at 76.

[16] *See* Kent Garber, *Obama Under Pressure Over Role of Ethanol in Energy Policy*, U.S. NEWS AND WORLD REPORT, Nov. 21, 2008, citing Energy Information Administration[hereinafter Garber, *Obama Under Pressure*]; *see also Ethanol, Biomass, Biofuels and Energy*, *supra* note 10, at 76. The rise in the price of corn, due to high subsidization, alarmed beef producers. In 2007, the National Cattlemen's Beef Associated vocally advocated

Corn-derived ethanol recently has experienced a backlash in popularity because of dissatisfaction among a growing number of environmentalists and consumers. Environmentalists are concerned that corn-based biofuels are causing more harm than good because of the amount of fossil fuels needed to produce, process, and transfer the corn. Consumers worry that diverting corn for biofuels instead of for food will cause food prices to rise.[17] In response to concerns and criticisms, the corn industry recently decided to push back by founding an organization known as Growth Energy.[18] The purpose of organization, funded by the country's largest ethanol producers, is to offer a "fresh, aggressive voice in the energy debate."[19] While corn-derived ethanol is currently the mainstream biofuel, new research and the development of new refining technology has rendered corn-derived ethanol less desirable than some second- and third-generation biofuels.

B. Cellulosic fuel sources

Cellulosic material is the "most common biological material on earth."[20] Despite this fact, cellulosic fuel[21] sources have not been viable commercial options because of lagging

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policies that would reduce the intense subsidization of the corn crop, which was causing beef producers' costs to rise.

[17] For example, higher corn prices have caused chicken prices to rise in the United States and tortilla prices to rise in Mexico. Chicken prices have increased because corn is the number one chicken feed ingredient. Every pound of chicken is now, on average, six cents more expensive. Mexican tortillas have at least tripled in price. The global food market is closely tied to United States corn policies and prices. *See Ethanol, Biomass, Biofuels and Energy*, *supra* note 10, at 75.

[18] *See* Kent Garber, *The Behind-the-Scenes Struggle Over Ethanol*, U.S. News and World Report, Nov. 11, 2008 [hereinafter Garber, *Behind-the-Scenes-Struggle*].

[19] *Id.*

[20] *See* The State of Food and Agriculture 2008, *supra* note 1, at 18.

[21] Cellulosic fuel is made from plant parts which are usually discarded. Approximately half of the weight of dried plant matter is made of cellulose. While the starch from corn is edible to humans, the cellulose in corn and other

technology and the prohibitive cost.[22] Many politicians and some environmentalists see cellulosic ethanol as the fuel of the future, though. Congress, for instance, has established tax credits for cellulosic biofuels producers.[23] Also, according to the United States Department of Energy, cellulosic fuel could reduce greenhouse pollution by 86 percent.[24] Potential sources of cellulosic fuel include grasses, husks, and algae. As the U.S. Department of Energy points out, some biofuel plants grow in soil unsuitable for other cultivation:

> Crops grown to produce biofuels in the United States can also utilize a variety of agricultural lands. Future cellulosic crops will have the added benefit of being able to grow on marginal soils not suited for traditional agriculture. Less than one percent of farm land globally is currently used to grow biofuels crops.[25]

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plants is indigestible by humans. Normally cellulose is discarded after corn is harvested because cellulose is not able to directly generate energy; however, cellulose can be converted into sugars. Years of research have yielded techniques by which cellulose material can be "digested" into sugars to be used as biofuels. This process involves using enzymes produced by certain fungi and bacteria to break down the resistant cellulose. These enzymes have become known as cellulases. The effectiveness of the manufacturing cellulosic ethanol depends on the vigor of the enzymes used. Scientists continue to experiment to discover the most powerful enzymes to use in the cellulose conversion process in which biomass is changed into ethanol. *See* Cellulose Conversion Key to the Fuel of the Future, National Renewable Energy Laboratory at 2, Aug. 1994, *available at* http://www.ethanol-gec.org/information/briefing/2.pdf (last visited April 16, 2009).

[22] *See* Kent Garber, *Obama Under Pressure*, *supra* note 16; *see also* National Biofuels Action Plan, Biofuels Development Board at 12, October 2008, *available at* http://www1.eere.energy.gov/biomass/pdfs/nbap.pdf (last visited April 10, 2009)[hereinafter National Biofuels Action Plan]; *see also Ethanol, Biomass, Biofuels and Energy*, *supra* note 10, at 74.

[23] *See* 33A Am. Jur. 2d ¶ 15226 (2008). The cellulosic producer credit is part of the more general alcohol fuels credit provision. This nonrefundable tax credit applies to specified biofuels produced after December 31, 2008. These biofuels remain eligible for the income tax credit whether the tax payer sells the biofuels or uses them himself. However, the producer must register with the IRS and must not sell the biofuels to customers for use outside of the United States.

[24] *See* Biofuels & Greenhouse Gas Emissions: Myths v. Facts, U.S. Department of Energy, *available at* http://www.energy.gov/media/BiofuelsMythVFact.pdf (last visited March 25, 2009).

[25] U.S. Department of Energy, Energy Efficiency and Renewable Energy, Biomass Program, Biomass FAQs, http://www1.eere.energy.gov/biomass/biomass_basics_faqs.html (last visited March 25, 2009).

Most importantly, cellulosic ethanol has a substantially better net energy balance than does corn-derived ethanol.[26] With all these advantages, cellulose is currently favored in future-looking legislation; however, more technology must be developed before cellulosic biofuels become commercially feasible.

i. Grasses as biofuel sources

Grasses[27] in particular have been singled out as a feasible alternative to corn-derived ethanol. In President Bush's 2006 State of the Union Address, the president mentioned the necessity of developing the technology needed to process switchgrass to be used as a type of biofuel.[28] While President Obama remains a stalwart supporter of corn-derived biofuels, he also supports the development of grass-derived biofuel. President Obama's Secretary of Energy Steven Chu is a strong proponent of using grasses to produce cellulosic biofuel.[29] Unlike corn, grass is not eaten by humans; presumably growing grass for fuel would not disturb food prices. Grasses also need less fertilizer than corn crops. Also, compared to corn-derived ethanol, switchgrass has a superior energy balance.[30]

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[26] *See Ethanol, Biomass, Biofuels and Energy, supra* note 10, at 74. Cellulosic ethanol is estimated to be approximately 7-8 times as energy efficient as corn-derived ethanol. This results in a significantly more positive net energy balance.

