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16. Abstract

As the United States imports more than half of its oil and overall consumption continues to climb, the 1992 Energy Policy Act established the goal of having “alternative fuels” replace at least ten percent of petroleum fuels used in the transportation sector by 2000, and at least thirty percent by 2010. Currently, alternative fuels consumed in Alternative Fuel Vehicle (AFVs) account for less than one percent of total consumption of gasoline. This paper examines how alternative fuel E85 can be used to reverse that trend. In addition, this research paper will take a look at some of the ongoing government decisions concerning the use of the alternative fuel E85, and will discuss what policy makers might hold for the future in terms of the supply and demand of alternative fuels in the United States. This case study will be useful to all stakeholders involved in the transportation industry, including, but not limited to the government, policy makers, automakers, motorists, and researchers, eager to find a just balance with both a better transportation system and a healthy and clean environment.

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AN ALTERNATIVE TRANSPORTATION FUELS UPDATE: A CASE STUDY OF THE DEVELOPING E85 INDUSTRY

by

Sharon Lewis
Research Associate
Texas Southern University

Papa S. Travare
Graduate Research Assistant
Texas Southern University

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TEXAS SOUTHERN UNIVERSITY
3100 Cleburne
Houston, TX 77004

ABSTRACT

As the United States imports more than half of its oil and overall consumption continues to climb, the 1992 Energy Policy Act established the goal of having "alternative fuels" replace at least ten percent of petroleum fuels used in the transportation sector by 2000, and at least thirty percent by 2010. Currently, alternative fuels consumed in Alternative Fuel Vehicle (AFVs) account for less than one percent of total consumption of gasoline. This paper examines how alternative fuel E85 can be used to reverse that trend. In addition, this research paper will take a look at some of the ongoing government decisions concerning the use of the alternative fuel E85, and will discuss what policy makers might hold for the future in terms of the supply and demand of alternative fuels in the United States. This case study will be useful to all stakeholders involved in the transportation industry, including, but not limited to the government, policy makers, automakers, motorists, and researchers, eager to find a just balance with both a better transportation system and a healthy and clean environment.

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EXECUTIVE SUMMARY

Alternative fuels, including E85, play a key role in policy discussions about energy, agriculture, taxes, and the environment. In the United States, ethanol is made from corn but, is made from sugar cane in other countries. E85 is a blend of 85 percent ethanol and just 15 percent gasoline. E85 is an alternative fuel as defined by the Department of Energy (DOE). As transportation is vital to the economic growth of any nation, recent bumps in oil and gasoline prices have led to increased interest in finding alternatives to petroleum for the transportation sector.

With the United States importing more than half of its oil and overall consumption continuing to climb, policy makers are supporting the production and use of ethanol through tax credits and other financial incentives in order to reduce the United States dependence on foreign oil. Furthermore, the 2005 Energy Policy Act (P.L. 109-56) established a renewable fuel standard (RFS). However, the production and use of ethanol has its pros and cons. Supporters of ethanol argue that its use can help lower emissions of toxic and ozone-forming pollutants, and greenhouse gases, especially if a higher-level blend is used. For example, E85 is known to help reduce carbon dioxide (CO_2), a harmful greenhouse gas and a major contributor to global warming. They further argue that ethanol use can reduce petroleum imports, thus promoting energy security. Ethanol's detractors argue that various government policies and incentives used to support ethanol distort the market and lead to corporate welfare for corn growers and ethanol producers. As transportation is the second largest source of pollution, the United States has a key challenge in having all stakeholders work together in developing a sustainable market for E85 ethanol that would improve the economic and environmental picture of the United States.

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CHAPTER 1

INTRODUCTION OF THIS PROJECT

Background of Research

The term "alternative fuel" refers to methanol, denatured ethanol, and other alcohol mixtures containing 85 percent or more (or such other percentage, but not less than 70 percent, as defined by the Secretary, by rule, to provide for requirements relating to cold start, safety, or vehicle functions) by volume of: 1) methanol, denatured ethanol, and other alcohols with gasoline or other fuels; 2) natural gas, including liquid fuels domestically produced from natural gas; 3) liquefied petroleum gas; 4) hydrogen; 5) coal-derived liquid fuels; 6) fuels (other than alcohol) derived from biological materials; 7) electricity (including electricity from solar energy); and 8) any other fuel the Secretary determines, by rule, is substantially not petroleum and would yield substantial energy security benefits and substantial environmental benefits."As defined by the DOE Energy Policy Act of 1992 by then Secretary James D. Watkins, E85 is an alternative fuel, which is a blend of 85 percent ethanol and just 15 percent gasoline.

Generally, alternative fuels are environmentally preferable to petroleum based fuels such as diesel and gasoline with regards to emittants. Use of alternative fuels can contribute to a cleaner environment, reduce pollution, and lessen reliance on foreign oil. Alternative fuels can also be produced domestically by using USA resources and thus help strengthen the country's economy. The 1992 Energy policy Act established the goal of having "alternative fuels replace at least ten percent of petroleum fuels used in transportation by 2000, and at least thirty percent by 2010" (U.S. General Accounting Office, 2002). Currently, alternative fuels, consumed in Alternative Fuel Vehicles (AFVs), account for less than one percent of total consumption of gasoline. In addition, the United States imports more than half of its oil and overall consumption continues to increase. By supporting ethanol production and use, the government, along with policy makers, hopes to reverse that trend by offering tax and financial incentives to automakers. Tests have shown that E85 can reduce carbon dioxide (CO_2), a harmful greenhouse gas and a major contributor to global warming. Although there are some literature reviews on alternative fuels, there is a lack of a comprehensive research on how the U.S. government, policy makers, and stakeholders would work together to enact future policies and regulation for the supply and

demand of alternative oil in the United States. This paper will take a look at current and future government resolutions concerning the development of E85.

Research Objectives

This paper will focus on the following key objectives:

- Identify and study government initiatives concerning the production and use of Alternative Fuels in the United States.
- Identify and analyze key trends and key challenges facing the development of ethanol, including E85 in the United States.
- Discuss how all stakeholders, including, but not limited to the U.S. government, the policy makers, the auto makers, and motorists can work together to develop the production and use of renewable fuel for the economic and environmental benefits of the United States.

Report Outline

This report is organized in the following order:

Chapter 1	Introduction
Chapter2	Literature review of the production and use of alternative fuels with legislative opinions, public opinions, and the Pros and Cons for the use of E85
Chapter 3	Analysis of the E85 automobile development plan and discussion of the challenges to the growth of E85 vehicles
Chapter 4	Focus on the current government initiatives and policies
Chapter 5	Identify the new E85 refiners
Chapter 6	Case study of selected E85 refiners
Chapter 7	Conclusion and recommendations

CHAPTER 2

LITERATURE REVIEW

"The term *alternative fuel* means methanol, denatured ethanol, and other alcohols; mixtures containing 85 percent or more (or such other percentage, but not less than 70 percent, as determined by the secretary, by rule, to provide for requirements relating to cold start, safety, or vehicle functions) by volume of 1) methanol, denatured ethanol, and other alcohols with gasoline or other fuels; 2)natural gas, included liquid fuels domestically produced from natural gas; 3) liquefied petroleum gas; 4) hydrogen; 5) coal- derived liquid fuels; 6) fuels (other than alcohol) derived from biological materials; 7) electricity (including electricity from solar energy); 8) any other fuel the Secretary determines, by rule, is substantially not petroleum and would yield substantial energy security benefits and substantial environmental benefits" (United States Code Annotated, 2005). These fuels generally are environmentally preferable to petroleum based fuels such as gasoline and diesel fuel. Use of alternative fuels can contribute to a cleaner environment, reduce pollution, and allow less reliance on foreign oil (DEH Ethanol Standard Report, 2004). Use of alternative fuels will also contribute to the stability of rural farm economy by creating commercial markets for crops such as soybeans - a feedstock for biodiesel, and corn - a feedstock for ethanol (U.S. DOE Energy Efficiency and Renewable Energy).

The 1991 Energy Policy Act established the goal of having "alternative fuels replace at least ten percent of petroleum fuels used in transportation by 2000, and at least thirty percent…by 2000" (US General Accounting Office, 2002). Currently, alternative fuels consumed in Alternative Fueled Vehicles (AFV's) substitute for less than one percent of total consumption of gasoline.

