

The Future of the United States' Biofuel Policies

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I. Introduction

Tantalizingly promising, yet highly contentious, the issue of biofuels has recently played an important role in our national discourse. For good reason, as biofuels seem to hold limitless promise and are often held out as a solution to many of this nation's most pressing problems: global warming, national security, and economic stimulus. But despite all of these supposed benefits, a pervasive cloud of controversy continues to surround this contentious fuel source.

The United States is at an important juncture in deciding how best to move forward in the face of these challenges. Biofuels have an important role to play as the nation moves forward, but to what extent and how best to formulate a workable and effective policy remain critical questions. These are daunting questions face policy-makers on both a local and national level. Thirty years of policy experimentation have highlighted both the promises and shortcomings of biofuel use within the nation's borders. This experience will provide much needed guidance in the progression towards an improved and sustainable policy framework.

This paper takes the stance that biofuels can and will play a critical role as policy-makers determine how best to meet the energy demands of the future while taking security, economic, and environmental questions into consideration. Here it is argued that the privileged status many policy-makers have granted the corn-ethanol industry can not continue. First, the histories of the agricultural and energy policies which are responsible for leading the nation to this difficult crossroads are closely examined. Next, the paper discusses the unintended consequences that have arisen during these first thirty-years of American biofuel policy and the reasons for

continued ethanol support. The paper then considers the potential that a new policy, one based on on-farm biofuel production and consumption, will have to successfully achieve this nation's energy, environmental and economic goals. It goes on to assess the current policy framework that could be used to support on-farm biofuel production and use. Following is an outline illustrating one option which will result in a significant change to current incentives while maximizing biofuel benefits and minimize associated costs. Finally this paper will discuss the steps required to successfully implement and effectively promote this new framework.

II. Following the Yellow Brick Road: Back to the Beginning

A. Farm Subsidies: An Indirect Benefit to the Corn Ethanol Industry

Ethanol owes a great debt to favorable agricultural policies such as the Farm Bill and its industry-friendly subsidy structure. First created as part of the New Deal agenda, the original Farm Bill was designed to achieve a number of laudable objectives: bring a sense of stability back to crop prices by reducing agricultural overproduction; utilize surplus crops productively to combat widespread hunger; provide nutritional assistance to children by providing school lunch programs; implement strategies to prevent further erosion and soil loss from poor land conservation policies; provide crop insurance and credit assurances for subsistence farmers; and build community infrastructure for rural farming towns. In essence, the 1933 Farm Bill was designed to save small farms in America, signaling a return to the Jeffersonian ideal of an agrarian democracy on which this nation was built.¹

Ironically, the Farm Bill of present times has moved farm policy in the opposite direction by effectively creating a system which favors large industrial agricultural operations at the expense of the smaller farms. Today, the wealthiest 10% of farm subsidy recipients, a group which consists of large corporations, non-farming homeowners, and absentee landowners,

receive approximately 67% of all subsidy payments under the Farm Bill.² In fact, three out of five farmers receive no subsidies at all.³ This inequity has essentially reversed the priorities that Roosevelt and his New Deal Agenda had envisioned. A simple statistic illustrates the impact of Farm Bill legislation on the family farm: in 1935, there were 6.8 million farms in the United States with an average size of 155 acres. By 2002, there were only 2.1 million farms with an average size of 441 acres.⁴

One program in particular provides an excellent window into the wasteful and illogical nature of this current subsidy system, particularly as it pertains to corn production. Under the Loan Deficiency Payment Program (LDP), the government establishes a guaranteed price for each crop. A set per-bushel price is established for each crop-producing county nationwide. This price is posted daily. If the posted price is below the guarantee, the farmer is able to claim the difference as an LDP payment. Farmers may take the LDP any time after harvest and prior to the sale of the corn. After taking the LDP, the farmer can subsequently sell the corn for any price he can obtain. In 2005, farmers sold corn for an average of \$ 1.90 per bushel, which was five cents per bushel below the national price floor. But, by claiming their LDP when prices were higher, they could claim the difference between the two prices and collect their payment. Indeed, farmers received an average LDP payment of \$ 0.44 per bushel beyond what they had received on the market, costing the taxpayers around \$ 3.8 billion.⁵

Beyond the LDP program, the federal government also encourages farmers to plant corn by providing them with the most generous subsidy support of any commodity. From 1995-2005, total U.S. support for corn was over \$ 56 billion. During this period, the average yearly subsidy for corn was \$ 4.66 billion for an average of 71.3 million acres of corn equaling \$ 65.40 per acre.⁶

With this tremendous level of support, the market is prevented from functioning properly and the United States is left with a glut of corn. There have been a number of attempts to effectively dispose of this excess. First, surplus corn was used to support the livestock industry; now corn accounts for 50-60% of livestock feed.⁷ Next, the United States began exporting this surplus and today provides 60-70% of world corn exports.⁸ The United States even tried giving away this corn in the form of food aid.

The most recent attempt to manage this surplus involved the creation of a similarly poorly managed corn ethanol industry. As corn ethanol became a viable option for cleaner domestic fuel sources, it became the convenient choice to create demand sufficient to consume millions of bushels of surplus corn. However, it quickly became apparent that this infant industry required its own sort of government intervention.

As can be expected, once the government intervened in this commodity market though offering incentives encouraging the production of a corn supply for which there was insufficient demand to meet, it effectively removed any potential for free market forces to function properly. By promoting overproduction and creating a vast surplus, corn prices are considerably lower than it would be otherwise. This would not be the case if farmers' decisions were governed by the free market. But because production decisions are instead made according the subsidy incentives offered during that particular legislative period, the price of corn remains artificially low. These decision benefit ethanol producers tremendously. Indeed, the International Institute for Sustainable Development estimates that about 15% of the total subsidy to ethanol comes from ethanol's share of corn producers' subsidies.⁹

B. Biofuels Policy: A Focus on Corn Ethanol

Although biofuels have been around for centuries, the modern biofuel program was begun in the United States during the 1970s in response to the OPEC oil embargos. The first and arguably most impactful incentive, the Volumetric Ethanol Excise Tax Credit (VEETC), was created in 1978 by the Energy Tax Act.¹⁰ The VEETC applies to all blends of ethanol and gasoline, and the per-gallon measurements occur after the blending process. It originally provided blenders with \$0.40 for every gallon of ethanol that they blended with gasoline,¹¹ but has grown to an excise tax credit of \$0.51 cents per gallon of ethanol today. However, in the recently passed Food, Conservation, and Energy Act of 2008 (2008 Farm Bill),¹² Congress reduced the credit to \$ 0.45 per gallon in 2009, provided production exceeds a set threshold.¹³

In addition to the VEETC, there is the Small Ethanol Producer Tax Credit, the Renewable Fuels Standard and the Energy Independence and Security Act (EISA) of 2007. The Small Ethanol Producer Tax Credit program provides a small but significant tax credit for small ethanol producers, which are defined as those with a production capacity of no greater than 60 million gallons. The program allows a \$0.10 tax credit on up to 15 million gallons of annual ethanol production, a limit which is capped at \$ 1.5 million per year for each producer, and was originally enacted in 1990 under the Clean Air Act Amendments, and extended in 2004.¹⁴ The Renewable Fuels Standard, mandated by the Energy Policy Act of 2005 (EPACT),¹⁵ established a minimum requirement for ethanol usage in automotive fuels through 2012 requiring 7.5 billion gallons of biofuel to be utilized. The Energy Independence and Security Act (EISA) of 2007 set the lofty goal of providing 12.2 billion gallons by 2012 and 36 billion gallons of renewable fuels by 2022 under the Renewable Fuels Standard.¹⁶