[27] Switchgrasses, prairie grasses, and *miscanthus x giganteus* are several major types of grass that can be used to produce biofuels. Giant grass may be the ideal grass to use for biofuels because a larger amount of biomass can be produced with a smaller amount of land. *See* Giant Grass Miscanthus Can Meet US Biofuels Goal Using Less Land Than Corn Or Switchgrass, ScienceDaily, Aug. 2008, *available at* http://www.sciencedaily.com/releases/2008/07/080730155344.htm (last visited April 16, 2009).

[28] *See Ethanol, Biomass, Biofuels and Energy, supra note 10*, at 73.

[29] *See* Kent Garber, *Obama's Energy and Environment Team Includes a Nobel Laureate, Veteran Regulators*, U.S. News and World Report, Dec. 11, 2008.

[30] *See Ethanol, Biomass, Biofuels and Energy, supra* note 10, at 73. USDA studies have indicated that the net energy balance of ethanol made from switchgrass is approximately 3.5 times that of corn-derived ethanol.

Despite these benefits, growing grasses for fuel also has drawbacks. First, these grasses would take up large amounts of land. While proponents point out that grasses can be produced on land unsuitable for farming, this is exactly the point with which environmentalists take issue. Growing grasses could lead to increased deforestation, which in turn would contribute to aggregation of greenhouse gases in the atmosphere. Additionally, opponents to grass-derived biofuel argue that converting lands previously protected from farming would eliminate the natural habitat of thousands of animals and could damage the ecosystem substantially. For these among other reasons, *Times* magazine published an article in March 2008 stating: "[e]ven cellulosic ethanol made from switchgrass, which has been promoted by eco-activists and eco-investors . . . as the fuel of the future, looks less green than oil-derived gasoline."[31] While less energy may be needed to grow switchgrass than to grow corn, the grass must still be processed and transported, which involves a substantial amount of energy.

ii. Algae as biofuel material

Algae are another cutting-edge possibility for fuel derivation. The company Algenol Biofuels has developed the technology to turn algae into fuel.[32] Algae may be a greener alternative to some other cellulosic fuels because algae would not require the same amount of land for production. The current drawback to algae is the prohibitive expense of the technology needed to produce it on a large scale.

iii. Waste products as biofuel material

Husks and other waste products would be excellent sources of fuel because they are byproducts of other processes. While showing strong support for corn-derived fuels, Obama

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[31] Michael Grunwald, *The Clean Energy Scam*, TIMES, March 27, 2008.

[32] *See* Garber, *Obama Under Pressure*, *supra* note 16.

indicated during his campaign that husks and waste products, along with grasses, will be the future direction of development for biofuels.[33]

Waste coffee grounds are one waste product that has recently received substantial attention.[34] Last year, a Nevada study found that used coffee grounds may contribute up to 340 million gallons of biodiesel to the global fuel supply.[35] Additionally, oil from waste coffee grounds is more stable than some other biofuels because of its high antioxidant content.[36] Stability is important, as it has been one hurdle in the way of incorporating higher percentages of corn-derived ethanol into gasoline. If the necessary technology were developed, waste product biofuels could be the greenest biofuels yet.

In summary, the major types of biofuels are those which can be derived from corn, grasses, algae, and various waste products. Currently, United States policy is shifting away from promoting corn-derived ethanol. As more research has been conducted about the effects of producing vast quantities of corn-derived ethanol, the price of this production to the environment and consumers appears to be quite high. For this reason, the federal government has given increased attention to more advanced biofuels such as cellulosic ethanol.

IV. Current Uses of Biofuels

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[33] *See id.*

[34] *See* Mano Misra, Susanta Mohapatra, and Narasimharao Kondamudi, *Spent Coffee Grounds as a Versatile Source of Green Energy*, J. AGRIC. FOOD CHEM., Dec. 24, 2008, 56 (24), 11757–11760.

[35] *See id.*

[36] *See id.*

Currently, the primary role played by biofuels is that of supplementing and partly replacing the United States' use of fossil fuels.[37] While the percentage of fuel provided by biofuels will increase, it is unlikely that biofuels will completely replace traditional fossil fuel anytime in the next twenty-five years.[38] Presently, federal law permits 10% of the gasoline used for cars to consist of ethanol.[39] However, some automobile companies are now manufacturing flexible fuel vehicles ("FFV") capable of running on more than ten percent biofuels.[40]

In order for biofuels to arrive at the corner gas station, a number of steps are needed. In the fall of 2008, the Biomass Research and Development Board published a National Biofuels Action Plan.[41] Congress formed the Biomass Research and Development Board[42] in 2000 under the amended Biomass Research and Development Act.[43] The Board's purpose is to facilitate communications and organize biofuels and bioproducts projects undertaken by various federal agencies.[44] The Biomass Research and Development Board's Action Plan includes a "five part supply-chain framework": feedstock production, feedstock logistics, conversion, distribution,

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[37] *See* The State of Food and Agriculture, *supra* note 1, at 43. As discussed below, biofuels currently make up less than 1% of fuel used for transportation.

[38] *See id.*

[39] *See* Kent Garber, *Ethanol Questions Fuel a Pushback Over Regulation Changes*, U.S. NEWS AND WORLD REPORT, Dec. 26, 2008 [hereinafter Garber, *Ethanol Questions*].

[40] *See* Low-Level Ethanol Fuel Blends, Clean Cities Fact Sheet, National Renewable Energy Laboratory (a U.S. Department of Energy National Laboratory), April 2005, *available at* http://www.afdc.energy.gov/afdc/pdfs/37135.pdf (last visited April 4, 2009).

[41] *See* National Biofuels Action Plan, *supra* note 22, at 6.

[42] The Biomass Research and Development Board consists of officials from the Department of Energy, Department of Agriculture, Department of the Treasury, Department of the Interior, Department of Transportation, Department of Commerce, Department of Defense, the Environmental Protection Agency, and the National Science Foundation. The Board thus incorporates a diversity of expertise and interests. For more information, see *id.* at 5.

[43] *See id.*

[44] *See id.*

and end use.[45] The Action Plan further explains that there are three generations of biofuels.[46] The first generation is the least advanced types of biofuels; the first generation includes corn for ethanol and soybeans for biodiesel.[47] These are the types of biofuels that are being most second-guessed currently for their efficiency and environmental value. The second generation of biofuels reflects the concerns articulated about corn and soy. This next generation includes plant parts such as stems and husks, and demonstrates a need more cellulosic conversion technology.[48] The third generation includes algae and grasses.[49] While more research and development is necessary before these biofuels can be commercialized, they promise to offer more energy efficiency and less threat to food prices.