Alternative fuel vehicles and their fuels face two central problems. Primarily, they typically suffer from several marketplace disadvantages compared to conventional vehicles running on conventional fuels. Hence, they inevitably require government incentives or mandates to succeed. Secondly, they typically do not provide cost-effective solutions to major energy and environmental problems, which undermine the policy case for having the government intervene in the market to support them (Romm, 2005).

Lawmakers often use tax and other financial incentives to spur the development of socially valuable industries (Gielecki, Mark, et al., 2001). Lawmakers hope that such incentives will help the target industries gain market shares and eventually become viable competitors in

their relevant markets, at which point the incentives will be able to sunset (Gielecki, Mark, et al., 2001). If the incentives are successfully implemented the industry is then, subject to taxation, the government may be able to recoup its investment (Gielecki, Mark, et al., 2001). However, creating incentives that allow an industry to gain strength and flourish on its own is not a simple task.

The United States and the European Union (EU) have used various incentives to promote the biofuels' industry for decades. Government financial incentives for the production and use of ethanol and biodiesel have been praised as a way to support the environment and decrease dependence on foreign oil, however, critics of biofuel incentives point out that biofuels have not always delivered on their proponents' environmental and political promises (Eric, 1980).

The United States began financially supporting the biofuel industry with tax incentives in 1978 when the Energy Tax Act was signed by President Carter. That act exempted alcohol fuels such as methanol and ethanol from the $.04/gallon excise tax on petroleum fuel (American Jobs Creation Act, 2004). Since then, a producer's credit and substantial changes in the structure of biofuel excise tax incentives have been introduced (Gielecki, Mark, et al., 2001).

USDA has established a preference policy for the use of fuels such as ethanol and biodiesel which are made from renewable agricultural products. Greater use of ethanol as a fuel has many important benefits. It could reduce American dependence on imported oil which would lower America's annual deficit and increase national security (Jennings, 2005). Domestic refineries of ethanol would create highly skilled jobs and provide a substantial boost to the economy (Steil, 2005). Ethanol use can also improve public health and protect the environment (Ethanol fact Book, 2003).

Ethanol, also known as ethyl alcohol, is an organic chemical compound composed of oxygen, carbon, and hydrogen (DEH Ethanol Standard Report, 2004). Ethanol is made from plants that contain sugar.[7] In Brazil, ethanol is made from sugarcane. In the U.S., ethanol is primarily made from corn in a process called dry grinding. Ethanol can also be made from ethylene by the direct reaction of extremely pure water and ethylene gas which is called synthetic ethanol (DEH Ethanol Standard Report, 2004). Advanced Bioethanol Technology allows fuel ethanol to also be made from cellulosic (plant fiber) biomass, such as agricultural forestry residues, industrial waste, material in municipal solid waste, and trees and grasses (US DOE). E-85 ethanol is used in engines modified to accept higher concentrations of ethanol. Such flexible-

fuel engines are deigned to run on any mixture of gasoline or ethanol with up to 85% by volume (DEH Ethanol Standard Report, 2004). There are about five million "flexible fuel" vehicles on U.S. roads that can handle E85; there are only 1,145 public stations that offer the fuel nationwide, according to the National Ethanol Vehicle Coalition. Meanwhile, domestic automakers have promised to double their production of flexible-fuel vehicles by 2010.

Environmentally, ethanol's use in blended automotive fuel reduces both carbon monoxide and carbon dioxide emissions by nearly thirty percent (Pacific Ethanol Inc.). It reduces noxious fumes associated with gasoline burning and lowers the amount of particulate matter released into the atmosphere (Ethanol Facts). Ethanol has a large role in reducing the pollution caused by fossil fuel use. Ethanol production can also reduce another environmental concern-animal waste. In Hereford, Texas, the 6,300 tons of animal waste created daily by cattle cause serious environmental problems (Levine, 2006). A new ethanol plant has agreed to burn that waste in order to power its processing plant (Esfahani, 2006). The plant waste from the corn used to make ethanol is suited for cattle feed (Levine, 2006). This new ethanol plant will actually provide feed for the cattle, and in turn use the waste of these cattle to power its plant (Levine, 2006).

There are clear obstacles in the wider use of ethanol. Many motorists fear that ethanol can damage their cars (National Road and Association, 2002). This fear is bolstered by automobile manufacturers' threats to void car warranties if motorists use an ethanol mixture greater than ten percent in their cars (Jennings, 2005). Cars travel fewer miles per gallon with ethanol than they do with gasoline (Meeks, 2005). Critics suggest that greater ethanol use is not a great environmental solution and is, in fact, "an inefficient use of our nation's resources" (Meeks, 2005).

Ethanol, in its pure form, is corrosive and often damages rubber hoses and other plastic car parts, but the added cost of building a car that can handle 85 percent ethanol fuels is about two hundred dollars (Lashinsky, Adam, et al., 2006). While older cars will need modification, if they are going to run on fuel with high ethanol content, updating cars for compliance with changing federal fuel regulations is not new. When leaded fuel was banned in 1995, many older cars used soft-metal engine valves (World Bank Group, Pollution Prevention and Abatement Handbook 93, 1998). At the time of the ban, it was thought that some expense would be required to compensate for the absence of lead and its deleterious effect on these soft-metal valves (World

Bank Group, Pollution Prevention and Abatement Handbook 93, 1998). This projected expense did not deter the ban and it should not deter cost necessary to promote the greater use of ethanol (World Bank Group, Pollution Prevention and Abatement Handbook 93, 1998). Nearly every automaker in the world allows the use of ethanol, or E-10, within their warranty (National Corn Growers Association). The price of ethanol has been higher than gasoline (Healey, 2006), but it will only become more competitive as world oil supplies decrease (Tita, 2006). The lower fuel efficiency of ethanol is not as straightforward a market as price per gallon, but the same logic applies (Lashinsky, Adam, et al., 2006). It should be understood in terms of dollars per mile. As oil prices rise, the dollar per mile cost of ethanol will become more competitive (Lashinsky, Adam, et al., 2006).

Environmental risks of any agricultural program should be carefully considered. Automobiles and their combustion-engine brethren are some of the worst sources of air pollution (Wilson, 2006). Ethanol, when used in these engines, eliminates most of that pollution (Ethanol Fact Book). Proponents of ethanol have lauded its use as an emissions-reducing oxygenate additive to gasoline. Petroleum fuel is a major cause of ozone-depleting carbon monoxide emissions in the United States. Oxygenate additives help reduce harmful emissions. In 1990, the Clean Air Act amendments mandated that addition of oxygenates to gasoline in areas of the United States that struggle with high levels of air pollution. Therefore, the balance must be struck between the clear environmental benefits and the speculative fears of increased ethanol use. These concerns have merit, but should not stand in the way of America's ethanol support by weighing the environment, national security and economy.

CHAPTER 3

E85 AUTOMOBILE DEVELOPMENT PLAN

E85 fuel is designed for use in Flexible Fuel Vehicles (FFVs) (Clean Air Choice, American Lung Association). An E85 FFV is similar to a standard gasoline powered vehicle (Minnesota Department of Commerce, 2001). Power, acceleration, payload and cruising speed are generally comparable to gasoline powered vehicles (Minnesota Department of Commerce, 2001). As the percentage of ethanol increases in the fuel tank, the power output of the engine actually improves. Ethanol enhances engine power by increasing the fuel's octane level and oxygen ratio. E85 fuel keeps the fuel system clean and acts as gas line antifreeze (Minnesota Department of Commerce, 2001). The main differences in the vehicles are the materials used in the fuel systems and special engine computer calibration that allow FFVs to adapt to E85 fuel (Minnesota Department of Commerce, 2001). The computer takes signals from input sensors in the engine management system and uses them to optimize the ignition timing and fuel flow rate that best suits the fuel being used. This process occurs automatically as the vehicle is being driven. The only difference is that FFVs aren't limited to burning gasoline; they offer individuals a choice (Minnesota Department of Commerce, 2001).