Aside from implementing tax incentives and mandating consumption, the federal government also offers a series of grants and loans designed to promote biofuel infrastructure

development. Implemented by the Department of Energy, the 1980 Energy Security Act granted insured loans for small ethanol producers that covered up to 90% of construction costs on ethanol plants.¹⁷ The Agriculture Department has a similar program where the government subsidizes producers up to \$ 7.5 million per project. The final allotment is based on how much the use of feedstocks for ethanol production increases from year to year.¹⁸ Additionally, an accelerated cost recovery tax credit designed to promote biofuels infrastructure is available to individuals investing in fuel equipment that dispenses at least 85% ethanol. Finally, there is the alternative refueling stations tax credit. Intended to increase the number of alternative fuel gas station nationwide, it grants individuals installing alternative fuel refueling property a credit of up to 30% of the property cost, capped at \$ 30,000 per year at each location.¹⁹

In addition to these subsidies, the United States has leveled two tariffs on imported ethanol. The first is the general ad valorem tax of 2.5%.²⁰ However, the most controversial and indeed, the recipient of the most international attention, is the Omnibus Reconciliation Tax Act of 1980, which established the tariff on imported ethanol. This tariff is currently set at \$0.54 per gallon, and effectively ensures that consumers eschew imported biofuels in favor of artificially cheaper domestically produced blends.²¹

Between both corn and ethanol subsidies, the federal government has expended tremendous amounts of resources in creating and promoting this industry. This commitment has ensured that corn ethanol has nowhere to go but up. Indeed, as of 2007, there were 119 ethanol refineries with an expected 77 new or expanded refineries with a total capacity of 12 billion gallons of ethanol per year.²² Today, the US produces more ethanol than any other country, exceeding the output of more efficient and better situated countries around the globe.

III. Ethanol and Unforeseen Consequences: A Problem Masked as a Solution

As delineated above, the policy path the United States has chosen has effectively fostered an atmosphere conducive to large-scale corn-ethanol production. Indeed, in this country, biofuel and corn-ethanol are practically interchangeable terms. While ethanol itself is relatively benign, many negative externalities are unique to corn production in particular. As the environmental, social, and economics costs become more salient, many people are questioning the overall sustainability of corn ethanol and its priority in the United States' biofuel program

A. Environmental: Using More and Producing Less?

Two threshold issues require consideration: whether corn ethanol provides a net energy benefit (NEB) and whether it actually reduces greenhouse gasses (GHG). These questions, especially the former, are hotly debated. Many studies have concluded that corn ethanol is an inefficient source of energy. Growing and harvesting corn requires a host of fossil fuel inputs including petroleum-based fertilizers, petroleum to run the farm equipment, and petroleum to transport the corn to distilling facilities. In fact, planting, growing, and harvesting corn accounts for approximately 30% of the total fossil energy used in the production of ethanol. The distillation process also requires significant energy inputs.²³ Ethanol facilities are often powered by either natural gas or coal, which further reduces its potential to achieve a positive energy ratio.

These facts indicate that the amount of fossil fuels expended in the production of biofuels undermines any serious energy gains it may offer. As early as 1991, the Department of Energy estimated that 85,000 to 91,000 British thermal units (Btus) of energy were needed to produce a gallon of ethanol containing only 76,000 Btus.²⁴ While technology has improved in the last eighteen years, a more recent study concluded that it takes 29% more fossil fuel to produce a liter

of ethanol that the actual ethanol produced and of this, around 50% of the energy is used to grow the corn.²⁵

Such a NEB ratio makes spurious the suggestion that corn ethanol is a viable option for off-setting foreign oil imports and meeting this nation's transport needs. At the current rate, even if all of the United States' cropland was dedicated to corn ethanol, it would only be successful in offsetting 12% of United States gasoline consumption.²⁶ For example, in 2007, 24% of the corn crop went to the fuel market, producing about 6.5 billion gallons of ethanol. This total was able to offset only 4.5% of the gasoline consumed in the United States.²⁷

Related to the negligible energy benefits of corn ethanol are its questionable GHG offsets. The primary source of GHG stems from the high amounts of fossil fuel needed to produce the corn. One study even shows that the GHG offsets for corn ethanol is only around 30%, meaning that about 70% of the GHG emission savings are negated by fossil fuel use both to grow the corn and produce the ethanol.²⁸

Changes in land use, spurred by the desire of farmers to bring more and more land into corn production as they seek to take advantage of higher commodity prices, have also contributed to an increase in GHG emissions. In order to meet the EISA mandated 36 billion gallons of biofuel by 2022 under the current policy scheme, farmers must increase corn production.²⁹ They can accomplish this by either expanding the amount of land under corn cultivation, often cutting into land enrolled in the Conservation Reserve Program, or diverting lands used for other crop into corn cultivation.

These two scenarios affect GHG emissions either directly or indirectly respectively. When a farmer clears forest or grass-land in order to plant corn, he directly releases much of the carbon dioxide (CO₂) these lands were previously storing in the vegetation as the plant matter

decays. Moreover, land under conservation management has the potential to sequester carbon at much greater rates than land devoted to row crops, which further undermines corn's GHG benefits.³⁰ If instead he and other farmers divert other crop land into ethanol corn fields, or sell more of their corn to ethanol refineries, food prices rise leading farmers in other parts of the world to clear existing forest or grass-lands in order to plant food crops. When these latter farmers clear land for their crops, they release stored carbon in the same way.

Already, these GHG scenarios are playing out. In 2007, 92.9 million acres of corn was planted in the United States, up 19% from 2006 and 14% from 2005.³¹ Of this, 2.3 billion bushels out of 13 billion bushels of corn were used for corn ethanol.³² Experts estimate that the resulting land use changes from this expansion are responsible for about 20% of the world's annual GHG emissions.³³

Besides increased GHG emission, land-use changes often result in higher chemical input application. For example, farmers may be encouraged to abandon beneficial practices such as crop rotation and low or no-till methods in order to increase per-acre yields to take advantage of higher corn prices. This results in higher erosion rates and lower soil nutrient health. Already, out of 370 million acres of cropland in the U.S., close to one-third is classified as "highly erodible land."³⁴ Erosion and the associated loss in nutrients severely inhibit crop productivity. Also, as more acreage is planted in corn monocultures, crop health is compromised due to the disease and pest vulnerability associated with extensive single crop fields.

To compensate for such negative effects, farmers will be forced to apply more chemical inputs such as pesticides and fertilizers. Corn is already an input intensive crop and requires large amounts of pesticides and fertilizers in order to survive. Further additions of chemicals will have serious environmental implications. For example, Atrazine, the most common

herbicide used on cornfields, is a hormone disrupter in wildlife as well as a potential threat to human health.³⁵ Increasing the acreage under Atrazine treatment contains serious health implications.

Fertilizers are equally culpable. Many farmers apply nitrogen, phosphorous, and potassium to promote and maintain crop growth. This too has the potential to significantly harm soil resources. In many cases, fertilizer remains in soil for years at a time.³⁶ This promotes weed growth and offers habitat for invasive species thus increasing the need for herbicides.

When applied inappropriately, or in excessive amounts, these surplus nutrients and chemicals are carried from farmlands into nearby waterways. Within the United States, 1.16 million tons of phosphorous and 4.65 million tons of nitrogen are discharged into waterways annually.³⁷ High concentrations of both nitrogen and phosphorus frequently contribute to the deleterious growth of algae and other nuisance aquatic plants. Nutrient runoff influences the health of natural systems by stimulating the eutrophication of water bodies, resulting in anoxic conditions that are toxic to aquatic animal populations throughout the watershed.³⁸ Such conditions in the Mississippi Valley have are responsible for the “dead zone” in the Gulf of Mexico where little to no marine can survive.

