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I. Introduction

The 2005 Energy Policy Act mandated the use of 7.5 billion gallons of renewable fuels by the gasoline industry annually by the year 2015. The United States has already achieved this modest goal. As a result of recent successes with ethanol, the new Energy Independence and Security Act of 2007 (House Resolution 6) has increased the goal to 36 billion gallons of renewable fuels to be in use by 2022. The goal of the legislation is to move the United States toward energy independence; however, the feasibility of reaching it in the given time period is widely debated. As a result of the difficulty of measuring new and innovative environmental policies, few cost-benefit analyses have been performed on alternative fuels. This article presents the debate surrounding ethanol becoming the main commercial alternative fuel through a qualitative cost-benefit analysis so as to better evaluate new energy policies.

II. Background Information

The Energy Independence and Security Act of 2007 refers specifically to three types of ethanol as the predominant biofuels, or alternative fuels, that the United States must use to reach the goals set by the bill. Ethanol is made from starchy crops such as sugar, corn, and wheat and broken down to alcohol that can be used as a fuel source for vehicles or electricity. Conventional ethanol in the United States is made from corn. Corn is the most abundant and fertile crop in America and corn ethanol is currently the "only biofuel in serious quantity" (Montenegro). The Energy Policy Act of 2005 helped to push corn ethanol production forward, causing an increase of nearly a billion gallons. This push for more biofuel usage in the United States has contributed to the 60 percent increase in corn prices since last September, giving farmers a boost and providing congressmen in the Corn Belt an incentive to go green (Yacobucci CRS-4).

Unfortunately, environmentalists contend that corn-based ethanol is the least environmentally friendly of the main alternative fuels. Corn is an energy intense crop and requires a great deal of either natural gas or fossil fuels to break it down into ethanol. Further, because it is a row crop that requires a large amount of fertilizer and pesticides it is also one of the more environmentally destructive crops. As a result of the amount of energy needed to grow corn and break it down into ethanol, the end benefit to the environment is much less than sugar based or cellulosic biofuels (Yacobucci CRS-12). This controversy over corn led the House of Representatives to limit the amount of corn ethanol that can be utilized to reach the goals set by HR 6. Corn ethanol production will increase until 2016 at which point all further increases in ethanol production to meet the 2022 goal must be met with advanced biofuels such as cellulosic ethanol (HR 6).

Sugar ethanol is another common type of ethanol used globally. Sugar ethanol is not widely in production in the United States but is the main form of renewable fuel for Brazil, which produces it more cheaply and efficiently than the United States produces corn ethanol (Montenegro). There is currently a tariff on Brazilian ethanol to protect the domestic corn ethanol market. In general, producing ethanol from sugar cane is less expensive than producing it from corn because the production process requires fewer steps. Corn must first be broken down into a starchy sugar and then broken down again to make the alcohol for fuel. Unfortunately, sugar cane ethanol production in the United States is not economical. The United States does not have the proper growing conditions for large-scale sugar crops and creating them artificially would be very expensive.

In terms of ethanol production, Brazil has mastered the market. Brazilian use of sugar-based ethanol has replaced more than 40 percent of their gasoline consumption and was still on the rise as of mid-2006 (Reel). Brazil has the right to claim reaching "energy independence" from their ethanol development (Reel). It is crucial to note, however, that "most of these policies were developed over decades, and mistakes were made," in the process that helped Brazil arrive at the efficiency it has achieved today (Hester 13). The United States can learn from some of Brazil's mistakes, but the most important lesson is that moving from an all-gasoline society to one that incorporates ethanol is a slow process that requires government support. Brazil began its process in the 1970s with subsidies and financial aid to its ethanol market and has only decreased these incentives in recent years now that the market has become strong on its own. Furthermore, now that it has attained energy independence, moving forward is an even slower process that will require detailed research into the positive and negative consequences of high levels of ethanol use (Hester 17).