Light-duty FFVs include a wide range of vehicles, from sedans to sport utility vehicles to pickup trucks to minivans. FFVs are widely available; the Energy Information Administration estimates that more than four million FFVs are currently on U.S. roadways, although many buyers remain unaware that they have FFVs and may fuel with E85.

Few transit agencies currently operate ethanol buses in their fleets. The only large ethanol bus fleet consists of 333 buses at Los Angeles County Metropolitan Transportation Authority LACMTA.) These buses were converted from methanol operation during 1995 and 1996. (Note: these buses have been recently converted back to methanol.) No transit agencies currently have any ethanol buses in order. The appendix lists the selected E85 compatible FFVs.

The US Renewable Fuels Association (RFA) has urged US buyers to consider the two main reasons for FFVs. Analysts see E85 as putting U.S. in an area of fuel conversion where the Japanese automakers are not active in (Mateja, 2006). What makes this interesting is that while the domestics are offering a growing number of E85 – compatible vehicles, the imports, especially the Japanese, have few if any that can run on E85 (Mateja, 2006). GM is using E85 as

a marketing tool to look green (Mateja, 2006). The Japanese have the lead in hybrids; the domestics in E85. Two major Japanese car companies, Honda and Toyota, are missing out on E85 compatible FFVs for US buyers (Bunting, 2006). Mitsubishi, another Japanese company announced its first four-wheel drive flex-fuel model in June 2007. Nissan, another Japanese company, will introduce the Armada FFV/E85, joining the Titan FFV/E85, which has been on sale since 2004; while Brazil will introduce 100% bio-ethanol fuel (E100)-ready models by 2009 (Mollet, 2006).

Senator Dick Lugar (Indiana), in November 2006, wrote to the executives of General Motors Company, Ford Motor Company and Chrysler Group encouraging them to increase the number of flexible fuel vehicles they are presently producing.

Ford has announced that the C-Max FFV will cost EUR 21,912 (ex works). The price includes a 50 percent VAT rebate and Ford also points out that not only is E85 twenty percent cheaper than regular petrol, which the FFV can run on, but also that insurance companies are starting to look favorably on low emission vehicles as they tend to be driven by safer drivers (Twomey, 2007).

GM has over two million FFVs on the road today in all 50 states, able to operate on gasoline or on a blend of 85 percent ethanol and 15 percent gasoline. By 2012, GM in partnership with Daimler- Chrysler and Ford, aim to have half of annual vehicle production be E85 flexible fuel or bio-diesel capable. So, you can choose the fuel that's best for you. That's good to know, because E85 fuel is not yet widely available. Also, vehicles running on E85 may have a cruising range that is about 25 percent shorter than the same vehicle operating on regular gasoline.

As the costs of making ethanol continue to fail, ethanol can be used as a fuel, not just as a fuel additive. At a minimal extra cost, FFVs can now be made that can run either on gasoline or on E85. For example, if a hybrid-electric car, that normally goes 40 miles for every gallon of gasoline in its tank, were an FFV, it would run about two hundred miles on E85--mostly burning ethanol, except for the 15 percent gasoline component—before it had burned a gallon of gasoline. About five million FFVs are on the road today; however, in the United States, many of their owners do not know it (O'Connor, 2005). If one of the big three U.S. automakers chose to sell all of its models as FFVs, it might quickly gain a competitive advantage with consumers--and perhaps outrun pressures for a government FFV mandate (Bordetsky, Ann, et al., 2005).

Simple factory-produced modifications of gasoline engines change vehicles into FFVs. The technology for this change already exists in production with certain manufacturers, and a number of vehicles are offered every year (Smolin, 2006). Ford, General Motors, and Chrysler are all pressing to produce more FFV vehicles and advertise E85 use in these vehicles (Smolin, 2006).

For FFVs to have a significant effect on U.S. fuel-use patterns, it will be essential to ensure the growth of a fueling infrastructure. A Department of Energy official said in July 2005, that there are over 225 public E85 stations nationwide (up from fifty-two in 2000), almost half of them in Minnesota (O'Connor, 2005). But, in September 2005, the New York Times reported that the number of stations selling E85 had "nearly doubled since January, to more than 460" (Hakim, 2005). There are about 180,000 gasoline stations in the United States. The major oil companies make little or no effort to put E85 in their pumps because they do not want it to get a foothold in competing with their main product. The major companies, after all, are vertically integrated, with major resources devoted to exploration, production, refining, transportation, and marketing (Deffeyes, 2001). Without access to the needed infrastructure, ethanol and other renewable fuels will not make headway against an established competitor. Yet, we assume that one or more of the majors, or at the very least owners of independent service stations, would aggressively sell ethanol at their stations given the right economic incentives. E85 is now available at over 1000 refueling locations in the U.S.A. Over 630 of these are found in the Upper Midwest (Clean Air Choice, American Lung Association). Therefore, the U.S. needs more E85 fueling stations in places besides the Midwest with the increases in production of E85 fuel itself. G.M. Ford and Chrysler are increasing their FFVs production with the anticipation of more demand of FFVs in the future.

CHAPTER 4

CURRENT GOVERNMENT INITIATIVES & POLICIES

Introducing and sustaining the use of alternative fuels is neither a quick nor an easy understanding. Consistent long-term government commitment can be hard to maintain. For example, alternative fuel initiatives can struggle when industry is not actively involved in vehicle development, fueling system construction, and marketing.

Developing sustainable markets for renewable energy technologies present complex challenges; financial, institutional, and informational obstacles impede their advancement. Policy makers have often utilized tax incentives in dealing with such challenges. For almost ninety years, the United States has granted tax incentives, direct subsidies, and other support to the energy industry in an effort to enhance U.S. energy supplies. Historically, theses incentives targeted only the fossil fuel industries—oil, gas, and coal. Since the late 1970s, however, Congress has also enacted incentives to encourage investment in the development and production of alternative and renewable energy sources. Alternative energy sources have the potential to reduce petroleum consumption and greenhouse gas emissions while, at the same time, produce significant energy savings.

Lawmakers often use tax incentives, grants and other financial incentives for the development of socially valuable industries. The industries later gain market share and become viable competitors in their relevant markets, at which point the government begins to tax the industry to recoup its investment.

President H.W. Bush's energy plan, the Energy Policy Act of 1992, included several provisions aimed at reducing consumption of petroleum through the use of alternative fuels in light-weight vehicles (cars and light-weight trucks). The act established goals for reducing the use of petroleum fuels in the United States by ten percent by the year 2000, and thirty percent by the year 2010. Limited progress towards achieving these goals has occurred since the act's passage. In a 1999 draft report, the Department of Energy (DOE) reported that only 4.23 billion gallons of gasoline were replaced by replaced by alternative fuels during 1998. This equated to only 3.6 percent of all gasoline use during 1998—well short of the 10 percent goal. According to the DOE, the reasons for failure include the *economic disadvantages* of alternative fuels, and the lack of infrastructure necessary for an alternative energy society. In short, the Energy Policy Act

of 1992 lacked the necessary tax incentives and mandates for making alternative fuels a more viable source of energy. Furthermore, the DOE concluded that, "before public investments [in alternative energy] are made…more people will need to be convinced about the energy and the environmental benefits of alternative fuels."

When President George W. Bush took office in 2001, he established the National Energy Policy Development Group (NEPDG), led by Vice President Dick Cheney, with the purpose of developing "a comprehensive long-term strategy that uses leading technology to produce an integrated energy, environmental and economic policy."

In a 2003 interview, Matthew Simmons, one of George W. Bush's key energy advisors, was asked whether it was time for Peak Oil and the future of our nation's energy to become part of the public policy debate. He replied, "It is past time. As I have said, the experts and politicians have no Plan B to fall back on. If energy peaks, particularly while five of the world's 6.5 billion people have little or no use of modern energy, it will be a tremendous jolt to our economic well being and to our health—greater than anyone could ever imagine."

In response to rising prices in gasoline and electricity, Congress passed the Energy Policy Act of 2005 (EPAct 2005). It was the first omnibus energy legislation enacted by Congress in thirteen years. In terms of scope and impact, the 1700 page bill is the most ambitious legislation since a package of bills passed during the administration of President Carter (Energy Tax Act, 1978). Upon signing the bill, President Bush stated, "EPAct 2005 launches an energy strategy for the 21st century by providing a more balanced approach to energy conservation and reproduction."