Ethanol production also impacts water resources because of its water dependant growing and distillation needs. To be sure, ethanol production requires billions of gallons of water straining water sources and relations with other water users.³⁹ A typical ethanol plant requires around 500 gallons of water per minute.⁴⁰ As of 2008, there were already several challenges in six states to the construction of ethanol facilities because of water competition.⁴¹ Also, as corn production expands in response to current ethanol policies, it is being planted in drier regions of the United States which increases its dependency on irrigation from local sources.⁴² Maintaining

current ethanol policies which encourages corn expansion to drier states could result in bitter legal clashes between water users similar to current on-going tensions in California.⁴³

B. Economic: Higher Taxes for Affordable Fuels?

Because it costs more to produce ethanol than it does gasoline, the United States' ethanol market is supported by significant economic incentives from both the federal and state government.⁴⁴ The cost of these incentives is staggering. For example, in 2007, the federal government paid over \$ 2 billion in direct payments to farmers growing corn⁴⁵ and in 2001, South Dakota paid \$ 3.1 million in subsidies to ethanol refineries in three towns alone.⁴⁶

The infrastructure needed to support ethanol is also costly. Because water causes ethanol to separate from gasoline, ethanol cannot be shipped in regular pipelines, but must be transported by railcar adding to the total production costs and making it unavailable in certain areas.⁴⁷ Moreover, in order to use all the mandated ethanol, the U.S. auto industry must produce cars that are capable of running on higher levels of ethanol and U.S. consumers must be willing to buy these cars.⁴⁸ The U.S. government therefore must spend more money in incentives to encourage this behavior. Continued corn-ethanol expansion will only continue to drain federal and state coffers while producing questionable benefits at best.

Because government sponsored incentives are necessary to support the ethanol industry, this reliance becomes problematic for each and every citizen. The ethanol industry thrives on public financing — from the actual planting and harvesting of the corn crop to the federally subsidized grants and loans used to erect infrastructure necessary for transport and development to the actual distilling process. Total, these incentives are predicted to cost taxpayers up to \$20 billion a year by the year 2022.⁴⁹

C. Social: Does Fuel Trump Food?

Ethanol has not escaped criticism from social scientists and others concerned with social welfare. Much of this criticism stems from the fact that the production of ethanol fuel has resulted in a dramatic increase in the price of food. Because the demand for corn is higher than ever before, while supply has stayed the same or experienced only a nominal increase, the price of corn itself has experienced a significant increase. The United States no longer has the surplus experienced in years past and this upward demand pressure is largely a result of the relatively new corn-ethanol industry. For example, in 2007 the government-created demand for ethanol was responsible for diverting 20% of the corn crop to ethanol refineries.⁵⁰

This is significant because corn is an important food staple in the United States as well as many other countries. In fact, the United States supplies nearly 65% of all international corn exports.⁵¹ The Congressional Budget Office estimates that from April 2007 to April 2008, the price increase of corn attributable to ethanol production contributed between 0.5% and 0.8% of the 5.1% increase in food prices worldwide.⁵² The impact is great: the USDA estimates that the price of corn rises 4-8 cents for every 100 million bushels of corn used to produce ethanol.⁵³ Between 2005 and 2007, this resulted directly in a 60 percent increase in corn prices.⁵⁴

These prices have made a previously inexpensive commodity prohibitively expensive for many foreign and domestic buyers of grains.⁵⁵ This trend is especially troublesome for developing countries who have come to rely on affordable exports. As corn becomes more increasingly scarce and correspondingly expensive, people dependent on this grain must look elsewhere for food, often turning to less nutritious sources. These climbing prices could also lead to socio-economic and political unrest in developing countries as it has already done in Mexico.⁵⁶

These price spikes affect not only corn used for direct human consumption, but other industries that rely on corn. Higher corn prices are raising livestock feed costs throughout the nation.⁵⁷ Beef, hog, poultry, and dairy producers all use corn in their feed rations and as the cost of feed continues to rise, so too will the cost of meat, milk, and eggs.⁵⁸ While distillers grain, a co-product derived of the ethanol production process, does provide an accessible and inexpensive food source for livestock, not all livestock producers can take advantage of this feed source.⁵⁹ Until the government ceases to create incentive programs which places food and fuel in competition with each other, these trends will likely continue creating further problems in the future.

D. International: Our Policy, Their Consequences

As the impetus for biofuel production continues to grow globally, it is clear that the United States', or any other countries' large-scale ethanol models and supporting policies, will negatively impact developing countries. Researchers have noted several environmental and social issues relating to corn-ethanol production arising in developing nations.⁶⁰ Equally troubling is that many countries have begun to replicate large-scale biofuel schemes. The ramifications of large-scale biofuel production seen in the United States will only be exacerbated in developing nations and has the potential to further marginalize already vulnerable groups of people.

1. Environmental

Implementing large-scale biofuel production poses many environmental problems for developing countries. First, biofuel feedstock may be produced in carbon rich areas which release massive amounts of CO₂ when existing vegetation is disturbed or eliminated. For example, large-scale palm plantations in Indonesia have led to drastic increases in GHG emissions. In

order to cultivate these palms, existing peatlands must be drained, which release large amounts of carbon as the peat dries. The combination of draining peatlands and clear-cutting the forest for these plantations have led Indonesia to be one of the top three emitters of GHGs in the world.⁶¹

Biofuel's effects on biodiversity are another significant concern in developing countries. Because many developing nations are in the tropics, which are very species rich, the threat to biodiversity is more severe. Illegal timber trade, poverty, and poor resource management already threaten biodiversity in many developing nations. For example, more than half of Malaysia's new palm-oil plantations have been established in previously forested areas thereby eliminating crucial habitats for many forest-dwelling species. Transplanting a large-scale biofuel in this region would only add more pressure to the biodiversity.⁶²

2. Economic

The most influential feature of the U.S. biofuels program is pervasive government interference with anything resembling a free market system. Indeed, “[a]ll liquid biofuel markets to date have been supported by government protection policies that include one or more of the following market interventions: fuel tax reduction or exemption, mandatory blending, producer subsidies, high import tariffs, and financial incentive programs for users of biofuels such as lower taxes on vehicles designed for biofuels.”⁶³ The United States' ethanol economics have been attacked on many grounds, not least of which involves the astute observation that the current approach is an inefficient way to achieve the ostensible ethanol goals of energy independence and environmental mitigation. What is more, this subsidization is directly responsible for many negative externalities, requiring an increasingly large portion of tax dollars to correct. Because of the questions surrounding the heavily subsidized system that prop up the

large-scale ethanol production in the United States, other countries would do well not to replicate this display of fiscal irresponsibility.

3. Social

Scientists warn that increasing populations, unpredictable weather patterns and decreasing amounts of available arable land throughout tropical countries will lead to increased food insecurity. This problem is made worse by countries which take land out of food production to cultivate biofuel feedstock. Moreover, because poor people are more heavily affected by food prices than energy prices, this increased competition between food and fuel will eventually lower social welfare.⁶⁴ Similarly, crops in many developing countries are dependent upon irrigation. Water will be diverted away from food crops in order to irrigate fuel feedstock, further contributing to food insecurity.

Large-scale biofuel production could also facilitate poor working conditions in developing countries. Already, palm-oil and sugarcane used in ethanol in many countries are produced under substandard working conditions including some cases of forced labor and child labor.⁶⁵ Large-scale biofuel production also requires access to large tracts of land and extensive chemical inputs. In developing countries, poorer people, especially women, do not usually have access to these assets.⁶⁶ By facilitating continued income inequality, large-scale biofuel production has the potential to further marginalize the disadvantaged.

E. Political: A Special Interest Democracy

With the multitude of problems surrounding corn ethanol, it may be somewhat surprising that this fuel still enjoys the national biofuel spotlight. However, a deeper look into the ethanol players reveals the truth behind this paradoxical political support. In a time where special interest groups tend to dominate politics on a local and national stage, the corn-ethanol industry

has provided yet another forum where money dictates policy. In what Food and Water Watch has dubbed the “iron triangle of ethanol production,” three wealthy and well-connected groups of players have formed a tight alliance to drive the ethanol industry and ensure its survival.