V. Future Uses of Biofuels

Some politicians would like to change the use of biofuels in the future by incorporating larger percentages of ethanol into gasoline. The amount of biofuels that commercial car systems can tolerate without harm remains an open question. The Department of Energy has been running a multiyear test to see how cars are affected by 15-20% ethanol gasoline blends.[50] So far, no damage is apparent in the short-term but researchers are now investigating the long-term

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[45] *See id.* at 6.

[46] *See id.* at 7.

[47] *See id.*

[48] *See id.*

[49] *See id.*

[50] *See* Garber, *Ethanol Questions*, *supra* note 39.

implications.[51] Ultimately, the EPA will determine the appropriate level of ethanol in gasoline.[52]

Ethanol sellers insist that 15-20% ethanol gasoline would pose no threat to car systems.[53] Opponents of increased percentages of ethanol in gasoline[54] express concern that emissions would increase rather than decrease with higher ethanol allowances and that safety and efficiency of engines would be compromised.[55]

VI. Benefits and disadvantages of biofuels

The biofuels debate focuses on an analysis of the pros and cons of using plants to produce fuel. The benefits of using biofuels may include reduced reliance on foreign oil, reduction of pollution, the production of a byproduct that cattle may eat, and economic benefit to American farmers and processors. The detriments of biofuels may include vehicle safety issues, increased pollution, soil erosion, deforestation, and increased food prices.

A. Advantages of biofuels

i. Reduced reliance on foreign oil

If biofuels make up even a modest percentage of the gasoline used today, reliance on foreign oil might be reduced. Theoretically, this may offer the United States more clout when dealing with countries in the Middle East. However, the extent to which biofuels are capable of

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[51] *See id.*

[52] *See id.*

[53] *See id.*

[54] Opponents of increasing ethanol percentages in gasoline include the American Lung Association, Association of International Automobile Manufacturers, Outdoor Power Equipment Institute, National Petrochemicals and Refiners Association, among others. *See id.*

[55] *See id.*

replacing fossil fuels is relatively small.[56] For example, a report issued by the United Nations revealed that biofuels currently make up only 0.9 percent of the fuel used for transportation.[57] Even more alarmingly, by 2015 the International Energy Agency foresees this percentage increasingly only to 2.3 percent.[58] By 2030, the percentage of transportation fuel derived from biofuels will be only 3.2.[59] These numbers are vastly lower than the expectations of the public, fed by the glowing stories about biofuels in the media. The percentage of fuel from biomass appears small; however, even a three percent displacement of foreign fossil fuel could have a substantial impact on the United States' relationship with oil-rich countries.

ii. Reduced pollution

It is also possible that an increased use of biofuels could reduce pollution. Biofuels are biodegradable and not harmful when released in the environment. The potential for reduction of greenhouse gasses is significant, at least when the advantages of advanced biofuels such as various types of cellulosic ethanol are considered.[60] Mixing ethanol with fossil fuel to make gasoline helps to reduce air pollution because it causes fewer sulfur oxide, lead, and other polluting particles to be released into the air when the fuel is burned.

iii. Availability of biofuel byproducts for animal feedstock

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[56] *See* The State of Food and Agriculture, *supra* note 1, at 43.

[57] *See id.*

[58] *See id.*

[59] *See id.*

[60] *See id.* at 88.

Additionally, a byproduct of the production of corn-derived ethanol is Distiller's Dried Grains ("DDGs") or Distiller's Dried Grain Solubles ("DDGS").[61] This material may be used as a high-protein feedstock for cattle, pork, and poultry producers.[62] Since the majority of the demand for corn comes from the need for animal feedstock, the use of ethanol could supply meat producers with feedstock while, theoretically, not substantially interfering with human demand for corn.[63] As a study by Texas A&M University found, "Distiller's grains provide an additional feed for livestock producers to help offset higher corn prices and reduced availability as corn is sent to ethanol plants."[64] If meat producers could use DDGs, then the higher price of corn would not affect them as harshly. By extension, consumers would also be benefitted because meat would cost less than it would if livestock producers had to pay much higher prices for corn.

iv. Economic benefit for American farmers

American farmers will continue to enjoy economic benefits from demand for corn for the manufacture of biofuels for some time. If the rest of the world demands more biofuels, countries like the United States could enjoy even larger export profits. The United States does not compete directly with Brazil in the biofuels market because Brazil's lucrative biofuels crop is sugarcane while the United States' lucrative biofuels crop is corn. Both sugarcane and corn are used to manufacture biofuels. The demand for biofuels is so great that neither country is in danger of being cornered out of the market.

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[61] *See* U.S. Department of Engery, Energy Efficiency and Renewable Energy, Biomass Program, Biomass FAQs, http://www1.eere.energy.gov/biomass/biomass_basics_faqs.html (last visited March 25, 2009).

[62] *See id.*

[63] *See id.*

[64] *The Effect of Ethanol on Texas Food and Feed*, Texas A&M University, April 10, 2008, *available at* http://www.afpc.tamu.edu/pubs/2/515/RR-08-01.pdf (last visited March 25, 2009).

B. Disadvantages of biofuels

The detriments of biofuels usage, such as potentially higher food prices, vehicle safety issues, increased pollution and deforestation, and a potentially negative energy balance have caused the public to reexamine the push for an increased use of biofuels.

i. Rise in food prices

One of the American public's concerns about ethanol is the potential for a rise in food prices. The Economic Research Service of the United States Department of Agriculture states: "A gradual shift to corn away from other crops reflects the high levels of domestic corn-based ethanol production and gains in exports that keep corn demand and producer returns strong."[65] While the corn ethanol boom results in large profits for farmers, this type of ethanol causes food prices to rise.[66] As more corn is diverted for the biofuels market, the demand for corn as food is stressed by a decreased supply. Rising food prices hurt consumers generally, and they hurt poorer consumers in particular. The poor are especially vulnerable to harm through climbing food prices because the poor tend to spend greater percentages of their income on food items.

ii. Vehicle safety concerns

There are several safety and performance concerns related to the use of biofuels in automobile and plane engines. While the use of flexible fuels in cars appears to be unproblematic in the short term, the long-term effects on the engine of using biofuels have yet to be determined. Some opponents to increased use of biofuels also contend that engine performance may be significantly compromised by the use of a high percentage of biofuels.[67]

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[65] Corn-Based Ethanol Expansion Expected to Slow, *supra* note 9.