Several proponents of the EPAct 2005 believe that the subsidies allocated to the alternative and renewable energy industries will eventually be the solution for reducing U.S. dependence on foreign oil. The act includes a number of incentives for the development of alternative energy and approximately $6.0 billion in subsidies to renewable energy industries. Bill Stevens, Executive Vice President of the Texas Alliance of Energy Producers, stated, "EPAct 2005 spreads the money or incentives around between renewable, hydrogen, nuclear, coal, oil, and gas. And, hopefully, that will give us a firm basis from which to increase our overall energy production." Whether domestic energy production actually increases depends largely on the nation's willingness to integrate alternative and renewable energy into its

lifestyles. EPAct 2005 also aims to promote a cleaner environment by encouraging new innovations and alternative power sources.

EPAct 2005 contains an array of provisions addressed to energy efficiency and provides for half a dozen federal programs aimed at encouraging energy efficiency throughout the federal government and its various facilities (American Jobs Creation Act, 2004). It also creates several programs to assist states with energy efficiency (Jennings, 2005). EPAct 2005 gives statutory blessing to the Energy Star Program and establishes a number of education initiatives (Steil, 2005). It also expands the number of products to be covered by Department of Energy efficiency standards (Clean Fuels Development Coalition, Ethanol Fact Book 26, 2003). Several energy-efficiency studies are mandated as well (Swisher, 2005).

Various aspects of energy supply and demand including provision encouraging energy efficiency, alternative fuels, and renewable energy are addressed by EPAct 2005. Alternative fuels provisions incorporate voluntary and regulatory strategies targeting fundamental changes to the U.S. energy market. The U.S. Department of Energy's Clean Cities Program implements the voluntary portions of EPAct. The Department's Office of Transportation Technologies coordinates the regulatory aspects of EPAct; many of the regulatory strategies focus on creating a stock of alternative fuel vehicles in specific metropolitan cities. Accordingly, EPAct establishes vehicle-purchasing requirements. Under EPAct mandates, certain entities operating fleet of light-duties vehicles must follow the requirements. These include state and federal government agencies, and alternative fuel providers to purchase alternative fuel vehicles as a percentage of their annual light-duty vehicle purchases. EPAct also mandates when feasible, fuel provider fleets should use alternative fuels. However, this program applies to fleets located in designated metropolitan areas having more than 50 light-duty vehicles. Similarly, EPAct mandates the Federal Alternative Fuel Vehicles program. In addition to EPAct, an Executive Order also mandates the federal program. The Act also provides credits for certain fuel cell vehicles, certain hybrid vehicles, and certain other vehicles. The government offers tax incentives and low interest rate loans to encourage alternative fuel vehicle use and requires conversion to alternative fuel use for both government and private fleets. A corollary credit is established for refueling property. In the federal program, by the year 2005, federal agencies must decrease their annual petroleum consumption by 20 percent. The Executive Order and EPAct encourage federal agencies to achieve this goal by using alternative-fuel vehicles, increasing alternative fuel in alternative-fuel

vehicles, improving efficiency of alternative-fuel vehicles, and increasing efficiency in fleet operations. The policy directs all federal vehicles, light, medium, and heavy duty to comply. However, the policy exempts law enforcement, emergency, and military vehicles.

The EPAct 2005 also includes several incentives for renewable energy sources, reauthorizes the Renewable Energy Production Incentive program, includes incentives for increased efficiency at existing dams, directs the federal government to use more renewable energy, and includes the new "Renewable Energy Security Act." Both the Renewable Energy Production Incentive and additional renewable energy subsidies encourage the initial investments necessary for these industries. These provisions are aimed at alleviating the excessive startup costs associated with alternative energy. The financial incentives also provide stability to an industry wary of changes in U.S. policy concerning renewable energy. The Renewable Energy Production Incentive has expired numerous times, leading renewable energy producers to question the United States' commitment to their industries. Renewing the incentive within an Act aimed at increasing domestic energy production provides needed stability to the renewable energy industries.

Last, and probably of most importance, the EPAct 2005 includes several incentives for energy efficient technologies: hybrid vehicles, ethanol and biodiesel fuels, and hydrogen fuel cells. Of the alternative technologies that are currently available, energy efficiency is not only the most sensible, but also the most sustainable. The Energy Policy Act of 2005 includes tax incentives for owners of hybrid vehicles, a flexible, cost effective renewable fuel standard that will double the amount of ethanol and biodiesel in our fuel supply over the next seven years, and will give provisions which "help keep the momentum of the [Hydrogen Fuel Initiative]." Currently, each of these technologies lacks viability; yet, the incentives provided by the Energy Policy Act of 2005 may be able to ease the hurdles each industry currently faces. If this were the case, the question would then become whether the bill does enough to further these technologies. As of right now, the answer is unclear, and will only be answered in due time.

The original legislation modified from a 50 percent tax credit to 30 percent for installation of E85 pumps; up to $30,000 would cover the cost of putting in E85 pumps. Experts in the field indicate this will triple the number of E85 pumps (World Bank Group, Pollution Prevention and Abatement Handbook, 1998).

Below is the chart showing an increase in demand of E85 in January 2007.

mg = million gallons, b/d = barrels per day

Fuel Ethanol Production	488.1 mg	375,000 b/d
Fuel Ethanol Use	539.0 mg	414,000 b/d
Fuel Ethanol Stocks	361.0 mg	20.8 days of reserve
Fuel Ethanol Exports	0.0 mg	n/a
Fuel Ethanol Imports	44.4 mg*	n/a

*Source: U.S. International Trade Commission

Financial incentives take many forms. Loans, grants, production payments, tax credit or deduction, and tax exemptions all provide some type of assistance. 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. Below are some of the current biofuels tax incentives in the United States and the European Union.

Table 1: Current Biofuels Incentive Policies in the United States and the EU

United States		European Union	
Legislation	Description	Legislation	Description
Energy Policy Act of 2005 (EPA)	A major overhaul of U.S. Law • concerns all energy source types • restructures the old ethanol **tax incentives** • allows biodiesel to benefit from **tax incentives.**	1997 White Paper	Lays out a general community strategy for increasing use of biofuels.
Volumetric Ethanol Excise **Tax** Credit (VEETC)	Gives a $.51/gallon reduction in excise **tax** for ethanol, and either a $1.00/gallon or $.50/gallon reduction in excise **tax** for biodiesel. Recently restructured to avoid taking money from the Highway Trust Fund.	2000 Green Paper	Focuses on developing and promoting energy supply security. Suggests doubling the percentage of renewable energies used compared to total energy.
Renewable **Fuels** Standard (RFS)	Requires 7.5 billion gallons of renewable **fuels** be consumed per year by 2012; almost doubles current amounts.	2001 white Paper	Focuses on reducing harmful emissions caused by transportation and urges increased use,.

Policy Justification to Support Alternative Fuels & E85

The war on terror, the uncertain future of oil and their subsequent price, international trade policy and trade imbalances, and the national budget deficit are only a few of the important issues policy-makers must address.