The first key players are the corn lobby and the growers that benefit from the current subsidy structure. The National Corn Growers Association and the Corn Refiners Association have spent about \$ 9 million in lobbying expenditures between 1998 and 2007.⁶⁷ These lobbyists and growers also ensure healthy political support for candidates who are sympathetic to corn and corn-ethanol. In return, the lobbyists and growers secure incentive structures supporting the problem —corn overproduction— and the solution — ethanol. This support also ensures that the corn growers’ subsidy payments continue. It is important to note here that these growers are not small family farmers, but large agribusiness and industrial farms. Indeed, 19% of all corn subsidy payments go to the top 1% of growers while the bottom 80% of corn growers receive only around 13% of these subsidy payments.⁶⁸

The second group of key players is the ethanol refineries, which are also dominated by big agri-business. Again, a handful of big agri-business reaps many of the benefits from the current subsidy structure. For example, Archer Daniels Midland (ADM), a vertically integrated corporation which controls almost every facet of the ethanol production process and also happens to be the nation’s largest ethanol producer, produced over one billion gallons of corn ethanol in 2006 comprising around 20 % of this nations total ethanol output.⁶⁹ From 1980 to 1997, the government paid ADM over \$10 billion in ethanol subsidies.⁷⁰ Because the American taxpayer supplies the money used for these subsidies, “every dollar of ADM ethanol profits is costing the American public more than \$30.⁷¹”

Also, like the corn growers, these ethanol refineries have a significant economic interest in maintaining the subsidy status quo and thus help finance political campaigns for politicians sympathetic to corn ethanol. From 1990 to 2006, ADM contributed almost \$8 million to politicians during the election cycles.⁷² In 2003, researchers calculated that for every dollar spent by this same company on campaign contributions, whether to push for commodity subsidies or ethanol incentives, the company received \$ 2,500 in tax benefits.⁷³

Finally, Washington politicians complete the corn ethanol triangle. Many politicians see increased ethanol use as a way to promote environmental goals and energy security goals while also catering to key interest groups as mentioned above.⁷⁴ Without these politicians' continued support for ethanol policies in Washington, the current subsidy structure would undoubtedly come under greater scrutiny. Instead, these politicians receive large campaign donations and votes, as noted above, and enjoy a fairly secure position in Washington. It is no surprise then that corn, with all of its shortcomings, is the dominant ethanol feedstock crop.⁷⁵ In the face of these special interests, there is no room for sound science.

IV. The Good News: Values and Benefits of Biofuels

Despite ethanol's shortcomings, biofuels still hold promise. This section will begin with a discussion of biofuels in general, illustrating the benefits and making an argument in support of pursuing this valuable resource. Next, it will consider alternative feedstocks as the nation looks to life after corn ethanol noting that cellulosic ethanol and biodiesel hold particular promise. Finally it discusses the current policies which promote the use and development of these feedstocks.

A. Better Biofuels: Life beyond Corn Ethanol

Biofuel supporters cite numerous reasons for encouraging the use of alternative fuels. Included are the benefits of insulating the United States from rising fuel prices, decreasing United States' dependence on foreign oil, increasing national energy security, and reducing greenhouse gas emissions resulting from fossil fuel combustion.⁷⁶ Because biofuels can be produced domestically, the United States can reduce its vulnerability in the face of a volatile global oil market. The use of biofuels also offers universal societal benefits in the way of improved environmental health and an improved economy. Unlike fossil fuels that emit greenhouse gases such as carbon dioxide, a significant contributor to global warming, biofuels produce little to no carbon dioxide.⁷⁷ By growing fuel on domestic farms, economic opportunities have the potential to abound.

Corn-ethanol does have certain advantages relative to petroleum fuels. First and foremost, it is a renewable fuel and represents an important step forward in American energy policy. It is also a cleaner burning fuel than fossil fuels. Many scientists agree that when burned, ethanol releases less greenhouse gases and other noxious emissions such as sulphur oxide.⁷⁸ It also has a higher oxygen content than fossil fuels, which produces less smog related emissions than fossil fuels, and a higher octane number which increases engine efficiency.⁷⁹

However, corn-ethanol remains an inefficient option when contrasted with other possibilities. Currently, annual crop-based biofuel production is 30 gallons of fuel per acre using corn; 60 gallons per acre using soybeans; 150 gallons per acre from canola; 650 gallons per acre from palm; and 2000 to 5000 gallons per acre from algae.⁸⁰ Based on these numbers, it is imperative to look towards alternative crops and biomass in the hope of mitigating or overcoming many of the negative externalities associated with corn-ethanol production.

B. Cellulosic Biofuels: The Long Road Ahead

Cellulosic biofuel and biodiesel in particular present attractive options as the biofuels industry searches for new feedstocks in their effort move beyond corn. A fuel derived of cellulosic sources has been touted by many as the answer to the biofuels question. Cellulosic biofuel is defined as "any liquid fuel which is produced from any lignocellulosic or hemicellulosic matter that is available on a renewable or recurring basis."⁸¹ The Energy Policy Act of 2005 identifies cellulosic material as lignocellulosic feedstock and lists barley grain, rapeseed, rice bran, rice hulls, rice straw, soybean matter, and sugarcane bagasse as meeting this requirement.⁸² To qualify for many incentivizing provisions, cellulosic biofuels must have "lifecycle greenhouse gas emissions that are at least 60% less than the baseline lifecycle greenhouse gas emissions" when compared to gasoline or diesel, whichever is being replaced by the cellulosic fuel.⁸³

Agriculturally, cellulosic sources are superior because they can be grown on marginal or degraded land, and provide increased regional agricultural income without consuming land that is already being used for food production.⁸⁴ Cellulosic material can also be produced from trees, forest residues, and agricultural residues, all of which are non-food sources. Such non-food feedstock would allow farmers to grow it on marginal lands not already in use, a possibility which allows land under food cultivation to remain so. Further, cellulosic ethanol requires less pesticides and fertilizer than corn-based ethanol and offers the potential for a significantly improved net energy balance.⁸⁵

When compared to corn-ethanol, the results look promising. A recent life-cycle study found that the energy requirements as well as the adverse environmental impacts associated with the production of biofuels are low for both switchgrass and hybrid poplar when compared to corn crops.⁸⁶ However, there are some drawbacks. Principle among these is the lack of technology

available to produce cellulosic biofuels on a large scale. To date, cellulosic conversion technology is rudimentary and expensive despite the fact that considerable investments have been made over the last few years in an effort to make cellulosic biofuels economically viable.⁸⁷ While it is true that this uncertainty will prevent cellulosic ethanol from having any discernable impact on our fossil fuel consumption in the near future, renewed attention and increased investment — particularly a diversion of research and development away from corn-ethanol and towards cellulosic sources — make this a practical option for the future.

C. Biodiesel: Playing a Greater Role

A second option is biodiesel. Many of the obstacles associated with cellulosic sources are mitigated or non-existent with biodiesel. Moreover, biodiesel already has the technology and market to enable this biofuel to play a much greater role. Biodiesel is most often made from soybean oil but offers the flexibility to include diverse sources such as rapeseed oil (canola), palm kernel oil, sunflower seed oil, castor oil, groundnut oil, cotton seed oil, and coconut oil (copra).⁸⁸ Domestically, soybean oil accounts for 90% of vegetable oil biodiesel production.⁸⁹ Over the last decade, biodiesel production has experienced a slow, but consistent increase. The United States produced seventy-five million gallons of biodiesel in 2005, increasing to 700 million gallons in 2008.

When compared to corn ethanol, biodiesel is a superior alternative. Soybean-based diesel results in 1% of the nitrogen, 8.3% of the phosphorus, and 13% of the pesticide releases per unit of energy gained in comparison to corn ethanol. A report from the National Academy of Sciences reports that soybean diesel has a NEB ratio of 1.93 in contrast with the 1.25 NEB associated with corn-ethanol. In short, this means that biodiesel has the ability to produce 93% more energy that is required to produce it.⁹⁰ This improvement in efficiency along with the ease

with which biodiesel can be produced and the abundance of feedstocks, render this an option worthy of additional exploration.

V. Expected Benefits: Advantages of an On-Farm Approach

It is clear that biofuels feature a number of positive attributes making it unwise to forego biofuel as an energy option for the United States. It is equally clear, however, that the corn-ethanol industry fails to adequately showcase or capitalize upon these positive attributes and instead exacerbate many of the problems which the industry was expected to help overcome. Thus the issue is one of finding an equilibrium point: how to capture the benefits of biofuels while eliminating their harmful externalities.