The final type of ethanol addressed in the Energy Independence and Security Act of 2007 is cellulosic ethanol. Cellulosic ethanol is made from the cell walls of starchy plants that store high levels of energy and can be broken down into ethyl alcohol. The plants used in the production of cellulosic ethanol are referred to as biomass. Biomasses that can be used for the production of cellulosic ethanol in the United States include switchgrass, poplar, willow, wood pulp, corn stock, among others (USDA). All forms of ethanol discussed yield approximately two-thirds the energy of gasoline, but cellulosic ethanol is three times more environmentally efficient (EIA), meaning it and other alternative energies do not harm the environment. There are many new alternative fuels, such as corn ethanol and liquid coal, whose production have serious negative impacts on the environment. Producing cellulosic biomass, however, does not require the fertilizer and pesticides that corn needs. As discussed later in this article, the costs of these chemicals to the environment are substantial. Cellulosic ethanol in its final form is chemically the same as conventional ethanol, but is made through a three-step process from biomass. Experts in the biofuels field are now beginning to point to cellulosic ethanol in increasing numbers as the answer to fulfilling America's alternative fuel needs. Cellulosic ethanol, unlike corn ethanol, will not directly take away from the food market and is overall much more environmentally efficient. The new House Resolution 6 will require at least 16 billion gallons of the mandated 36 billion gallons to come from cellulosic biomass.

III. Literature Review

Today's ethanol development is distinct from similar markets of the past. Cascone notes that "globally, biofuels developments are primarily driven by three fundamental policy considerations: rural development, energy independence, and a reduced carbon footprint" (95). The reduction of the carbon footprint is an unusual motivation for such large and broad policies globally and generally stems from the moral argument that societies must do something to combat global warming. Traditionally, changes that occur at a global level have related to political or territorial integrity and not to managing an economic 'bad.' Nevertheless, the push to reduce the carbon footprint of the United States, the world's greatest polluter, is increasing (UNDP). Additionally, a very distinct aspect of the ethanol market is that "demand for biofuels is not driven by customers or economics, but by social and political issues" (Cascone 95). Cascone's arguments are critical to remember when considering the costs of this new market in the cost-benefit analysis section that follows. When bringing together various sectors of society to create a new market forcibly, there will be significant costs in the early stages of market creation.

Currently in this line of research, Hahn and Cecot perform a cost-benefit analysis on ethanol use in America. They conclude in their research that, "the costs of increased production are likely to exceed the benefits by about three billion dollars annually" (2). Their paper provides an extensive quantitative review of the costs of ethanol production at an increasing rate from 4 billion gallons per year to 7 billion gallons per year (Hahn and Cecot 10). While there are serious costs there are also significant environmental benefits to the production and use of ethanol, such as lower emissions. The paper discusses the issues behind ethanol production in the United States, focusing mainly on corn ethanol while generalizing for ethanol across the board as well as comparing the production of corn ethanol in the United States to sugar ethanol in Brazil. Overall, the analysis is positive, but each type of ethanol is distinct and therefore cannot be generalized in this manner. This is the most common mistake people make when discussing ethanol, especially in America where ethanol is commonly thought of only in terms of corn ethanol—the least efficient biofuel. Even within corn ethanol production, the costs can vary depending on the energy source used to break down the corn into alcohol. While a good cost-benefit analysis must generalize across these variables it is important to address the nuances of the costs.

Even with all of the recent ethanol legislation and success stories from Brazil, the article by Hahn and Cecot concludes that further support for ethanol is not a certainty in the future (16). The costs, including subsidies for farmers, are too high when the benefits of corn ethanol are not monetarily or environmentally substantial after accounting for these production costs. In addition to production costs and subsidies, there are the costs of the ethanol tax credits in America. Tax credits and subsidies for corn ethanol cost U.S. tax payers $2.47 billion annually. Furthermore, the tariffs that are in place against sugar ethanol from Brazil, in addition to the recent mandates declared by the administration, artificially keep prices higher (de Gorter and Just 12). Economics tells us that "this is because imports decline with a tariff, requiring an increase in domestic supply to fulfill the mandate" (de Gorter and Just 12). As a result, the prices of both ethanol and corn rise in America. Thus, from a market perspective, decreasing ethanol's price would increase its demand and ability to compete with gasoline. However, increasing competition would also decrease corn prices which would harm farmers.