[66] *See* The State of Food and Agriculture, *supra* note 1, at 8.

[67] *See* Garber, *Ethanol Questions*, *supra* note 39.

The government is currently undertaking a study aimed at learning more about the long-term effects of biofuels on automobile engines. One safety concern regarding the use of biofuels in commercial airliners is that plant-derived fuels are more likely to freeze than fossil fuels are when surrounded by low temperatures.[68] While pilots have been completed one hundred percent plant-fueled flights successfully, most airline industries are not ready to use pure biofuels in passenger flights until more research has been gathered.

iii. Pollution

Ironically, one disadvantage of biofuels may be pollution. Biofuels may result in an increase in some pollutants because fossil fuels are used in the production of biofuels.[69]

The release of greenhouse gases is at the top of a list of environmental concerns. Increased ethanol use may cause changes in land use that would actually increase greenhouse gas emissions.[70] *Times* published a series of negative articles on the biofuels trend. In a March 2008 article, author Michael Grunwald stated:

> Biofuels do slightly reduce dependence on imported oil, and the ethanol boom has created rural jobs while enriching some farmers and agribusinesses. But the basic problem with most biofuels is amazingly simple, given that researchers have ignored it until now: using land to grow fuel leads to the destruction of forests, wetlands and grasslands that store enormous amounts of carbon.[71]

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[68] *See Airline in First Biofuel Flight*, BBC NEWS, Feb. 24, 2008, *available at* http://news.bbc.co.uk/2/hi/uk_news/7261214.stm (last visited March 27, 2009).

[69] Fossil fuels are a major part of biofuels production. First, land must be cleared or prepared by machines that consume substantial amounts of fossil fuels. Then, the biomass used to create the biofuel must be planted. The sowing process also uses oil and causes an increase in greenhouse gases. The fertilizer necessary to grow biofuels plants is also problematic. Modern fertilizer is made with large amounts of fossil fuels. Then, the fertilizer must be transported to the land to be used. Then, the fertilizer must be applied using farm machinery fueled by oil. Once the biomass plants mature, they must be harvested with more farm machinery running on fossil fuels. Once harvested, the biomass must be transported to a processing plant. There, the plants are processed using fossil fuel energy. Finally, the resulting biofuel must be transported to the ultimate destination where it will be used.

[70] *See* Garber, *Behind-the-Scenes Struggle*, *supra* note 18.

[71] Michael Grunwald, *The Clean Energy Scam*, TIMES, March 27, 2008.

The following month, *Times* made the biofuels controversy its cover story: *The Clean Energy Myth*.[72] The United States Department of Energy and the United States Department of Agriculture submitted a response to the magazine: "The one-sided and scientifically uninformed piece ignores the large potential of second- and third-generation biofuels to reduce greenhouse gases and the ability of modern agriculture to responsibly manage land use."[73] While the *Times* article focused on currently available biofuels, the Department of Energy and the USDA focused on biofuels that will be available in the future.

iv. Energy balance

Finally, an extremely controversial potential advantage or disadvantage of biofuels is energy balance.[74] Do biofuels take more energy to produce than they actually supply? This question is closely related to the problem of pollution because of the greenhouse gases released during production. Government-ordered studies report that biofuels have a net positive balance,[75] while other studies indicate that the net energy balance is negative.[76] The government contends that even if biofuels do not have a high net energy balance today, the technological

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[72] *See The Clean Energy Myth*, TIMES, April 7, 2008.

[73] Ed Schafer, U.S. Department of Agriculture Secretary, and Samuel W. Bodman, U.S. Department of Energy Secretary, *More on Biofuels*, *Inbox*, TIME.COM, April 17, 2008, *available at* http://www.time.com/time/magazine/article/0,9171,1731865,00.html (last visited April 3, 2009).

[74] *See Ethanol, Biomass, Biofuels and Energy*, *supra* note 10, at 71-72. The majority of the scientific community supports the research and results reached by the USDA: the net energy balance of ethanol is positive.

[75] *See* U.S. Department of Energy, Energy Efficiency and Renewable Energy, Biomass Program, Biomass FAQs, http://www1.eere.energy.gov/biomass/biomass_basics_faqs.html (last visited March 25, 2009).

[76] *See Ethanol, Biomass, Biofuels and Energy*, *supra* note 10, at 71-72 (reporting on David Pimentel's study on the energy balance of ethanol). David Pimentel, of Cornell University, found that the amount of energy used in the production of ethanol is greater than the amount of energy that ethanol offers in output. In summary, about 70% more energy is needed to create ethanol than there is energy in the ethanol end-product. This study was supported by a number of other scientists.

developments on the horizon will allow biofuels to become extremely efficient energy sources in the future.

VII. Politics of Biofuels

As an increasingly mobilized global population puts stress on the diminishing fossil fuel supply, the development of alternative energy has become a higher priority.[77] In a bold declaration, President Bush stated in his 2006 State of the Union speech that "America is addicted to oil."[78] The Bush Administration began the Advanced Energy Initiative the same year.[79] This initiative involved raising the amount of funding for research on new types of biofuels.[80] While the Bush Administration did promote biofuels, the Obama Administration has made biofuels development a renewed objective. In his inauguration speech, President Obama said, "We will harness the sun and the winds and the soil to fuel our car and run our factories."[81] When the economy plunged in 2008, the development of biofuels became more than an environmental goal; it became a way of providing jobs and stimulating the economy. Energy spending was a significant part of laws aimed at revitalizing the economy.

The production of biofuels is an extremely political subject because it is ancillary to the most explosive of all trade objects: oil. Fossil fuel companies, especially foreign fossil fuel

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[77] *See Ethanol, Biomass, Biofuels and Energy*, *supra* note 10, at 61 (stating that a "[d]iminishing worldwide petroleum reserves coupled with growing demand from China, India, Brazil and other nations has created a precarious situation in regards to energy procurement").

[78] *See* National Biofuels Action Plan, *supra* note 22, at 4.

[79] *See id.*

[80] *See id.*

[81] *See Obama Administration Pushes Accelerator for Renewable Fuels*, Marketwire, Jan. 21, 2009, *available at* http://www.marketwire.com/press-release/Canadian-Renewable-Fuels-Association-Crfa-940151.html (last visited April 4, 2009).

companies, stand to lose if biofuels even replace a percentage of oil consumption.[82] Corn farmers stand to gain exponentially from new demand for their product and the resulting high prices. The planting and harvesting of cellulosic fuel crops could revitalize the American farming economy by employing farmers in a new and more lucrative business. Whatever the policy Congress chooses to pursue, there will be winners and losers when it comes to fossil fuels.