The first answer seems obvious: turn federal attention away from corn. Principally responsible for both the survival of the corn-ethanol industry, the removal of production incentives will enable governments to better focus resources and attention elsewhere. A second, and perhaps not as obvious, answer is to scale-down the size of biofuel production. Many of ethanol's impacts can be attributed to the use of an 'economies of scale' mentality, a philosophy which has led to many of the harmful impacts caused by large-scale corn production. The creation of an on-farm biofuels production and consumption incentive will facilitate the achievement of these objectives.

Aside from allowing farmers to take advantage of the benefits of biodiesel and other more efficient ethanol feedstocks, an on-farm production and consumption incentive beneficially focuses resources on small-scale biofuel production. Small-scale agriculture is better able to foster environmental stewardship, which will translate into achieving the environmental goals set out by ethanol policies. Economically, this incentive has the potential to cost the government

less. Further, the economic benefits of this incentive will remain with the actual producers of biofuel feedstock instead of being captured by politically well-connected and wealthy agribusinesses. Also, by decentralizing biofuel production, the United States is laying the foundation for a resilient national energy security scheme based on a diverse biofuel system that is not dependent on one feedstock or one region of the country. Finally, this small-scale emphasis will help policy-makers view biofuels as they should be —just one part of a holistic national energy solution, and not the energy panacea as some would like to believe.

A. Flexible Options

By encouraging farmers across the country to grow biofuels to suit their particularized needs, this incentive will ensure biofuel diversification. Taken from the financial world, diversification is an approach designed to reduce risk while maintaining returns.⁹¹ Within the biofuels context, diversifying the nation's biofuel production means diversifying the feedstock sources, the production technology, the regions of the country where feedstocks are grown, and the kinds of biofuel produced.

Different biofuel sources can include, “any organic matter that is available on a renewable or recurring basis, including agricultural crops and trees, wood and wood wastes and residues, plants (including aquatic plants), grasses, residues, fibers, and animals wastes, municipal wastes, and other waste materials.”⁹² As noted above, cellulosic ethanol and biodiesel are two feasible options farmers could explore. The biofuel neutral incentive will encourage farmers to grow a variety of feedstocks and utilize a variety of materials to produce biofuel depending on their farm's location and needs. A wider base of feedstock to draw from will help further national energy security goals by insulating biofuel production from the failure of one feedstock and creating a more resilient biofuel market.

As already noted, non-food biofuel feedstocks provide more energy per unit than food feedstocks.⁹³ Higher energy returns and increased efficiency, combined with an incentive which is feedstock neutral will likely encourage farmers to choose non-food feedstocks for use in the biofuels production process. By facilitating the opportunity to shift feedstock sources away from food plants, biofuel production can avoid impacting world food prices and grain availability. Non-food feedstock could be grown on land not suited for food crop production, thereby eliminating some of the competition for arable land between food and fuel. Due to per-unit efficiency increases, less land is required than would be for less efficient feedstocks such as corn.

As of now, the technology for producing second-generation biofuel is lagging. A technology neutral incentive will foster an atmosphere of ingenuity and innovativeness. Farmers have a long and continuous history of innovation in areas ranging from equipment manufacturing to farming practices.⁹⁴ Because they are adept at solving their own problems, allowing each farmer to determine which feedstock and production method works best will lead to innovation in the biofuel field. A broader biofuel technology base also strengthens the national energy security objectives by increasing the variety of biofuel technology.

B. Sustainable Practices

Small-scale biofuel production also offers a host of potential environmental advantages over large-scale production. First, small farms implement diversity on many levels including cropping systems, biological organization, and farming practices.⁹⁵ Farmers can plant biofuel crops in small plots or integrate them into existing land-use systems. Under either scenario, biofuel feedstock would increase the heterogeneity of the landscape by increasing crop varieties, minimize the use of mono-cultured cropping systems, encourage crop diversification, and increase biodiversity.

Second, small-scale biofuel production can occur almost anywhere, including degraded land.⁹⁶ Non-food feedstock is especially suited to growing on marginal land since many do not require the same nutrient input as those grown for food.⁹⁷ Biofuel crops, such as switchgrass planted on degraded land can improve soil fertility, control erosion, and provide a variety of ecosystem services.⁹⁸ Switchgrass and other perennial feedstocks can also provide carbon sequestration on a long-term basis

Finally, by rewarding farmers for producing and consuming biofuels in a sustainable manner, some of the problems associated with large-scale ethanol production will be alleviated. Organic farming practices, often easier to implement on smaller-scale farms, will reduce input requirements. Also, farmers can begin to experiment with feedstocks which are less resource dependent. For example, native plants which require only minimal inputs as they have already adapted to growth conditions within the region.⁹⁹

C. Increased Profitability

By growing and processing feedstocks on the same premises, the cost of producing biofuel will quickly decrease due to a reduction in transportation and infrastructure costs, directly improving economic feasibility. One study has shown that for every thirty miles a biofuel is transported, there is an extra 10% increase in cost of production.¹⁰⁰ Another study prepared for the U.S. Department of Energy in the 1980s suggests that these lower capital and transportation costs will make farm-scale ethanol production economically feasible.¹⁰¹ Moreover, if gas prices continue to rise, farm-scale biofuel production will only become more attractive.

From a farmers' point of view, farm-scale biofuel production offers a host of economic advantages. The 2007 Agricultural Census shows that farmers are spending well over \$ 10 billion per year in oil and gasoline expenses alone, accounting for roughly 5% of total farm

expenses.¹⁰² This incentive will help farmers save money by reducing energy costs, eliminating distribution related price inflation and providing protection from oil price fluctuations.¹⁰³ Moreover, the opportunity to diversify will undoubtedly assist many farmers who struggle to remain viable in the face of increasing input prices and unrelenting competition from larger corporate farms that are able to use size to their advantage.

This increased profitability will trickle down to benefit rural communities. Currently, seventy-five cents out of every dollar spent on fossil fuels leaves the community.¹⁰⁴ By utilizing local resources and creating a closed-loop production cycle, farmers can work to improve rural economic health by supporting local businesses. The farmer can benefit too: biofuel production creates beneficial co-products, such as glycerin, which can become an inexpensive source of animal feed for his animals or those of a nearby farmer.¹⁰⁵ In order to ensure the greatest community impact, however, farmers, community members, and policy makers must recognize the benefits of localized production.¹⁰⁶ Promoting local ownership of biofuel production could ensure that most of the money spent on this fuel stays local.

D. Energy Security

Minimizing overall fossil fuel use is essential to a holistic energy policy. Agriculture is a fairly intensive user of these depletable resources. Twenty percent of America's fossil fuel consumption occurs in the agricultural sector, which includes growing and harvesting crops and livestock along with other post harvest processes such as packaging, transport and refrigeration.¹⁰⁷ Reducing reliance upon foreign oil on the part of the agriculture sector will help to shift fossil fuel consumption and work to mitigate fossil fuels' harmful impacts.¹⁰⁸

Agriculture uses energy both directly and indirectly.¹⁰⁹ Direct energy is principally in the form of petroleum-based fuels used in pick-ups, cars, and field machinery; while petroleum

derived chemical inputs comprise indirect use.¹¹⁰ In 2002, both direct and indirect agricultural energy consumption accounted for 1.7% of the nation's total consumed energy.¹¹¹ Up to 90% of direct agricultural energy goes towards cropping activities such as planting, harvesting, irrigating, and applying fertilizers and pesticides.¹¹²

Some statistics here will be useful. In 2002, farms used a total of 79 trillion Btu of liquid petroleum, 146 trillion Btu of gasoline and 469 Btu of diesel.¹¹³ The direct use of gasoline and diesel in farm equipment such as tractors and irrigation pumps accounted for 4.2 billion gallons of fuel used in 2005.¹¹⁴ In 2008, agriculture used 6.6 trillion btus of energy and of this, 2.1 trillion btu was motor gasoline.¹¹⁵ To further break it down, 27.3% and 8.5% of direct energy use was comprised of diesel and gasoline respectively. Total, farmers spent around 6.5 billion dollars on fuels during this year.¹¹⁶ Another break down of agricultural energy use shows that this sector consumes around 1.4% of total gasoline and close to 6.1% of total diesel sold in the United States.¹¹⁷ Incentivizing small-scale on-farm biofuel production can help the agricultural sector begin to decrease its use of gasoline and diesel, which can impact the total amount of fuel consumed in the United States. Encouraging reduced fossil fuel use is a necessary step for the United States' overall energy policy.