Economic Political Factors: The economic and political drivers for a switch from petroleum-derived fuels to more efficient energy conversion equipment and alternative fuels include the following:

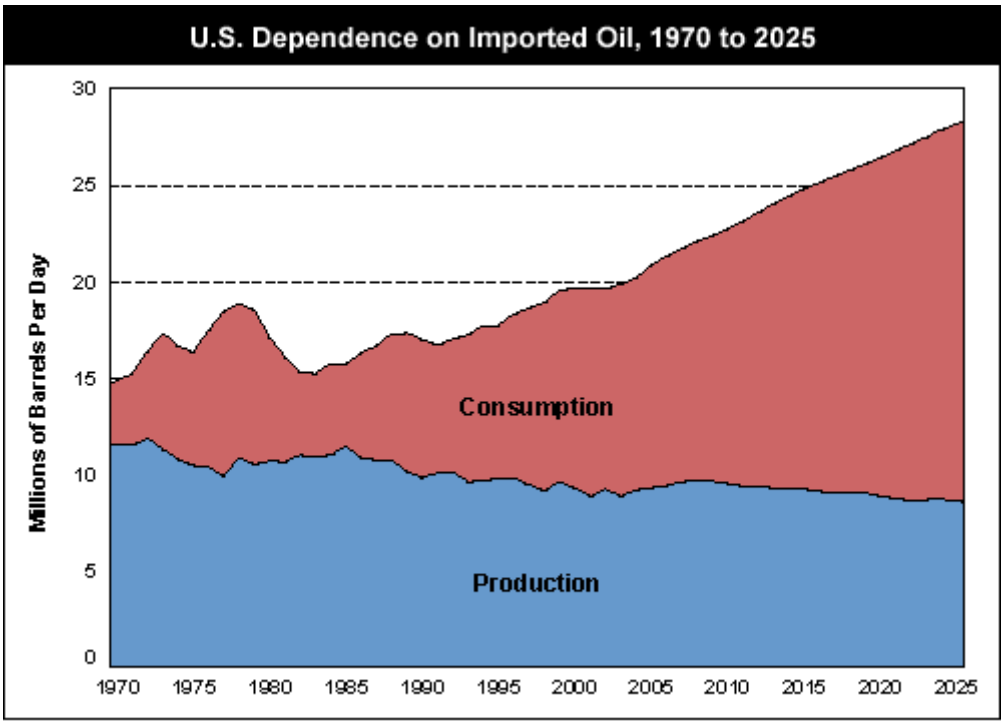
- Almost half of all the crude oil ever created by global processes - has already been pumped out of the ground.
- Hubbert's Peak - refers to the point in time at which the increase in demand is greater than the increase in reserve (new oil discoveries), which also seems to correspond to the point of maximum worldwide production of crude oil, sometimes called peak oil.
- Saudi Arabia- is running out of oil. Recent projections describe Saudi Arabia's reserves, which have the world's largest reserves of crude oil, as lasting between fifteen and thirty more years. In actuality, no one in this country knows, and the Saudi either do not know or are not telling. Also, the oil that is still in the ground is increasingly difficult to extricate.
- The oil industry in Iraq - has not been able to produce the crude oil said to be on the ground, for a number of reasons,
- Developing nations - are increasing their demand for oil and gas as their growing populations, including China and India, which together contain one-third of all earth's inhabitants, climb into the middle class and demand the kind of lifestyle that many enjoy in the United States. Recently, China has been attempting to buy the rights to the Canadian oil sand reserves (Clean Air Choice, American Lung Association).
- Canadians and Europeans - pay more for gas than we do in the United States. Although this difference is due to tax policy, transportation fuels represent a potential for increased taxes in the United States.
- Domestically produced renewable fuels - will be less expensive option as fossil fuels become scarcer.
- Vehicle technologies - are already in production to drastically alter the United States demand for petroleum transportation fuels. A change to more economical systems and fuels will have the many advantages for the United States.

- Renewable fuels - are almost carbon neutral as compared with gasoline and petroleum diesel and therefore contribute less to the increase of carbon dioxide in the atmosphere (Smolin, 2006).
- Domestically produced fuels - do not require the United States to support Middle East and South American governments or to protect their energy stocks. The actual effect on American foreign policy deserves extensive study.
- Domestically produced fuels - add to the nation's economy and reduce the deficit balance of payments that the United States carries with other countries.
- An expanded renewable fuels industry in the United States - will strengthen our agricultural and forestry sectors.

More efficient vehicles and renewable fuels will be produced in this country in response to consumer demand; this will make alternative fuels competitive to petroleum. According to private correspondence with producers and potential producers, ethanol and biodiesel are less expensive to produce than gasoline and petroleum diesel. In some locations, biodiesel blends are beginning to sell as the same price as petroleum diesel at the pump. Increasing numbers of auto manufacturers are converting their lines of automobiles and SUVs to hybrid and FFVs, which will encourage the production of ethanol. For example, major oil corporation BP (formerly British Petroleum) is looking ahead and now signs its advertisements "BP Beyond Petroleum."

Oil Reliance on Foreign Countries: The continuing Middle East conflict has prompted intense debate in the popular media about America's continued dependency on foreign oil. Americans' nearly exclusive reliance on petroleum for transportation fuel has become an increasing threat to U.S. economic and security interests. The major dangers of oil dependence, to name a few, include volatile and increasing oil prices, now projected to average $63 a barrel in 2006; growing uncertainty over long-term oil supply; high current account deficits; and the financing of terrorism and tyranny by U.S. petrodollars. One estimate, cited in the Department of Energy's 2004 Transportation Energy Data book, put the cost of U.S. oil dependence at $7 trillion in 1998 dollars over a thirty-year period. Petroleum dependence is also a threat to the environment, human health, and the goal of spurring global trade and development by reducing agricultural subsidies.

As history shows, the dependence on black gold has significantly affected the United States. Shortages of oil have created recessions in our economy and have been the basis for many global conflicts. According to the Energy Information Administration, net petroleum imports in the United States amounted to over 12 million barrels a day in 2006; 59.8 percent of the daily petroleum consumption in the United States.



Source: Energy Information Administration, *Annual Energy Outlook 2004*

Figure 1. U.S. Dependence on Imported Oil, 1970 to 2025

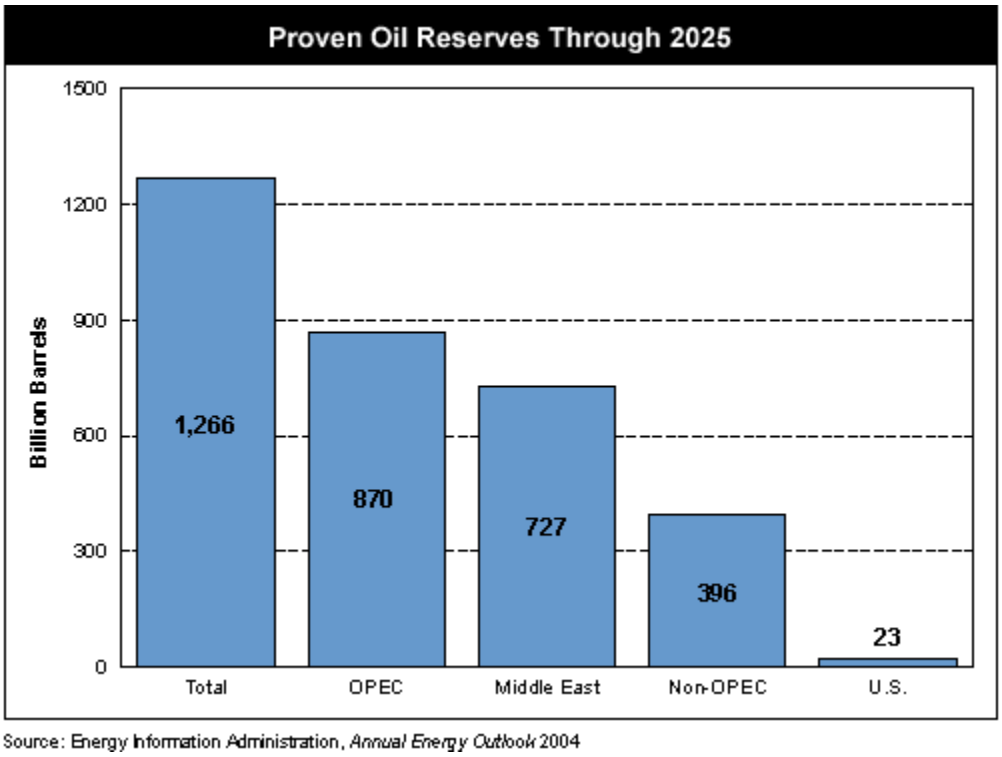


Figure 2. Proven Oil Reserves Through 2025

Many analysts estimate that production of oil has peaked or will peak in the immediate future, eventually leading to a continuous reduction in the global supply of oil. The current world production of oil is eighty-four million barrels per day. In a February 2005 report entitled "Peaking of World Oil Production: Impacts, Mitigation, and Risk Management," the DOE observed that, without timely mitigation, world supply/demand balance would be achieved through massive demand destruction (shortages) and drastic oil price increases, both of which could create a long period of significant economic hardship worldwide. The Federal government first recognized the benefits of a national energy policy during the 1930s; legislators have only recognized the need for a domestic energy plan within the last thirty years. During the 1970s, when the nation was faced with a Middle Eastern oil embargo, President Jimmy Carter proposed a national energy plan attempting to confront "the greatest challenge our country will face during our lifetimes." Carter's plan, codified as the National Energy Act, was intended to be a comprehensive response to the energy crises that affected energy prices and the economy.