VIII. Discussion of Relevant Laws

Beginning with the Bush Administration's Advanced Energy Initiative, the Department of Energy has been implementing a wide-ranging plan to increase the use of alternative fuels such as biofuels.[83] President Bush also issued an Executive Order titled "Strengthening Federal Environmental, Energy, and Transportation Management."[84] This Order specifies fuel-related goals of the executive branch and delegates duties to agencies.[85] The Energy Policy Act of 2005[86] established grants to promote the production of cellulosic-derived ethanol.[87] This

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[82] Currently, the United States pays oil corporations fifty-one cents per gallon of ethanol that is blended into the gasoline consumers buy at the fuel pump. Still, supporters of ethanol explain that this is a relatively low cost compared to the subsidies the government spends on imported fossil fuels. *See* Mark Clayton, *The Politics of Ethanol Outshine its Costs: Despite Higher Food Prices and Environmental Damage, It's Warmly Embraced in Congress*, The Christian Science Monitor, Nov. 15, 2007, *available at* http://www.csmonitor.com/2007/1115 /p02s02-uspo.html?page=1 (last visited April 20, 2009).

[83] *See* Biofuels & Greenhouse Gas Emissions: Myths v. Facts, U.S. Department of Energy, *available at* http://www.energy.gov/media/BiofuelsMythVFact.pdf (last visited March, 25, 2009) (stating that the "U.S. Department of Energy is carrying out a comprehensive plan to increase energy efficiency as well as the use of renewable fuels in the transportation sector").

[84] Exec. Oder No. 13423, WL 186535 (2007).

[85] *Id.*

[86] Energy Policy Act ("EPACT"), Pub. L. No. 109-58 (2005).

[87] *See Energy Independence and Security Act of 2007: A Summary of Major Provisions*, CRS Report for Congress, RL342941 at 11, Dec. 21, 2007 [hereinafter *Energy Independence and Security Act*].

initiative, along with the 2007 Energy Security and Independence Act[88] and the Food, Conservation and Energy Act of 2008,[89] set the stage for more recent biofuels law developments under the new Obama Administration.[90] The most significant piece of legislation regarding biofuels in the new administration has been the American Reinvestment and Recovery Act of 2009.[91]

When these laws are viewed together, there are two trends. First, there is an overall increase in the amount of biofuels demanded. Second, there is more importance laid on biomass alternatives to corn in the more recent laws. While corn is still the primary source of biofuels in the United States, recent laws promote the development of the technology needed to implement the use of other biomasses to create biofuels.

A. Energy Security and Independence Act of 2007

In Title II of the Energy Security and Independence Act, Congress dictated the Renewable Fuels Standard.[92] Subtitle A of the title that sets the modified standard requiring nine billion gallons of renewable fuels in 2008 also requires prospectively thirty-six billion gallons of renewable fuels by 2022.[93] Twenty-one of these thirty-six billion gallons must consist of cellulosic ethanol and other "advanced biofuels."[94] "Advanced biofuels" means cellulosic

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[88] Energy Security and Independence Act, Pub. L. No. 110-140 (2007).

[89] *See* Food, Conservation and Energy Act of 2008, Pub. L. No. 110-234 (2008). This act is also known as the 2008 Farm Bill.

[90] *See* Pub. L. No. 110-140. It is interesting to note that the Energy Security and Independence Act of 2007 originally was named the Clean Energy Act of 2007.

[91] Pub. L. No. 111-5 (2009).

[92] *See* Pub. L. No. 110-140; *see also Energy Independence and Security Act*, *supra* note 87, at 2.

[93] *See id.*

[94] *See* Pub. L. No. 110-140; *see also Energy Independence and Security Act*, *supra* note 87, at 6.

ethanol and other biofuels derived from plants other than corn starch.[95] There is a caveat to this provision, however; the statute enables the Environmental Protection Agency Administrator to temporarily bypass the biofuels mandate if the government finds that a substantial disturbance related to the market of plant material used for biofuels might occur.[96] Also, the possibility of disturbance of a market circumstance other than that of biofuels feedstock would permit the Environmental Protection Agency Administrator to temporarily ignore the biofuels mandate.[97] Would severe hikes in food prices enable the Administrator to bypass the general mandate because such hikes would constitute disturbance of a market circumstance? The statute does not foreclose this possibility.

Subtitle A of the Energy Security and Independence Act also includes incentives for biofuels refineries to reduce their greenhouse gas emissions.[98]

Subtitle B refers to biofuels technology development and research. This section includes a description of grants for the promotion of biofuels, a directive for researchers to find out how to convert corn plant parts into cellulosic ethanol, and a directive for researchers to determine the feasibility of using algae as a biofuels.[99]

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[95] *See* Pub. L. No. 110-140; *see also Energy Independence and Security Act, supra* note 87, at 10.

[96] *See id.*

[97] *See id.*

[98] *See* Pub. L. No. 110-140; *see also Energy Independence and Security Act, supra* note 87, at 10 (stating that "[f]uels produced from biorefineries that displace more than 80% of the fossil-derived processing fuels used to operate a biofuel production facility will qualify for cash awards").

[99] *See* Pub. L. No. 110-140; *see also Energy Independence and Security Act, supra* note 87, at 11.

Subtitle C targets the existing infrastructure of biorefineries and vehicle fuel systems.[100] This section also raises the amount of money going to the Department of Energy's biofuels research projects.[101]

Another interesting provision of the statute is the Renewable Energy Portfolio Standard. This standard applies to electric utilities companies.[102] These companies are now required by law to ensure that a minimum percentage of the electricity that they supply to utilities consumers is created from renewable fuels such as biofuels.[103] The law allows a loophole, however; electricity companies may choose not to meet the minimum renewable fuels requirement so long as they buy tradable credits equal to the amount of renewable energy that they should have used to create the electricity.[104] The determination of the minimum requirement is based on a percentage of the total amount of electricity retail sales enjoyed by the company.[105]

B. Food, Conservation and Energy Act of 2008

The Food, Conservation and Energy Act of 2008[106] paved the way for more farmland to be set aside for biofuels agriculture. The Act reduced the maximum Conservation Reserve

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[100] *See id.*

[101] *See id.*

[102] *See* Pub. L. No. 110-140; *see also Energy Independence and Security Act*, *supra* note 87, at 7.