VI. A Biofuels Reform: Policy Changes for a Better Future

While the corn-ethanol industry continues to receive the bulk of government support, the most recent generation of biofuels legislation has had the effect of creating opportunity for the development and production of alternative feedstocks for biofuels use. The following legislative endeavors make clear that biofuels still have a place in the future while offering opportunities for both better science and better management. If managed correctly, these provisions will result in a better biofuels policy, giving producers the chance to pursue alternative feedstocks.

A. Farm Bill: Incentives for Biofuels Production

The 2008 Farm Bill provides more than \$1 billion in federal money to subsidize biofuel development between fiscal year (FY) 2009 and FY 2012. This amount will likely be supplemented, as increased funding has been explicitly made available subject to open-ended directives and authorizations.¹¹⁸ As shown by this striking financial commitment, the 2008 Farm Bill marks a major transition in renewable biofuels policy by moving away from the dominant corn-based industry.¹¹⁹ Transformation has been achieved by directing resources not simply towards biofuels in general, but specifically towards advanced biofuels, which are defined as “any fuel that is derived of renewable biomass other than corn or corn based products”.¹²⁰

Emphasis throughout the bill is placed on advanced biofuels, which is a substantial change from previous versions. As utilized by the Congress, this term encompasses a broad range of feedstocks and fuel sources. Included are commercially-scaled technologies such as biodiesel and sugar ethanol, as well as all types of cellulosic sources. Significantly, corn ethanol does not qualify.¹²¹

Section 9003 seeks to provide incentives for the construction of plants capable of producing advanced biofuels on a commercial scale. This \$ 320 million program offers a loan guarantee meant to cover no more than 90% of project costs for the construction of advanced biofuel infrastructure and demonstration scale projects.¹²²

Section 9004 offers an opportunity to increase the market for biofuel products where a biorefinery is already a part of the local economy. Currently, many biorefineries are powered by more conventional energy sources, such as coal or natural gas.¹²³ Section 9004 provides

mandatory funding of \$35,000,000 for FY 2009, which is set aside to fund efforts that replace fossil fuels used to produce the heat or power necessary to operate biorefineries. This is done by making payments for the installation of new systems which qualify simply by utilizing renewable biomass as a primary energy source.¹²⁴

Section 9005 is a significant step towards ensuring the long term viability of markets for biofuels and the prospects for continued use. Under the Bioenergy Program for Advanced Biofuels, payments will be made to eligible producers to “support and ensure an expanding production of advanced biofuels.” Like many other government based incentives, there is a good chance that many of the larger and better funded farming operations will apply for, and receive, a significant portion of the payments reserved for this section. This is due both to economies of scale and the general organizational capacity of larger organizations.

However, § 9005 works to distribute the total amount of funding available in an equitable manner. This helps ensure an opportunity for even the smallest producers to take advantage of this guaranteed market. Available until expended, mandatory funding under this section exists in the form of \$55,000,000 in 2009 and 2010, increasing to \$85,000,000 in 2011 and \$105,000,000 in 2012. Additional discretionary funding has been provided for in the amount of \$25,000,000 for each year listed above.¹²⁵

Found in § 9011, the Biomass Crop Assistance Program (BCAP) is designed to support the establishment and production of eligible crops for conversion to bioenergy. To qualify, an eligible crop must be used, and this crop must be planted on eligible land. An *eligible crop* is defined simply as one of renewable biomass, excluding commodity crops. Eligible land does not include land enrolled in CRP or any other Environmental Quality Incentives Program (EQIP) program, and does not include land that is native sod as of the date of the program’s enactment.

The BCAP provides substantial assistance in facilitating the collection, storage, harvest and transportation of these materials. Under this section, there are three different forms of payments available, and it is assumed that a producer will be eligible for all three. *Established payments* are designed to compensate a producer for up to 75% of the cost necessary in establishing the crop. This will go towards the cost of seeds as well as the cost of planting. *Annual payments* are based on the opportunity cost a farmer has incurred in his transition from the production of conventional crops to those eligible under this program. Additional payments are reserved specifically for the collection, harvest, storage, and transportation of the biomass product to the biomass conversion facility. These are matching funds, and \$1 will be provided for every \$1 per ton provided by the biomass conversion facility, in an amount that cannot exceed \$45 per ton for a period of two years.¹²⁶

An additional incentive for biofuel production can be found in § 15321. This section makes available a tax credit of \$1.01 for each gallon of cellulosic biofuel one produces. A producer would qualify under § 15321 if he sells the fuel he has produced to another person for use in the production of a biofuel mixture, for fuel in their business or trade, or to another who will sell biofuels at retail.¹²⁷

B. Energy Policy Act of 2005

The Energy Policy Act of 2005 (EPACT) also represents a significant opportunity to move away from a corn ethanol biofuel regime. Section 941 amends the Biomass Research and Development Act of 2000 to expand bio-based fuel research and development programs in a stated effort to overcome what is termed as the "recalcitrance of cellulosic biomass."¹²⁸ The expansion of biofuel research is critical as advanced biofuels are often hampered by difficult and costly production processes. As noted, the primary obstacle to utilize cellulosic sources lies in

the difficulty of finding methods for large-scale, efficient production. Section 942 articulates the ambitious goal of creating a cellulosic biofuel program industry which would feature an annual production of 250 million gallons per year by 2013.¹²⁹

EPACT is perhaps best known for the establishment of a renewable fuel standard (RFS) which mandates the use of renewable fuels. The first mandate of its kind, the law requires "the inclusion of specific aggregate volumes of renewable fuel in motor vehicle fuel sold or dispensed in the contiguous United States."¹³⁰ Additional provisions found in EPACT include the requirement that federal agencies purchase bio-based products and grants to market such products. Significantly, § 206 rewards consumers' rebates in connection with the installation of renewable energy systems to one's dwelling unit or small business.¹³¹

C. Energy Independence and Security Act of 2007

Finally, the Energy Independence and Security Act of 2007 (EISA) targets advanced biofuels in a similar fashion. Under this bill, the term advanced biofuels includes ethanol from feedstocks other than corn, including cellulosic ethanol, biodiesel, biogas (including landfill gas and sewage treatment gas), and other fuel derived from biomass including algae.¹³² Again, there is a requirement that each advanced biofuel also have lifecycle GHG emissions that are at least 50% less than baseline GHG emissions, the baseline calculation being that of the fuel which the advanced biofuel is meant to replace.¹³³

This act also features a renewable fuel requirement. The total requirement for 2009 is 11.1 billion gallons of renewable fuel. It is mandated that 5% of this requirement be met by using the advanced biofuels defined above. Significantly, the percentage of advanced biofuels required as a portion of the renewable fuel standard increases until 2022, when 21 billion of the required 36 billion must represent an advanced biofuel source.¹³⁴

Interestingly, there are separate provisions for the use of cellulosic biofuels, a sub-set of advanced biofuels. The renewable fuel standard must be met using 100 million gallons of cellulosic biofuel in 2010. Again, production is to increase each year until the total reaches 16 billion gallons in 2022.¹³⁵ Cellulosic ethanol is promoted further in § 230, where \$50 million for cellulosic ethanol research.¹³⁶

D. Current on Farm Incentives

As already noted, there are a host of programs available which support the research, development, and production of advanced biofuels. Because the production of on-farm biofuels would most commonly include crops such as soybeans and rapeseed as the primary fuel source than corn, any fuel physically produced and consumed as part of an agricultural operation would qualify as an advanced biofuel. However, it is unclear which of these policies, if any, offer support for small-scale, on-farm production. This valuable practice simply goes unmentioned.