In a similar string of events, President George H.W. Bush proposed a revamped energy plan to promote "energy conservation and efficiency, increased development, and greater use of alternative fuels" in 1991. President Bush conceived this plan in response to U.S. fears of oil

price shocks caused by Saddam Hussein's occupation of Kuwait and the subsequent US-led Desert Storm Operation.

Environmental concerns: In recent years, preservation of the environment has become a prevalent issue for countries throughout the world. Countries are particularly concerned with acid rain, global warming, and the depletion of the ozone layer. Motor vehicle emissions comprise a major source of environmental pollution. Therefore, improving emissions, developing clean, alternative fuels, and creating environmentally safe automobiles are essential in order to prevent and control pollution.

The United States has more motor vehicles than any other nation with approximately 190 million; Japan follows with more than sixty-one million. Motor vehicles contribute 25 percent of the total accumulation of greenhouse gases into the atmosphere. These gases are emitted "at rates of megatons per year, per industrialized country." The excessive use of gasoline and petroleum products contributes to a significant amount of emission pollution. This pollution poses a threat to the environment and health of future generations. Transportation is the second largest source of greenhouse gases in the U.S.

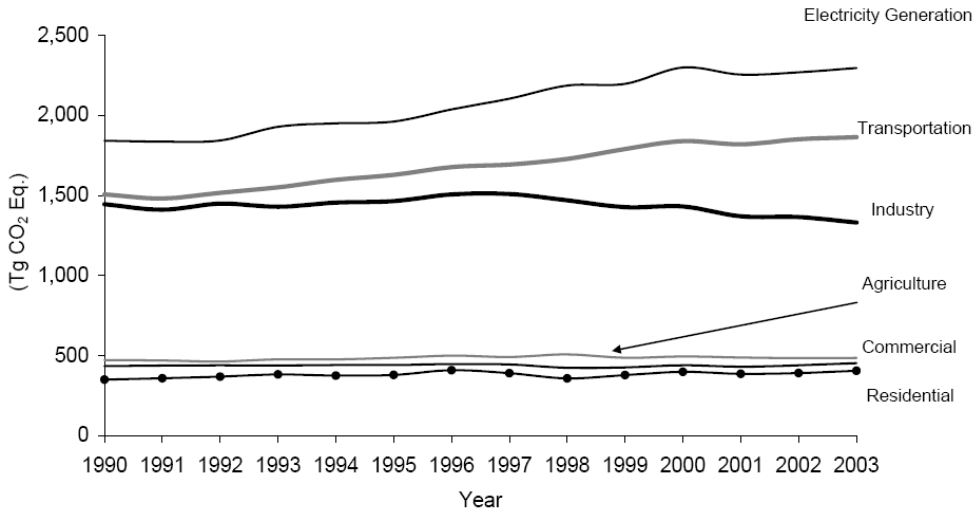


Figure 3. Pollution Rates by Sector
*Source: U.S Environmental Protection Agency.

Automobiles emit sulfur dioxide (SO_2), nitrogen oxide (NOx), carbon monoxide (CO) and carbon dioxide (CO_2). Sulfur dioxide causes acid rain, which interferes with the chemical and biological stability of ecosystems, thereby harming lakes and forests. Nitrogen oxide causes acid rain and depletion of the ozone layer. "The stratospheric ozone layer encircling the entire globe prevents harmful amounts of ultraviolet radiation from reaching the earth. Depletion of stratospheric ozone by atmospheric pollutants could result in significant adverse impacts on human health, including an increase in skin cancer rates and suppression of human responses." Depletion of the ozone layer also involves serious environmental effects, including "reduced crop yields, adverse effects on aquatic ecosystems…, and potentially significant climatic changes." Carbon monoxide and CO_2 cause global warming, and if these pollutants "continue to grow at current rates; many scientists believe that global mean temperatures may rise by two to five degrees Fahrenheit over the next century." This increase could cause significant changes in precipitation patterns, storm frequencies and intensities, and ocean levels. Although scientists remain uncertain about when the world will experience the aftermath of pollution, nothing justifies the adoption of a "wait and see" attitude. A need exists to develop environmentally safe fuels and automobiles, because of the destructive effects that emissions have on human beings.

The United States has enacted laws and has implemented policies and regulations in regard to motor fuel emissions, as well as alternative fuel vehicles. U.S. policy is based upon a balance between the need for secure supplies of reasonably priced energy and the achievement of economic growth (Swisher, 2005). The U.S. government relies on mandatory fuel economy standards to improve vehicle fuel efficiency (Loven, 2005). U.S. regulations emphasize the conversion of the future U.S. vehicle fleet to alternative fuel use.

Domestic Income: Petroleum dependence is a threat to the environment, human health, and the goal of spurring global trade and development by reducing agricultural subsidies. This issue, while often polarized in the House and Senate by partisan politics, has penetrated into the public consciousness. A growing consensus exists among policy analysts, environmentalists, and U.S. farmers that alternative energy sources are a factor in the long-term solution to what may be America's most significant issue. The choice is simple: either pay another country to extract that fuel or pay local farmers to grow that fuel.

Price supports are all at odds with American trade policy. They injure the competitive ability of domestic and international farmers by unfairly and unnecessarily distorting commodity prices. In addition to supporting the price of domestic agricultural products, the United States gives millions of dollars in foreign aid to feed the farmers in countries where our domestic subsidies make farming unprofitable. Instead of encouraging farmers to grow unprofitable crops through price supports, the United States should embark on a journey to re-empower the agricultural sector by incentivizing crops that not only provide answers to some of the most pressing concerns facing the country, but that do so in an environmentally sound way (Press Release, National Roads and Motorists Association, 2002). For example, dependence on foreign oil is many drivers' mind. Many agriculturally-based fuels, including ethanol and biodiesel, can help alleviate that concern (Esfahani, 2006). Domestic price supports focus the agricultural might of the United States on growing crops for a guaranteed price. The government should instead push the agricultural sector into producing profitable and innovative crops which require no price supports. The latter approach would contribute to ending the nation's dependence on foreign oil, while simultaneously curtailing the conspicuous pollution encouraged by price supported crops. Once agricultural concerns are cut off from the pap of price supports, farmers will be forced to innovate (Ethanol Facts, supra note 19). Agricultural projects can supply profitability, while at the same time provide answers to some of the concerns facing the United States.

CHAPTER 5

NEW E85 REFINERS

New E85 Refiners is an appropriate theme for this year's *Ethanol Industry Outlook*. It reflects the unprecedented growth that has occurred over the past several years. Once serving just niche markets in the Midwest, ethanol is now a ubiquitous component of the U.S. transportation fuels market. Ethanol is now sold from coast to coast, and is blended to 30 percent of the nation's gasoline.

In 2004, 81 ethanol plants located in 20 states produced a record 3.41 billion gallons, a 21 percent increase from 2003 and 109 percent since 2000 (Jennings, 2005). Construction of 12 new ethanol plants was completed in 2004 (Jennings, 2005). These new facilities, combined with expansions at existing plants, increased annual production capacity of 500 million gallons to over 3.6 billion gallons (Energy Tax Act, 1978). At the end of 2004, 16 plants and two major expansions were under construction, representing an additional 750 million gallons of production capacity (Jennings, 2005).

In response to rising demand, U.S. ethanol production broke both monthly and annual production records for 2005. For the year, 95 ethanol refineries located in 19 states produced a record four billion gallons, an increase of 17 percent from 2004 and 126 percent since 2001. In 2005, dry mill ethanol refineries accounted for 79 percent of production capacity, and wet mills 21percent. Fourteen new refineries were completed and brought online in 2005. These new refineries, combined with expansions at existing facilities, resulted in record annual capacity growth of 779 million gallons (Energy Tax Act, 1978). At the end of 2005, 29 ethanol refineries and nine expansions were under construction with a combined capacity of more than 1.5 billion gallons (Energy Tax Act, 1978). Table below gives an overview of the total capacity of individual states in producing E85.