[103] *See id.*

[104] *See id.*

[105] *See id.*

[106] *See* Pub. L. No. 110-140; *see also* Food, Conservation and Energy Act of 2008, Pub. L. No. 110-234 (2008). This act is also known as the 2008 Farm Bill.

Program, freeing up 7.2 million acres for farming.[107] The government hopes that this additional cropland will help to mitigate high food prices fueled by high demand for food in the United States.[108] Some might argue this additional acreage was needed not only because of food demand, but that the demand for biofuels played a role in the rising prices.

Also in 2008, Congress directed the Environmental Protection Agency to research and to evaluate the role of ethanol in emissions, land use, and other environmental concerns.[109] Today the Environmental Protection Agency continues to conduct studies on the matter. It is important to know the consequences of biofuels because the United States is using increased amounts of ethanol every day. In 2008, there was a national biofuels capacity of 10 billion gallons.[110] Before President Bush left office, he set the 2009 biofuels capacity at 11.1 billion gallons.[111] Growth in the biofuels energy sector was mandatory. This year, the new administration will set the 2010 biofuels level for the country's renewable portfolio standard gallons.[112]

C. American Reinvestment and Recovery Act of 2009

President Obama has continued to support increased funding and development of biofuels. The American Reinvestment and Recovery Act, signed into law on February 17, 2009,

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[107] *See also* Agricultural Baseline Projections, U.S. Crops, 2009-2018, Briefing Rooms, Economic Research Service, United States Department of Agriculture, Feb. 12, 2009, *available at* http://www.ers.usda.gov/briefing/Baseline/crops.htm (last visited April 4, 2009).

[108] *See id.*

[109] *See* Garber, *Behind-the-Scenes Struggle*.

[110] *See* Steve Gelsi, *Bush Leaves Some Unfinished Business in Renewable Energy*, MARKETWATCH, Jan. 21, 2009, *available at* http://www.marketwatch.com/news/story/bush-leaves-some-unfinished-business/story.aspx?guid={1A247240-94A6-4C94-AB5D-497ACC441C1F} (last visited April 4, 2009).

[111] *See id.*

[112] *See id.*

included funding and tax incentives for alternative energy.[113] In particular, the Act establishes an Alternative Fuel Vehicles Pilot Grant Program, also known as the Department of Energy Clean Cities Program.[114] This program consists of grants available to government purchasers of alternative fuel vehicles and to leaders who would create the infrastructure necessary for a primarily alternative-fuel society.[115] Thus, recipients of these grants are not individual consumers but rather "state governments, local governments, and metropolitan transportation authorities in partnership with an active designated Clean Cities Coalition."[116]

In conjunction with the American Reinvestment and Recovery Act, the Environmental Protection Agency has also allocated resources for various alternative fuel projects.[117] The Office of Transportation and Air Quality ("OTAC"), for example, receives funding to regulate types of fuels.[118] Also under this same Act, the Local Climate and Energy Program aids local governments in the attempt to green their energy programs by offering technical support, tools, and a network of support.[119]

Tax credits have also been extended in order to promote renewable energy production:

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[113] *See* Pub. L. No. 111-5 (2009); *see also* American Recovery and Reinvestment Act of 2009: A Guide to Renewable Energy and Energy Efficiency Opportunities for Local and State Governments, United States Environmental Protection Agency at 1, Feb. 27, 2009, available at http://www.epa.gov/solar/ documents/local_guide_to_arra.pdf (last visited April 4, 2009).

[114] *See* American Recovery and Reinvestment Act of 2009: A Guide to Renewable Energy and Energy Efficiency Opportunities for Local and State Governments, United States Environmental Protection Agency at 10, Feb. 27, 2009, available at http://www.epa.gov/solar/documents/local_guide_to_arra.pdf (last visited April 4, 2009).

[115] *See id.*

[116] *See id.* at 11.

[117] *See id.*

[118] *See id.* at 11-12.

[119] *See id.* at 12.

> Facilities that generate power from wind, closed-loop biomass, and geothermal resources are eligible for a tax credit of 2.1 cents per kilowatt-hour (kWh) for the first ten years of a renewable energy facility's operation. Facilities that generate power from open-loop biomass, landfill gas, municipal solid waste resources, qualified hydropower, and marine and hydrokinetic (150 kilowatt or larger) resources are eligible for a tax credit of 1.0 cents/kWh. This credit is an alternative to taking a tax credit to cover the cost of purchasing and installing the property that generates the energy. This credit will be based, as stated above, on the amount of energy generated.[120]

In summary, through pronouncements of policy, grants, and tax credits, the government has demonstrated strong support for alternative energies such as biofuels. Private organizations, universities, and the Department of Energy together have set aside one billion dollars for the research and development of biofuels from now to 2012.[121] The money appears to be in place for the development of biofuels; now time is needed to learn how feasibly biofuels may be converted into a primary source of energy.

IX. Analysis

This section of this paper includes a weighing of the advantages and disadvantages of biofuels and an analysis of the legal framework surrounding biofuels. The analysis will reveal that the advantages of modern biofuels outweigh the disadvantages. While current legislation provides a useful platform for the necessary development of biofuels, technology has not yet caught up with the legislative aspirations. Some technology-forcing may be necessary to overcome the status quo of corn-derived ethanol. This would be desirable because cellulosic ethanol is more environmentally friendly than corn-derived ethanol and poses less threat to food prices within the United States.

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[120] *See id.* at 16.

[121] *See* National Biofuels Action Plan, *supra* note 22, at 5.

A. Weighing advantages and disadvantages of biofuels

While the world needs an alternative to fossil fuel, questions remain about the efficiency of biofuels. The traditional corn-derived ethanol raises special problems regarding land use, energy, and fertilizer needed for production. Additionally, diverting corn for fuel may result in higher food and animal feed prices.

The long-term and short-term effects of using biofuels are another central part of this debate. In the short-term, biofuels programs do not look nearly as green as proponents originally hoped. Fossil fuels are integral to the creation of biofuels at many stages: planting, fertilizing, harvesting, transporting, processing, and transporting again. Add deforestation and soil-erosion to the equation, and biofuels look disastrous.

The short-term effects of biofuels production may be alarming; however, the long-term benefits may justify the negative consequences of the short-term initial investment in biofuels. For instance, once more biofuels are produced, more of the fuel (currently petroleum) that is used in the creation of biofuels could be made from plants itself. This would depend on the development of technology rendering vehicles capable of running on high percentages of biofuels. While deforestation and soil erosion still would be problems, at least petroleum would not be needed to produce biofuels in the first place. Finally, future production of biofuels will likely be greener than such production is today because in the future, the fossil fuel that currently goes into creating biofuels would be replaced by biofuels. If fossil fuel could be eliminated from the biofuels process, or its role seriously reduced, biofuels would be much cleaner and greener.