Further, due to logistical difficulties which center on the impossibility of monitoring or verifying actual on-farm production and use, it becomes clear that the energy legislation detailed above — the Energy Independence and Security Act of 2007 and the Energy Policy Act of 2005 — will not provide the policy infrastructure necessary to promote on-farm biofuels production or reward those farmers who do.

This leaves the 2008 Farm Bill as the primary vehicle for the establishment of a viable on-farm biofuels industry. Section 9007, also known as the Rural Energy for America Program (REAP), is one of the most important programs featured in this forward-looking legislation. The REAP program promotes both energy efficiency and renewable energy development for agricultural producers and rural small businesses alike through grants and other financial assistance.¹³⁷ This replaces § 9006 of the 2002 Farm Bill, the Renewable Energy Systems and

Energy Efficiency Improvements Program, and adds some important changes that could function as a catalyst as farmers look for ways to cut back on production costs and produce fuel on the farm.

Section 9007 uses a series of grants and guaranteed loans to promote the development of energy in rural areas. This section includes a provision for mandatory funding of \$ 255 million, with an additional \$100 million authorized. Perhaps most important is that this section reserves a set amount of money for small projects requesting not more than \$20,000 in guaranteed loans, ensuring that as many farmers as possible get an opportunity to make a change.

While the first portion of § 9007 is devoted to grants for energy audits and renewable energy development assistance, the next provision is directed at farmers seeking to produce on-farm biofuels directly. Grants and loan guarantees offered through this segment have the stated purpose of assisting in the purchase of renewable energy systems, including those that may be used to produce and sell electricity, and make energy efficiency improvements. Examples include wind or solar systems, as well as materials necessary for the implementation of a biofuel conversion facility.¹³⁸

By offering financial assistance to farmers who wish to implement a biofuel conversion facility as part of their operation, § 9007 represents the first step towards incentivizing the production of on-farm biofuels and revitalizing the renewable fuels policy along the way. Moreover, this program is designed to prioritize projects while rewarding assistance to only the most valuable projects. In determining the amount of loan guarantee or grant under § 9007, the type of renewable energy system to be purchased and the estimated quantity of energy to be generated by this system are considered along with the expected environmental benefits derived

from the operation of the proposed project. Importantly, efficiency is paramount to getting the incentive.¹³⁹

To gather information about the project, Congress also made available separate grants designed to allow for a feasibility study of the proposed project. The results of the feasibility study will be used both to provide an estimate of the efficacy of the proposed project, as well as an estimate of the expenses required for implementation. Only 25% of the funds required to implement the proposal will be available in the form of a grant, with a guaranteed loan covering up to 75% of the rest.¹⁴⁰

VI. Implementing the Solution

The production and consumption of on-farm biofuels will allow farmer to take advantage of the positive attributes associated with the use of renewable biofuels while avoiding the negative consequences associated with the large-scale production of corn ethanol. However, the critical next step is to implement a policy reform which incentivizes the production of biofuels on the farm while simultaneously eliminating policies which promote the wasteful brand of biofuel production currently employed.

In the wake of a triad of pressing national needs — energy security, a clean environment, and economic opportunity to all citizens — biofuels are an important and viable option. While current policies cannot and will not achieve these goals successfully, it is important that government biofuel support continues. Because all three of these needs are public goods, and the private sector is notoriously poor at providing or protecting public goods adequately, it is clear that if these goods will be provided at all, they must be provided as a result of government intervention. Indeed, economists classify public goods as a classic market failure.¹⁴¹ Because the

private sector is unwilling or unable to provide public goods, and has little incentive to do so, the market becomes an inadequate tool and government intervention becomes necessary.

There are two primary methods at the government's disposal in order to promote an industry requiring support to survive and prosper. The first is the use of financial incentives to reduce costs to the industry at one or several points in the chain of production. The second involves the employment of regulatory mandates to impose a minimum usage requirement for certain products produced by the industry.¹⁴² Due to difficulties associated with monitoring and implementing regulatory mandates on a small scale, financial incentives appear to be the better option.

Financial incentives can take many forms. Loans, grants, production payments, tax credits or deductions, and tax exemptions all provide some type of financial assistance, and all can be effective under the right circumstances.¹⁴³ Loans and grants generally promote the development of an industry's infrastructure, research, and development. Tax incentives are generally more focused on promoting long-term production of a product.¹⁴⁴

Section 9007 of the 2008 Farm Bill is the sole policy provision which can arguably support the on-farm biofuel production. It features a host of grants and loan guarantees meant to assist individual farmers purchase and install the infrastructure necessary for the small scale production of biofuels. While this is a tremendous step in the right direction, especially when one considers the substantial amount of funding which has been congressionally mandated to support this program, it is unclear how much impact this provision will have in encouraging farmers to begin the production process.

The primary concern of each and every farmer, regardless of the size of the operation or the goods they produce, is profit. While there is little question that this section helps agriculturalists

overcome the initial barrier to beginning the on-farm fuel production process and the purchase of equipment, questions still remain. As § 9007 provides grants for the first 25% of project cost, each farmer becomes liable for the remainder.¹⁴⁵ This represents a substantial investment, and a correspondingly significant risk.

In order to minimize this risk and offer assurance to prospective producers as they seek to protect their investment, an additional incentive is necessary to ensure program participation. With constant variables facing farmers on a daily basis such as the fluctuation of commodity prices, the unpredictability of weather patterns and the increased potential for crop and livestock disease, each producer is faced with a modicum of uncertainty as they seek to expand their operation and diversify their product. Providing a consistent, tangible, and guaranteed financial incentive throughout the life of the project will offer the security necessary to both encourage and motivate agriculturalists who are considering this investment.

The effectiveness of incentives has already been proven with the ethanol experiment. Early economic studies have shown that biomass fuel refiners rely heavily on tax credits for profitability.¹⁴⁶ Indeed, the increase in ethanol from 175 million gallons in 1980 to 6.8 billion gallons in 2007 is largely credited to the federal incentive structure.¹⁴⁷ Government financial incentives for the production and use of ethanol have also been praised as a way to support the environment while decreasing national dependence on foreign oil.¹⁴⁸ While this paper has argued that these very financial incentives have fallen short of achieving significant gains in environmental health and energy security, a reformed biofuels policy featuring financial incentives, if done correctly, will be able to achieve these goals.

The next farm bill provides an excellent opportunity to incorporate legislation seeking to encourage the development of an on-farm biofuel industry. Because of the rapidly increasing

importance of biofuels, an energy title was added to the Farm Security and Rural Investment Act for the first time in 2002.¹⁴⁹ This title was continued and expanded in the 2008 edition.¹⁵⁰

Within this 2008 version, policy-makers made a conscious and explicit commitment to the future of biofuels by offering considerable incentives to those who have taken the time and effort to both produce and develop advanced biofuels. This commitment is substantial evidenced by § 15321's \$1.01 tax credit gallon of cellulosic ethanol produced.¹⁵¹ While it is impossible to measure the effect this provision has had on the development and production of cellulosic biofuels to date, this provision provides an incentive which was missing before the passage of this bill. It is difficult to speculate without empirical evidence which of the qualifying entities will in fact take advantage of this opportunity. This uncertainty stems from the recent passage of the bill and the very recent promulgation of regulations meant to implement this policy. Further, this uncertainty persists due to the uncertainty pertaining to the willingness or desire on the part of eligible entities to pursue this program.

Conversely, policy-makers can feel confident that farmers nationwide would take advantage of the opportunity to produce biofuels on the farm as long as financial risk is minimized and on-farm production makes economic sense. This is true for three reasons. First, farmers are stewards who care about the health of the environment if only because it increases their profitability.¹⁵² Generally speaking, agriculturalists are proud of their role as stewards of the land and will take steps to improve potentially harmful farming practices when profitability and viability is ensured.¹⁵³ Second, a strong and powerful market of biofuels produced on the farm exists. With few exceptions, each farmer employs fuel-consuming machinery in some capacity typically stemming from the need to cultivate and harvest crops, but more recently from fuel-powered mechanisms to process value-added goods, or simply provide heat and electricity for livestock.¹⁵⁴

Third, energy consumption represents a substantial investment for any farmer.¹⁵⁵ The ability to cut costs and diversify their production is an attractive concept to any business, and holds particular weight as smaller and larger operations alike struggle to remain viable.