Overall, the demand for ethanol as a fuel additive is increasing and will continue to increase with coming years and increasing oil prices. The mandate for alternative fuels also increases the need to expand ethanol markets domestically. Hester concludes that the most efficient way to combat the increasing demand for ethanol is to integrate the ethanol market in the hemisphere by opening the American market to Brazilian sugar ethanol (WP10 2). Brazil does not have enough ethanol to export to American markets that could put corn ethanol or even the birth of cellulosic ethanol out of business. Thus, importing Brazilian ethanol will result in only positive consequences for the U.S. market by bringing the United States closer to oil independence but not to energy independence. Hester concludes that in addition to market integration, a successful ethanol market in the U.S. will also depend on technological improvements, which will include cellulosic ethanol (WP10 22). Hester's arguments are compelling and supported by this article's conclusions, as well as those of many experts in the field.

In another paper, Hester states that there is a "consensus among all stakeholders…

that priority must be given to the development of cellulosic ethanol" in order to address a growing need for both energy security and a solution to the alternative fuel mandate (TP1 6). This concept is essential in the analysis of the costs and benefits of ethanol; moving forward with new cellulosic technology will be challenging and costly but, once established, will be the most environmentally friendly and cost efficient fuel over time. Cellulosic ethanol does not affect the production of food like corn ethanol does. For example, feedstock demand for corn has increased the demand for corn for ethanol production, "from 14% of U.S. total corn production in 2005 to almost 20% in 2006" causing food shortages in the third world (Hester TP1 8). Etter from the *New York Times* adds that "opponents of ethanol also have hammered on an Agriculture Department projection that by 2010, less than 8% of the U.S. gasoline supply will come from corn-based ethanol - and 30% of the corn crop will be used to make it." This further demonstrates the need for the United States to develop cellulosic ethanol.

III. Cost-Benefit Analysis

It is important to note that cost-benefit analyses have their own pros and cons, especially in the field of environmental politics. Kraft and Vig state that "the basic premise underlying benefit-cost analysis is that the purpose of economic activity is to increase the well-being of the individuals who make up society" (194). Goodstein maintains that one of the advantages of cost-benefit analyses is that it limits the amount of political manipulation that can occur. Typically, while the numbers may tell the real story, they can also be manipulated to suit political purposes; however, cost-benefit analyses are not as easily influenced by politicians or interest groups (Goodstein 201). Ethanol production and energy policy is a partisan issue and by relying on data from cost benefit analysis, political influence is held at a minimum. Kraft and Vig note, however, that "the temporal separation of costs and benefits creates perverse incentives to defer needed policy responses" (307). Nevertheless, Goodstein states that "at its best, a benefit-cost study will clarify the decision-making process" (190). Keohane and Olmstead make four very important points about cost-benefit analyses for environmental policy:

> First, basing decisions simply on whether benefits outweigh costs omits important political and moral considerations….Second, discounting benefits that will occur in the distant future privileges current generations….Third, goods such as clean air…are devalued and cheapened when their worth is expressed in monetary terms. Finally, focusing on the net benefits to society as a whole ignores the identities of the winners and the losers… (45).

For these reasons cost-benefit analysis is predominantly conceptual and attempts to account for moral and ethical costs as well as externalities in order to provide a more accurate picture of the "true" costs and benefits of ethanol.

Another important feature of the following cost-benefit analysis is that much of this technology is in uncharted waters; there is very little past cost data measuring the effects of ethanol usage. Cellulosic ethanol has yet to hit the mainstream market or to be produced at a large-scale production plant for consumer purposes, and consequently has very little readily available cost data. The costs and benefits discussed below, therefore, are largely taken from data produced by experts from field experiments and is largely quantitative and not from consumer statistics.