Table 2: Ethanol Production Capacity Ranked by State

Rank	State	Ethanol Production Capacity (Million Gallons Per Year)
1	Iowa	1,262.5
2	Illinois	816.0
3	Minnesota	523.6
4	Nebraska	523.0
5	South Dakota	456.0
6	Wisconsin	210.0
7	Kansas	149.5
8	Indiana	102.0
9	Missouri	100.0
10	Tennessee	67.0
11	Michigan	50.0
12	North Dakota	33.5
13	New Mexico	30.0
14	Texas	30.0
15	Kentucky	25.4
16	California	8.0
17	Wyoming	5.0
18	Ohio	4.0
19	Colorado	1.5
20	Washington	0.7
	United States Total	4,397.7

*Sources: Renewable Fuels Association, Washington, DC. Nebraska Energy Office, Lincoln, NE.

The growing ethanol industry provides a growing contribution to American economy. It creates new high-paying jobs, increases market opportunities for farmers, generates additional household income and tax revenues, and stimulates capital investment.

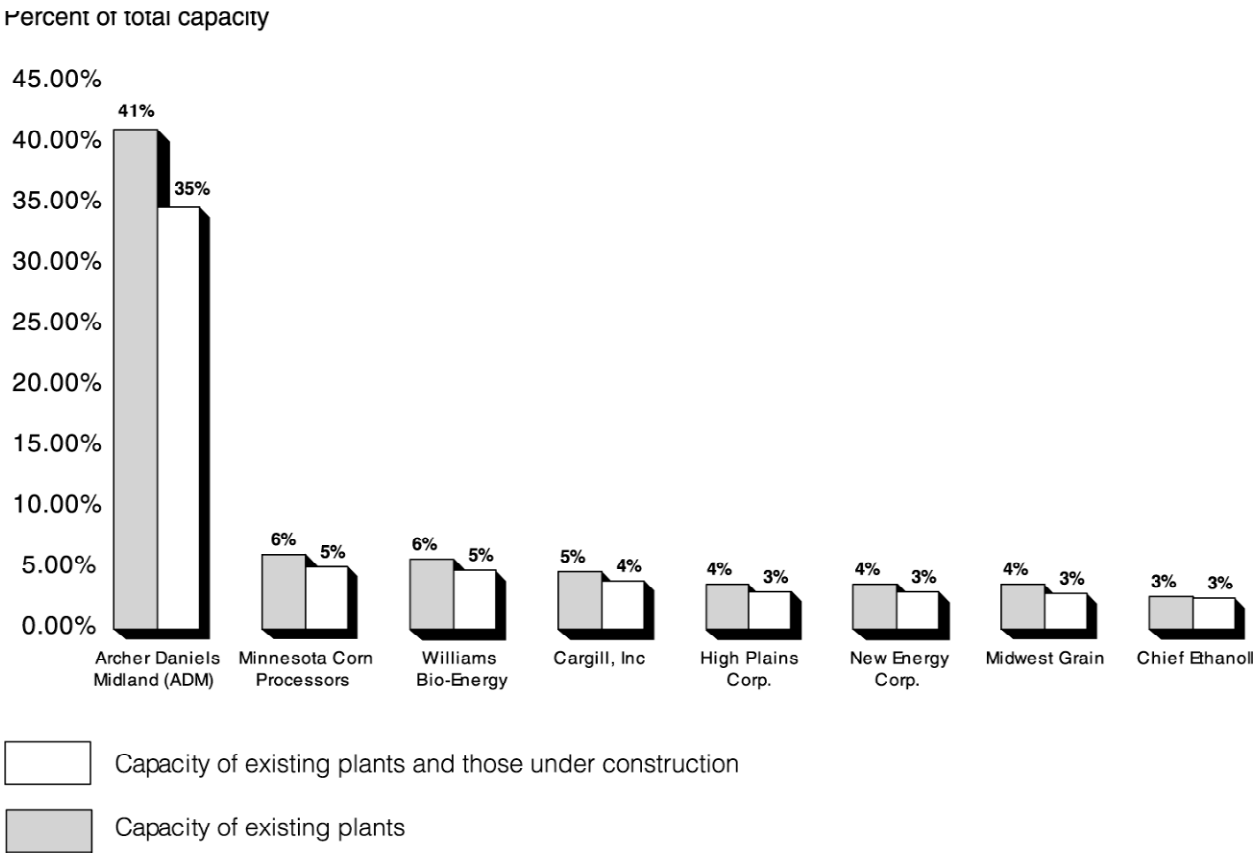


Figure 4: Top Eight U.S. Ethanol Producers by Production Capacity (2002)

The ethanol industry made the following contribution to the U.S. economy in 2005

- **Added $32.2 billion to gross output** the combination of spending for annual operations and capital spending for new refineries under construction.
- **Spent almost $5.1 billion on raw materials, other output, and goods and services,** the largest share of which was for corn and other grains used as the raw material to make ethanol.
- **Supported the creation of 153,725 jobs** in all sectors of the economy, including more than 19,000 jobs in America's manufacturing sector.
- **Increased household income by an additional $5.7 billion,** money that flows directly into the pockets of American consumers.
- **Added more than $1.9 billion of tax revenue** for the Federal government and nearly $1.6 billion for state and local governments.

Lists of established ethanol refineries are located in Appendix B.

With increased demand for ethanol from coast to coast, the industry witnessed several new projects beyond the traditional corn growing states (Energy Tax Act, 1978). In 2005, 43 refineries opened, began construction or expanded all across the country, with increasing activity in states like California, Colorado, Ohio, New Mexico and Texas (Energy Tax Act, 1978). At the same time, plans are underway for ethanol refineries in New York, New Jersey, Pennsylvania, Maryland, North Carolina, and Arizona, to name a few. Other Ethanol Refineries established in the last few years or under construction include: Bushmills Ethanol, Inc.; Central Iowa Renewable Energy, LLC; Illinois River Energy, LLC; Lincolnway Energy, LLC; Panhandle Energies of Dumas, LP; and Western Wisconsin Renewable Energy. LLC are also few new refineries for E85.

CONCLUSION

Renewable fuels are no longer an experiment, a concept or a thing of the future. The future is now and the demands are immediate. People need affordable energy, dependable energy, cleaner energy and renewable energy. The Energy policy Act of 1992 and 2005 included several provisions aimed at reducing consumption of petroleum through the use of alternative fuels in light-weight vehicles. The act established goals for reducing the use of petroleum fuels in the United States by10 percent by the year 2000 and 30 percent the year 2010. The United States is aiming to make alternate fuels our energy of the future.

The United States has experienced the results of dependence on imported oil in the past. Alternative fuels like E85 can reduce American dependence on imported oils which will lower America's annual deficit and increase national security. In addition, domestic refineries and agricultural crops required for ethanol would create a domestic job market and provide a substantial boost to the American economy. Furthermore, ethanol's use can reduce environmental effects on the ozone layer; transportation is the second largest source of pollution. Petroleum fuel is a major cause of ozone-depleting carbon monoxide emissions in the United States. Oxygenate additives help reduce harmful emissions and cellulosic ethanol can be used to reduce carbon monoxide emissions.

The United States has a challenge to meet in convincing its citizens to switch to E85/alternative fuels. The cost per mile E85 is expensive compared to gasoline. However, with the increase in demand, the cost of production, transportation and infrastructure will go down. Therefore, there is an egg and a chicken situation. There has been an increase in the number and variety of flex fuel vehicles being produced and purchased, due to government incentives and tax benefits in the 2005 Energy Policy Act. With the increase in number of vehicles being purchased, there is an increase in demand of E85. The United States has a superior capacity to produce E85. In the year 2006-2007, around 26 new E85 refineries were established. Highly regarded refineries like ADM, Vera Sun and Aventine Renewables can be examples for new emerging refineries trying to become established in the market.