This paper proposes that congress extend the \$1.01 per gallon income tax credit offered to producers of cellulosic ethanol to producers of on-farm biofuels. In the early stages of development, it is critical that assistance be substantial in order to provide protection for this significant investment and to encourage new entry into this field. The current credit is awarded to those who sell cellulosic fuel to another person for use in the creation of a biofuel mixture, to power their business or trade, or to who will simply sell the cellulosic ethanol at retail. A new section should be created which specifically pertains to eligible farmers who not only produce biofuels on the farm, but actually use this substance to power their operation.

In order to implement a successful policy, it is important not to adopt wholesale the restrictions applicable to § 15321, but rather create an entirely new set which pertain exclusively to on-farm biofuels production. The provision must be both technology and substance neutral. Instead of insisting on the production of cellulosic ethanol, this section must be amended to apply to the production of all advanced biofuels as currently defined. Because the vast majority of farmers rely on diesel fuel to power their operation, it is important biodiesel is included within this definition and its production incentivized. Technological neutrality is vital in order to encourage both innovation and creativity throughout the production process.

The primary goal is to promote a closed-loop process and is thus unnecessary to include the sale of biofuels produced on the farm as an incentivized exercise. Sales must be limited, especially at first, because the most environmentally and economically beneficial way to harness the advantages of biofuel use is to both eliminate fossil fuel consumption and to operate on a

small, less resource intensive production scale. Providing compensation to those farmers who sell biofuels on the open market will only encourage many of the harmful policies associated with the current production of corn-ethanol production. Removing this incentive will ensure that production occurs on an environmentally and socially responsible scale.

This new section must also include language which offers financial incentives for the production and installation of the somewhat costly equipment required to begin the production process. While § 9007 of the 2008 Farm Bill offers this opportunity, it is critical to expand funding. In the course of promoting this industry, the size of allowable grants in order to minimize start up costs must also increase.

Finally, in order to ensure prudent and efficient resource management, farmers wishing to take advantage of government sponsored financial incentives must meet a set of qualifications designed to maximize benefit and promote sound management. By establishing guidelines to measure the social, economic, and environmental benefit of each project, the managing agency will be able to prioritize projects while ensuring that funding recipients are equipped to manage their operation in a way that achieves many of the goals that a successful biofuel policy has the potential to achieve.

Prioritization schemes designed to achieve maximum project benefit are not without precedent. Perhaps the most salient, and arguably the most successful, example of this can be found in the Environmental Quality Incentives Program (EQIP). Authorized by the Food Security Act of 1985, EQIP was created in an effort to provide incentives for the implementation of farming and ranching practices that conserve and protect our natural resources.¹⁵⁶ This is a voluntary program which provides assistance to farmers and ranchers who face threats to the quality of soil, water, air, and related natural resources on their land. Reauthorized in the 2008

Farm Bill, the stated goal of this program is to promote agricultural production and environmental quality as compatible goals while optimizing environmental benefits.¹⁵⁷ To participate, each producer who wishes to enroll in the program enters into a contract with the local NRCS office for 5 to 10 years for any given conservation measure.¹⁵⁸

EQIP has been successful precisely because of sound resource management. EQIP priorities include the reduction of non-point source pollution such as nutrients, sediment, pesticides; reduction of groundwater contamination; conservation of ground and surface water resources; reduction in soil erosion and accompanying water sedimentation from agricultural land; and promotion of at-risk species habitat conservation.¹⁵⁹ Each potential participant must submit their proposal to the local NRCS office where it is evaluated against others submitted proposals throughout the region. The plans which best meets this list of priorities receives project financing.

Applying this framework to the proposed biofuels program would ensure necessary agency oversight in order to best manage funds. Because NRCS offices can be found in each region nationwide and the production of on-farm biofuels are consist with agency goals, a simple option would be to utilize this existing structure. By requiring that each producer enter into a contract for program participation, the agency will be able to ensure the long term viability of each project. Also, by promulgating a list of project requirements such as the size and type of the farming enterprise, the amount of fuel consumed as part of the operation, and the specifics of the project (proposed feedstock, processing methodology, etc.), the agency would be able to ensure that project resources are managed prudently. By implementing a sound program complete with government oversight and a mandate to maximize project benefits, encouraging and facilitating the production of on-farm biofuels could be viable policy choice.

In the face of any suggested policy reform, the primary question becomes one of economics: how can the government offer sufficient financing to beginning on-farm biofuels producers? The answer is not difficult. In order to successfully implement a wholesale biofuels policy reform, the government cannot simply create new incentives and innovative programs, but must simultaneously end those which have failed to yield expected impacts. As noted, current biofuels policy favoring corn-ethanol at the expense of more efficient, less costly options has fallen short of expected goals. In order to finance the creation of a viable on-farm biofuels industry, the government must eliminate the corn-ethanol policies which have produced these undesirable consequences and redirect these funds in support of a more sustainable approach.

While an assessment of the immense amount of financial support offered to the corn-ethanol industry is available elsewhere in this paper, two in particular are thought to be the most impactful: the blenders' tax credit (\$.51/gallon) and the ethanol import tariff (\$.54/gallon). Despite the fact that energy security, farm income support, and environmental GHG gains are important goals which the blenders credit was designed to help achieve, the most successful political argument available at the time of implementation centered upon the relative youth of the corn ethanol industry. In short, this credit was heavily supported and in the end justified as necessary to nurture an infant industry. The U.S. corn ethanol industry is no longer in an infant stage and the maturation of this industry is directly tied to huge profits made possible by a combination of subsidies and export restrictions.¹⁶⁰ Thus, the corn-ethanol industry no longer needs the same level of government support as it did in its nascent stages.

For this reason, it is essential to reduce the blenders' credit and once again allow free market policies to govern the use of corn-ethanol. The benefits are simply not worth the laundry list of negative consequences as experienced thus far. Furthermore, there is no reason to

continue down this path. As legislative incentives increase for the production of advanced biofuels in general, it is clear that congress is already moving in a new direction. By reducing this credit and diverting tax dollars to an industry which better protects the national interests and offers a greater opportunity to achieve the goals which have ostensibly catalyzed this expenditure in the first place, the United States can begin a sustainable biofuel program.

VII. Conclusion

The current incentives for large-scale corn ethanol have led the U.S. biofuel program down an unsustainable path by encouraging the large-scale production and expansion of corn-ethanol. As enumerated, corn-ethanol has caused a multitude of unintended negative environmental, social, and economic consequences both domestically and internationally. Moreover, it could be argued that corn-ethanol does not meet the ostensible goals of the biofuels program. First, its impact on GHG is questionable. Second, research has shown that even if all of the United States' crop land was producing corn, it would not be enough to meet the nation's transport fuels demands, thus begging the question as to why corn-ethanol is the primary beneficiary of the current policies. Finally, depending on fuel from crops in an era of climate change rather than fuel from the Middle East only trades one uncertainty for another in term of national energy security. These policies only commit the United States to an unsustainable biofuel program that overlooks both its own shortcomings and more efficient biofuel options. It is clear that the ethanol —and the policies that support it— must be re-considered.

A new biofuels policy must work to avoid, or at the very least mitigate, many of the harms, environmental and otherwise, associated with the current ethanol fuel industry. This includes promoting feedstocks which have a higher NEB and provide the greatest environmental

good. Finally, a new biofuels policy must work to reduce GHG emissions while providing a measure of national security by lessening national dependence on foreign oil.

This new policy should start on the farm. Incentivizing on-farm biofuel production and consumption can help farmers take advantage of biofuel potentials while reducing the externalities. Existing federal policies provide a useful starting point for implementing this new policy. Specifically, the Farm Bill offers many opportunities to expand second generation biofuel production. Also, while current federal incentives are misguided, such incentives would be necessary to catalyze on-farm biofuel production. With such reforms, biofuels could soon become a viable and beneficial aspect of a comprehensive national energy policy framework.

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