Benefits

Currently, ethanol in America is produces primarily from corn sources. As such, most of the hard facts regarding the benefits of ethanol production are in regard to conventional corn ethanol. The benefits of corn ethanol are limited because of the large amounts of fertilizer necessary; however, corn ethanol may bring some positive consequences. First, as mentioned above, ethanol has brought increased wages and employment to most states in the Corn Belt, according to a recent economic analysis (Blanco and Isenhouer). The data shows statistically significant evidence that the promises of enhanced employment and wages made by the ethanol industry have proven true, yet the economic impact from corn ethanol has been minimal (Blanco and Isenhouer). Ethanol Across America, for example, is a grassroots non-profit organization that pushes the use of ethanol in America maintaining that there is a great deal economically that ethanol production can do for Americans at both the state and local levels in the form of increased wages, jobs, and economic stimulation. These sentiments are largely echoed by politicians in these Corn Belt states as justification for continuing growth of corn ethanol.

Ethanol production also brings industry to America when industries are leaving the United States for China. Iowa reports an increase of $82.4 million in wages in 2005 alone (Ethanol Across America 6). While production is predominantly limited to the Corn Belt currently, the expansion of ethanol production and the rise of cellulosic ethanol will bring the industry to many regions in the United States. Currently, there are ethanol plants in states across the United States. There is a heavy concentration in the Corn Belt but ethanol has now managed to reach as far as the Southwest and the Southeast, in states such as California, Arizona, and Georgia. Additionally, the ethanol industry consumes a great deal of supplies and ingredients from other producers in the region of an ethanol plant. Ethanol Across America notes that the ethanol industry in Iowa has purchased more than $161.6 million in ingredients from local businesses (6). Local and state governments do and will continue to receive tax money from these businesses. Therefore, in order to account for this, the monetary benefits of each ethanol plant will have to be calculated. The average amount of jobs provided and taxes paid will be multiplied by the number of plants for this year and the predicted number of plants for future years. These are solid measurable monetary benefits of ethanol production.

It is not only the production process that has proven beneficial to local communities, however. Corn prices in these Corn Belt states have increased from $1.86 per bushel in 2005 to over $4 per bushel in 2007, bolstering the earnings of small farmers of corn (Hargreaves). Despite the subsidies to farming, small farms are still are not very profitable, and the ever-increasing corn prices are a blessing to the small farmer. Nonetheless, there are many mega-farms that also benefit extensively from rising corn prices. Most importantly, though, increasing corn prices have created a market for ethanol. Ethanol as a market is largely generated by legislation mandating its use and is not the result of demand for the product. With high corn prices, however, ethanol has found its market and is here to stay with the mandate and the new trend to "go green" as well as the desire of farmers to increase supply. It has opened the door to ethanol production and consumption as an alternative fuel to gasoline. This fact has huge consequences for the future of cellulosic ethanol and even other alternative fuels. Corn ethanol has succeeded in bringing alternative energy to the average consumer and opening the debate on alternative fuels wide open; America is going green by going yellow.

The future of ethanol now rests on the successes or failures of cellulosic ethanol since cellulosic ethanol is where the benefits of biofuels finally begin to outnumber the costs. The first major benefit of cellulosic ethanol is emissions reduction. While ethanol is only two thirds as efficient in producing energy as standard gasoline, meaning more fill-ups at the station, Yacobucci states that with advancing technology the "use of cellulose-based E10 could reduce fossil energy consumption per mile by 8%, while cellulose-based E85 could reduce fossil energy consumption by roughly 70%" (CRS-16). In general, one of the benefits of cellulosic ethanol is that it not only burns more cleanly but it also "obviates the need for a widely used gas additive…that helps car engines run more smoothly and pollute less" (Knauer 76).