When considering the feasibility of moving toward a biofuels nation, corn-derived ethanol and cellulosic and waste-derived ethanol must be analyzed separately.

Corn-derived ethanol appears to be the worst type of biofuel both from an environmental and consumer standpoint. Large amounts of fertilizer made from petroleum are needed to grow corn. Corn also cannot be grown just anywhere; it is demanding on its soil. Existing farmland can only support so much corn production and more land might be needed. Additionally, the diversion of corn from the food supply could cause hikes in corn, processed food, and meat prices.[122] The seductiveness of corn-derived ethanol is that American farmers are already positioned to grow massive amounts of corn and that the technology to make corn-derived ethanol economically feasible already exists.

In comparison, cellulosic ethanol and waste-derived ethanol pose strong short-term challenges but offer substantial long-term rewards. Once the technology makes the production and processing of these fuels economically attractive, the use of biofuels would be both environmentally and consumer-friendly.

Cellulosic ethanol has several advantages for the environment and for consumers. Since grasses and algae can grow in areas not traditionally reserved for agriculture, this will avoid the necessity of using land needed to produce food to produce fuel. Using cellulosic ethanol could also avoid the problem of diverting human or animal feed to fuel and the resulting rising costs of food. People don't eat grasses or other non-edible plant parts, so cellulosic ethanol would do little harm to the human food economy. The current challenge is technology. While the government has invested money into research and industry renovation, cellulosic ethanol remains second-chair to corn-derived ethanol.

Waste-derived ethanol may offer an even cleaner solution to the biofuels conundrum than cellulosic ethanol offers. Cellulosic ethanol's fossil fuel and land demands are less than corn-

[122] *See Ethanol, Biomass, Biofuels and Energy*, *supra* note 10, at 75.

derived ethanol's fossil fuel and energy demands, but waste-derived ethanol beats both of these candidates. Waste is produced without cultivation. It is constantly being produced; if it could be put to productive use instead of filling landfills, all the better. The disadvantage of waste products is the amount of technology and energy needed to process them. While used coffee grounds may be excellent biofuels because of their stable nature, the commercial technology is not currently in place to render filling up with java a possibility.

In conclusion, with new developments in technology every day, created largely because of economic incentives from the government, there is no reason to abandon the biofuels initiative. Indeed, it is only when the inertia from fossil fuel and automobile industries is overcome that true environmental progress can be made. The environmental potential of creating fuel from waste products or plants not consumed by humans is enormous. Additionally, when the very fuel that is burned to create biofuels is itself made from plants, the energy cycle will become a much more positive one.

B. Analysis of laws and politics

While biofuels are currently supplied primarily by corn, the disadvantages of massive corn biomass production have caused some rethinking of the push for corn-derived ethanol. During the last five years, a number of laws have refocused national resources on the development of more modern biofuels such as fuel derived from cellulose. The Energy Policy Act of 2005, for example, created grants to promote the production of cellulosic-derived ethanol, which currently plays an extremely small role in the national biofuel economy.[123] The 2007 Energy Security and Independence Act set the Renewable Fuels Standard, which requires that the majority of future biofuel production quantity goals be met by using cellulose and other

[123] *See* Pub. L. No. 109-58.

cutting-edge biofuels.[124] The Food, Conservation and Energy Act of 2008 (2008 Farm Bill) appears to have taken note of the reality that the massive production of corn for use in biofuels has the potential to increase food prices because of its curtailment of the supply of corn to be used in animal feed and food.[125] The Farm Bill freed up new land for farming use. American Reinvestment and Recovery Act of 2009 founded the Clean Cities Program which encourages state and local government offices to buy vehicles capable of using alternative fuel.[126] This recent Act also offers tax credits for producers of biofuels.[127] These Acts, among other orders and regulations passed during the last five years, demonstrate an awareness on the part of the federal government of the insufficiency of corn-derived ethanol to meet the objectives of a national biofuel economy.

Concern over environmental effects of using corn for fuel purposes and the additional concern over food prices have dampened the enthusiasm for corn-based ethanol. For example, in order to meet the Energy Policy Act of 2005 objectives, one fourth of the national corn crop would have to be set aside for ethanol production.[128] This could significantly impact the price of corn and, by extension, both national and international food markets.[129] The United States appears to be shifting toward using more cellulose-derived ethanol, if provisions in recent laws

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[124] *See* Pub. L. No. 110-140.

[125] *See* Pub. L. No. 110-234.

[126] *See American Reinvestment and Recovery Act*, *supra* note 114.

[127] *See id.*

[128] *See id.* at 75.

[129] *See id.* The rise in corn prices has an especially harsh effect on meat producers, who use corn as the primary component of animal feed. The National Chicken Council has publically stated that ethanol policies have caused the price of chicken to go up six cents per pound. Corn-derived ethanol policies affect both meat-producers and consumers on a very practical level.

requiring research and development of cellulosic technology are to be considered.[130] This is a positive shift because it will allow biofuels to be cleaner and greener than ever before.

Current laws are poised to propel the United States from a country extremely reliant on corn for its biofuel needs to a country with a number of biomass resources available to meet alternative energy needs. There is little more that should be done legislatively until research, technology, and various industries catch up with legislators' aspirations for cellulosic ethanol. Once cellulosic ethanol becomes mainstream, new laws should be passed in light of new information learned from research and experiments involving cellulose. Current laws properly allocate resources to the development of more modern and less environmentally damaging biofuels. Until the funds spent on the promotion of biofuels have accomplished what they were set out to do, there is not a present need for new legislation to override or change existing legislation.

X. Conclusion

This paper considered the discovery and development of biofuels, types of biofuels, and current and future uses. Additionally, the paper discussed the benefits and disadvantages of biofuels, as well as the politics behind biofuels. This was followed by a look at past and current laws relevant to biofuels. Next, the paper analyzed and weighed the pros and cons of certain biofuels. Finally the paper engaged in an analysis of past and current laws and found that these laws properly favor the development of new types of biofuels such as cellulosic ethanol.