As mentioned above, assigning a monetary value to environmental benefits from corn ethanol is a difficult task and can only be truly quantified by measuring a decrease in emissions and oil purchases resulting from increased ethanol production. Yet, cellulosic ethanol brings greater benefits to the environment than corn and even Brazilian sugar ethanol. Cellulosic ethanol can be made using plant waste products such as woodchips from logging and corn stalk from harvested corn. Cellulosic biomass such as switchgrass can be grown on lands that are not being used to produce anything currently, and are very minimally destructive for the land on which it is grown (USDA). Finally, carbon emissions will decrease substantially with the use of ethanol in general. A great portion of the monetary benefits of cellulosic ethanol will have to be formed through future price predictions and emissions benefits which may result in a larger margin of error.

Qualitatively, however, the benefits of cellulosic ethanol are considerable. Cellulosic ethanol will allow new marginal lands, including non-arable land, to be used for biomass production. This will open up new markets in different regions of the United States to profit from ethanol production. Cellulosic ethanol will also not decrease food production. According to the USDA at congressional hearings on ethanol in the summer of 2007, the United States has limited capacity to increase corn ethanol production much further than it already has, leaving the door open for cellulosic ethanol to meet America's alternative energy needs.

Additionally, cellulose expert, Dr. Lee Lynd, claims that cellulose, "offers game-changing environmental benefits, manageable technology, and no showstoppers if we have the will to develop it" (Weeks). The 2007 Farm Bill claims that cellulosic energy will "create economic opportunities for many farmers in diverse geographic regions across the United States" (USDA). Like corn ethanol, cellulosic ethanol will provide jobs and income to the regions that can produce or refine the ethanol. Unlike corn, however, cellulosic ethanol is not restricted to the Corn Belt and therefore may open up new markets in regions all across the United States, benefiting a wider group of people. From an equity-of-distribution standpoint, cellulosic ethanol will help level the playing field for people all across the United States who would like to benefit from this new technology.

Costs

It is clear that costs are not the same across the board; all ethanol is not made alike. In deed, corn is more costly than cellulose, but cost also depends on the fuel used to produce the ethanol as well. There are some corn ethanol producers that want to use coal instead of natural gas or other clean fuels to power their production in order to lower costs (Little). In coal states such as Kentucky, there is an even greater incentive to use coal and fuel local industry, rather than using cleaner fuels to result in a more environmentally friendly ethanol. Norris argues that "critics have long argued that traditional ethanol production consumes nearly as much fossil fuel energy as it saves, once all the energy costs of growing and processing corn are factored in," along with production energy costs. In contrast, other ethanol plants, such as the Panda Group, use local manure to fuel their production centers. The number of production centers using manure to fuel production is increasing and is becoming especially popular with smaller ethanol plants. By extracting the methane in cow manure the plant cleans up the air in two ways: first by producing cleaner ethanol rather than traditional carbon emitting fuels, and secondly by reducing the amount of methane which normally pollutes the air naturally from livestock manure.

There are more than just monetary costs included in this analysis. Those costs that can be quantified include the costs associated with increased infrastructure, subsidies, and production of the ethanol. The production costs include the land use necessary to produce the biomass for cellulosic ethanol, the fertilizer and pesticides that will also have to go into producing a new crop and, finally, manpower. The cost to those working in production of food at this stage in the analysis is unquantifiable, as it is largely unknown how much land will be moved from use for food production to cellulose production.

Infrastructure costs will also play a pivotal role in calculating the costs to the consumer and taxpayer. Moving forward with ethanol on a large scale will require an overhaul of the infrastructure necessary to transport and pump the new fuel. Ethanol is corrosive and can decay untreated joints and "tends to clean the internal surfaces, making them more susceptible to corrosion from water inside" (API). These issues can possibly be corrected by coating and treating the pipeline but may also require new infrastructure as a whole. In federal Congressional hearings on alternative energy, infrastructure is frequently referred to as the third stool leg. Ethanol, infrastructure, and vehicles together are known as the three stool legs; if any of these three portions are missing then the market will not stand on its own. Therefore, flex-fuel vehicles capable of running on ethanol and the infrastructure required to operate and maintain them must hit the market at the same time in order for the market to succeed.

The other leg of the stool analogy is the automobile industry. Currently all vehicles are capable of running on an E10 or E15 mix of ethanol and gasoline. This means that 10 percent or 15 percent of the fuel running the vehicle is made from ethanol and the remainder is regular gasoline. Currently, just under half of the gasoline in the United States is blended at the E10 rate (American Coalition for Ethanol). A cleaner fuel, however, is E85, the other common ethanol-gasoline blend for vehicles. This blend can only be used in automobiles that are designed as flex-fuel vehicles capable of running on high levels of ethanol. According to the Honorable David McCurdy, President of the Alliance of Automobile Manufacturers, changing a fleet of vehicles over to be capable of running off of E85 will be costly and time-consuming (Alliance of Automobile Manufacturers). It is entirely possible to change a fleet of cars and it is clear that this trend has started. Nonetheless, with Detroit suffering from their inability to compete with foreign cars and an economic recession looming in coming months, this change to accommodate new fuels and higher fuel economy standards will be costly and met with resistance. Others, however, such as Kurtzman of the Milken Institute, contend that the cost of making cars ethanol compatible is as easy as changing one relatively inexpensive part.

Other main costs will be production costs which will vary between corn and cellulosic. The costs of fertilizer and pesticides will have to be accounted for and are significantly higher for corn ethanol than they will be for cellulosic ethanol. Corn ethanol is very hard on the land and intensive in both fertilizer and pesticide use, which will increase costs dramatically, both financially and in terms of the emissions efficiency of the end product. Additionally, some land used for the production of other crops or land that was out of production will likely be shifted to corn production or even cellulosic biomass production in the future; these opportunity costs must be accounted for.

Additionally, there are costs to ethanol that are a direct result of the increasing corn production in the Midwest. The legislative mandate for ethanol usage and production has increased not only corn prices but corn production in the Midwest. Increased corn production in the Midwest however has not resulted in increased food production. Indeed, despite increases in production there are still decreases in overall output of corn for food because over 30% of the corn yield annually goes toward ethanol production (Etter). America is the world's largest supplier of corn and, as such, the increasing use of corn as ethanol has caused a decrease of corn-based food products on the global market (Runge and Senauer). This has resulted in less food being transported to the already starving nations in the third world, thereby generating a great deal of controversy over American ethanol production. In fact, prices on food using corn or high fructose corn syrup have increased in price over the last few years. Meat prices are also on the rise as the corn produced in the Midwest provides feed for cattle (both beef and dairy), pigs, and chickens.

Another far-removed cost of increased corn production for ethanol is the long-term environmental effect of the crop itself. The increase of corn production at the cost of other crops has limited crop rotation which results in soil erosion. This is not only bad for future crop yields but also results in greater run-off. Corn fertilizers and pesticides result in an excess of nitrogen that leaks into the ground water or runs off into streams and rivers and eventually joins up with the Mississippi River that drains into the Gulf of Mexico. The nitrogen from the corn production in the Corn Belt has now resulted in oxygen deprivation in the waters off of Louisiana and Texas (USGS). This condition is known as hypoxia and has resulted in decreasing fish populations and loss of plant life in this area (USGS). This condition is very serious for affected ecosystems and will continue to worsen as corn yields and production increase. While these costs seem far-removed from the actual cost of ethanol production, they are in fact a direct result of increased corn production for ethanol. Costs such as these are often not factored into cost-benefit analyses on ethanol production but are typically used by critics as proof that corn ethanol does not necessarily have a positive effect on the environment.

Finally, another cost of ethanol is the tax credits for corn ethanol that work as a subsidy for ethanol producers. These tax credits cost the government revenue that it would otherwise collect in taxes from producers. The Congressional Research Service reports the tax credits on ethanol to be 51 cents per gallon. According to the report, "this incentive allows ethanol - which has historically been more expensive than conventional gasoline - to compete with gasoline and other blending components" (Yacobucci PP 2). These tax incentives, as well as the additional credits and exemptions given to ethanol, will be a large portion of the costs to the American taxpayer. Unfortunately, the government is currently also taxing ethanol. There is a 19 cent per gallon tax on ethanol blended gasoline at the pump (Gas Taxes Links). This policy keeps ethanol from being competitive on the market. The best policy for the American government to pursue at this stage would be to decrease the tax on ethanol blended gasoline in order to make ethanol more competitive with non-blended gasoline on the market.