More research is needed to determine the cleanest and greenest ways to use biofuels and to design the technology necessary to process these fuels. As discussed throughout the paper,

[130] *See* Pub. L. No. 111-5 (2009); Pub. L. No. 110-234 (2008); Pub. L. No. 110-140 (2007); Pub. L. No. 109-58 (2005).

decisions regarding biofuels will directly affect the economy and the environment. Cellulosic biofuels are more environmentally friendly than corn-derived ethanol, and pose less challenge to the human food supply. Current laws appropriately promote the development of new types of biofuels that will avoid some of the detrimental effects of producing corn-derived ethanol. While biofuels have the potential to reduce pollution, it is vital to consider the effects on the environment and the effects on the food market of growing various biomasses for fuel. The effects of producing corn for ethanol appear to be too negative to continue promoting this traditional biofuel. This paper arrives at two conclusions. First, the use of corn-derived ethanol should decrease in proportion to the availability of other modern biofuels with fewer environmental disadvantages. Second, the laws, orders, and regulations currently governing biofuels properly promote second- and third-generation biofuels that are better for the environment and for consumers. Once the necessary technology is developed to use these more modern biofuels, the investment in biofuels will be very rewarding.

Table 1

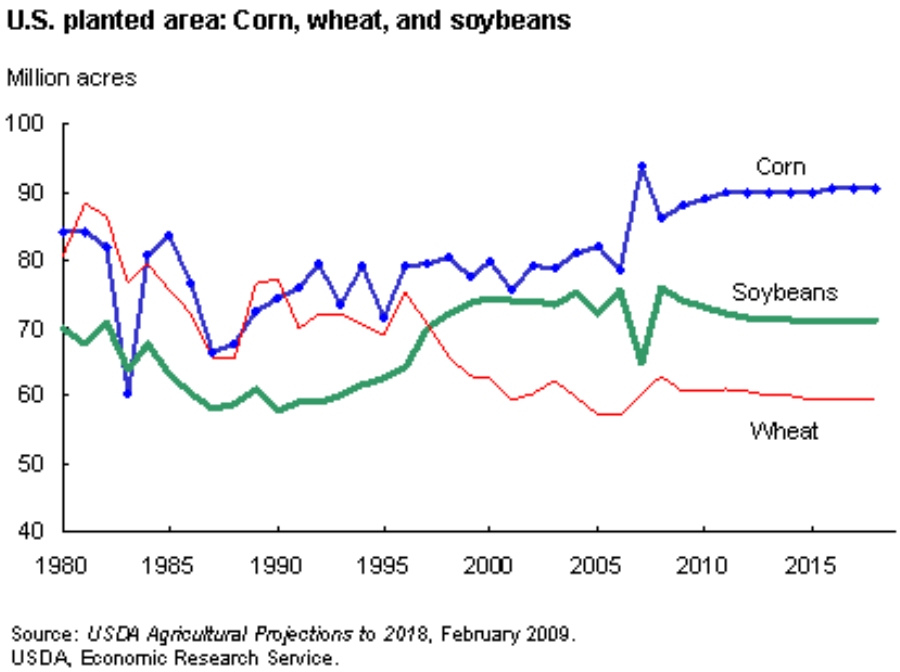

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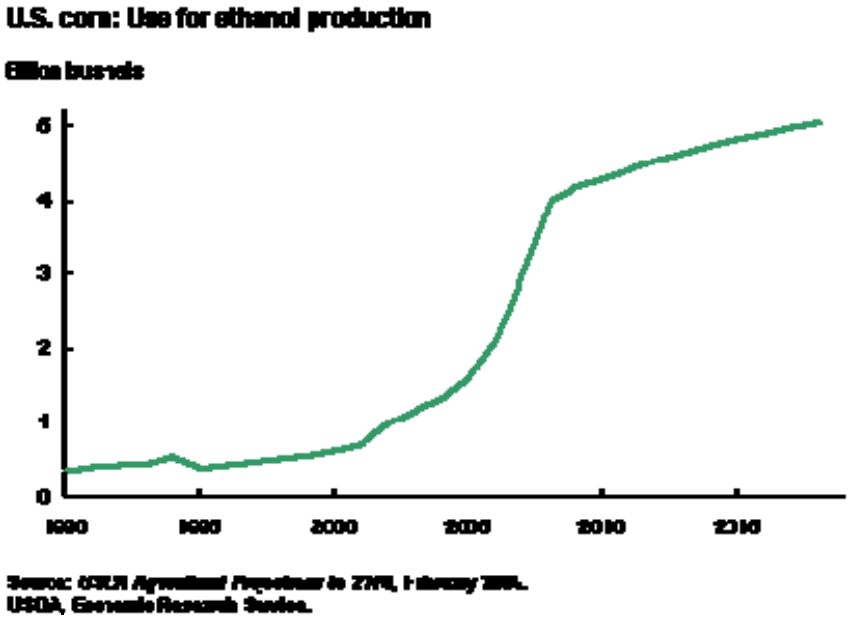
Table 2



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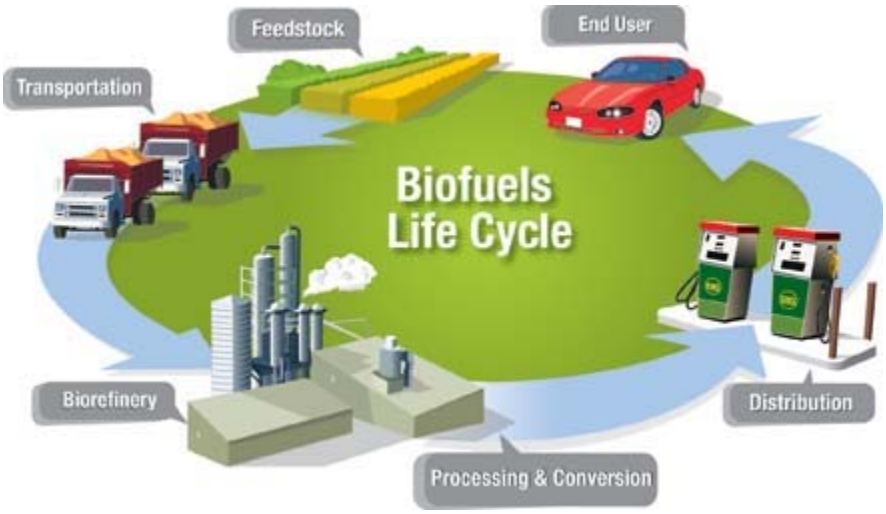
Major Biofuels Process Steps



Source: United States Department of Energy
Available at http://www1.eere.energy.gov/biomass/