IV. Policy Implications

The first policy implication, mentioned above, involves the fact that an ethanol tax makes the fuel, even when blended with gasoline, more costly to consumers. In addition to this tax is the tariff on Brazilian ethanol which is reducing potential supply of this greener fuel; dropping the tariff on imported sugar ethanol from Brazil will likely be necessary to meet future legislative goals. By fixing the stiff U.S. fiscal policy relating to subsidies, taxes, and tariffs on ethanol to allow a more free-market approach would certainly have long-term benefits for the ethanol market. However, it is important to note that in order to make this industry viable in the short term the subsidies must remain a cost to tax payers and be lessened gradually over time as ethanol becomes more stable on the market.

Another major implication of the findings of this analysis is that ethanol production is not financially beneficial for America in the short term. While it is hard to calculate ethanol's actual benefit to the environment, a predominant corn ethanol industry does not create benefits that outweigh the costs. The greatest benefits are seen in the rural corn farming communities and in the regions where ethanol plants are being built and will be built in the future. Assuming that Hahn and Cecot are wrong about the future support for biofuels, this analysis clearly shows that a shift away from increasing corn ethanol toward cellulosic is in the best interest of the United States. Cellulosic ethanol will provide a wider variety of benefits to a greater amount of people in the United States. However, we may only begin to see these benefits by the year 2020. Again, it is important to observe the slow, methodical Brazilian timeline and keep in mind that these momentous technological advances do not occur overnight. Not only that, the automobile industry and infrastructure must also keep pace with these developments for ethanol to be of any help.

There are also clear benefits in terms of energy dependence and national security. Increasing the use of ethanol will help the United States decrease its dependency on the Middle East for oil. The Energy Independence and Security Act of 2007 assures a future for biofuels at least until the year 2022 for the purposes of energy independence and to help stop global warming. At that point, however, if ethanol has failed to create its own market it is likely that critics will point to the failures of ethanol as inherent and the alternative energy movement may suffer a large blow. This fact has one very important implication on public policy: ethanol plays a tangible and innovative role in the alternative energy movement. As an alternative energy, ethanol is one of the first sources that has the potential to have a huge effect on United States transportation. The potential for large-scale, cost-effective production of ethanol exists, and as the quantity of ethanol on the market increases it becomes the symbol of new alternative energy and green fuels. As a result, critics maintain that if the industry fails to meet the goals set by the legislature or if ethanol remains too costly there may be grave consequences for the entire green fuel movement. Whether or not this would prove true is debatable; however, this concept proposed by critics of the green movement indicates that they would feel a sense of empowerment if ethanol did fail to reach its legislative mandates.

It is crucial to conclude from this analysis that, no matter what the benefits are of producing one particular type of ethanol, in order to meet America's growing demand given the supply of corn, a combination approach may be necessary. Cellulosic ethanol is only one part of a larger puzzle. Solving the energy question in America will necessitate many types of alternative energy used in conjunction with one another. Overall, adoption of biofuels as a larger part of U.S. transportation fuel seems inevitable, and until fuel cells reach the mainstream market ethanol is the only viable alternative fuel that is available.

My own conclusion from this research is that like coal, corn ethanol is an inevitable force in America's green movement. In America, both of these energy sources are abundant. The coal industry, as well as farm unions, will not allow Washington to neglect the needs of their industry. Instead of constantly battling with these energy giants, we should make this growing energy source as environmentally friendly as possible while at the same time making its production economically viable. A large portion of the United States has not adopted the need to save the environment as their mantra but instead look at alternative energy strictly from the perspective of national security. In order to meet this group in the middle environmentalists will have to search for new ways to improve corn ethanol production and commercialize the cellulosic ethanol market.

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