Oil companies are seeing alternative fuels as a threat. Therefore, they create a barrier in establishing alternative fuel pumps in their fueling stations. However, government initiatives and subsidies are helping gas stations to set up alternative fuels fueling stations. Certain oil corporations are forecasting a bright future for alternative fuels as a future energy source.

Therefore, corporations like BP and Exxon are investing in alternative fuel industry and trying to change their images as thinking beyond gasoline. Alternative fuels/E85 industry is walking a tortoise walk; however it has a very bright future in the energy industry. Government incentives are helping them achieve their goals easier. However, the only obstacle with the United States government is to convince its citizens by asking them to consider long term advantages like clear environment, national security, and a domestic economy versus short-term temporary advantages and convenience.

RECOMMENDATION

America has limited resources to produce corn or sugarcane, the key ingredients to produce U.S. ethanol. The result can be America's reliance on foreign crops. Therefore, America needs more incentives and grants to research the development of environmentally friendly cellulosic ethanol.

There is major concern among automobile consumers regarding damage to their cars due to ethanol. Therefore, government should encourage automakers to give warranty for ethanol related damage.

Developing sustainable markets for E85 presents complex challenges - financial, institutional and informational obstacles impede their advancement. The EPAct 2005 gives many incentives to help alternative fuel industries grow. However, it can fail to achieve its goals for several reasons like economic disadvantage of alternative fuels and lack of infrastructure necessary for alternative energy society, vehicle development, and marketing. Therefore, more fuel stations, refineries, FFVs and infrastructures need to be developed.

REFERENCES

Alliance of Automobile Manufacturers. (n.d.). *Advanced Technology Vehicles:Driving Innovation.* Retrieved 2008, from Alliance of Automobile Manufacturers: www.autoalliance.org/archives/ATV%20REV15.pdf

Bordetsky, A., & al, e. (2005, Febuary). *Securing America: Solving Our Oil Dependencies Through Innovation.* Retrieved 2008, from NAtional Resource Defense Council: www.Nrdc.org/air/transportation/oilsecurity/plan.pdf

Bunting, A. (2006). Toyota and Honda Missing Out on Flexible Fueling. *Westlaw* , WNLR 2483129.

Charleston Gazette & Daily Mail. (2006). Charleston Gazette & Daily Mail (WV). (www.westlaw.com, Ed.) *Charleston Gazette (WV)* , p. E5.

Clean AirChoice. (2008). Retrieved 2008, from American Lung Association: www.cleanairchoice.org/outdoor/E85background.asp

Deffeyes, K. S. (2001). THe Impending World Oil Shortage. *Hubbert's Peak* , p. 166.

Department of Energy. (2005, Septemeber 9). *Clean Cities Program.* Retrieved 2009, from Energy Efficiency and Renewable Energy: www.eere.energy.gov/cleancities/progs/afdc/ddown.cgi?/WHAT_NEW/480/1/

Department of Energy. (n.d.). *Energy Efficiency And Renewable Energy.* Retrieved 2008, from Department of Energy: www.eere.energy.gov

Department of Energy. (n.d.). *Energy Efficiency and Renewable Energy, BiomassProgram, Policy Questions.* Retrieved 2008, from Department of Energy: www.eere.energy.gov/biomass/policy_questions.html

Energy Act of 1978. (n.d.). *92 (3174)* , 96-618. (U.S.C., Compiler)

Eric, T. R. (1980). Synthetic Fuels: A False Start. *N.Y. Times* , p. 15.

Esahani, E. (2006, 2 24). From Cow Pies to Clean Power. *Business 2.0* , p. 24.

Ethanol Fact. (n.d.). Retrieved 2007, from Iowa Corn Growers Associations: www.iowacorn.org/ethanol/ethanol_3a.html

General Motors. (2008, December 5). *E85.* Retrieved 2008, from General Motors: www.gm.com/company/gmability/edu_k-12/5-8/fc_energy/e85_ethanol/e85_how.html

Gielecki, M. (2001). *Incentives, Mandates and Government Programs for Promoting Renewable Energy.* Retrieved 2008, from Energy Info: www.eia.doe.gov/cneaf/solar.renewables/rea_issues/incent.html

Hakim, D. (2005). The New Prize: Alternative Fuels, N.Y. Times. *N.Y. Times* , p. C1.

Healey, J. R. (2002, Feburary 14). *Cost of E85 Fuel is Higher Than Gasoline.* Retrieved 2006, from USA Today: www.usatoday.com/money/industries/energy/2002-02-14-e85-usat_x.htm

Japan/Brazil:Mitsubishi Launching Flex-Fuel-First SUV. (2007). *Westlaw.com* , WNLR 11646146.

Lashinsky, A. (2006). How to Beat High Cost of Gasoline: Forever! *Fortune* , p. 74.

Levine, S. (2006). Cows in Hereford Are All Fired Up About Ethanol Plant: They Produce a Cheap Fuel Nobody Has Wanted, A Cattle-Feed Byproduct. *Wall Street at A.I.*

Mateja. (2006). GM, Ford Promoting More use of Ethanol Blend. *Grand Forks Hearld (ND)* .

Meeks, A. (2005). *Many Reasons to Oppose New Ethanol Mandate.* Retrieved 2008, from Minn. Star: www.amexp.org/news/op-eds/2005-02-01.php.

Memebers Hotline to Report Ethanol Damage. (2006, 12 02). Retrieved 2007, from NAtional Road and Motorist Association: www.mynrma.com.au/cps/rde/xchg/SID-3F5768E7EF3AB28/mynrma/hs.xsl/193_release2002_01220b_1.htm

Minnesota Department of Commerce. (2001). *Flexibile Fuel Vehicles-E85: Fleet Managers Guide.* Retrieved 2008, from Minnesota Department of Commerce: www.state.mn.us/mn/externalDocs/commerce/FFV_Fleet_Sales_Guide_110802014008_E85Fleet.pdf

Mollet, A. (2006). *Nissan GReenPRogram 2010.* Retrieved 2006, from Westlaw Website: http://lugar.senate.gov/energy/industry/pdf/Auto_execs_FFVs_Nov21.pdf

National Corn Growers Association. (n.d.). *Consumer Myth Buster.* Retrieved 2008, from National Corn Growers Association: http://www.ncga.com/ethanol/vehicle/mythbusters.asp

O'Connor, K. (2005). *National Renewable Energy Laboratory, Petroleum Reduction in Public and Private Fleets Through Advanced Technologies and Alternatives Fuels 2.* Retrieved 2008, from Department of Energy:

www.eere.energy.gov/biomass/pdfs/bioethanol_fueling_sustainable_transportation.pdfat 17

Pacific Ethonal Inc. (n.d.). *Why Ethanol?* Retrieved 2007, from www.pacificethanol.net/_content/whyEthanol.php

Real Cost of Oil. (05, August). Retrieved 2007, from www.Ethanoltoday.com/pdf/Real_cost_of_oil_Aug_05.pdf

Renewable Fuel Association . (207). Ethanol Production: 2007 Picks Up Where 2006 let off. *Press Release* . Renewable Fuel Association.

Shultz, G. P. (2005). *Oill and Security, The Commitee on the Present Danger.* Retrieved 2008, from Reshaping the Energy and Security Debate: www.fightingterror.org/pdfs/O&S8-5-05.pdf. Our Planet 14-15

Smolin, M. (2006). Cumberland Law Review. Challenges and Opportunity for Energy Alternatives for Transportation in the united States. *CUMLR* (487), 36.

The Center for Energy and Climate Solutions. (2004). *The Car and Fuel of the Future: A Technology and Policy Overview.* Report for the National Commission on Energy Policy.

Tita, B. (2006, September). Alternative Fuel Talk Boos ADM 9. *Crain's Chicago Bus* , p. 4.

Twomey, B. (2007). Rear View Mirror: C-Max FFV. *Westlaw* , WNLR16205496.

United States Department of Agriculture. (n.d.). *Fuel Policy.* Retrieved 2008, from Energy and Enviroment: www.usda.gov/energyandenvironment/altFuel/policy.htm

Well, J. (2002). Lessons learned from Previous Research Could Benefit Freedom CAR Initiative:. (S. O. Investigation, Interviewer) www.gao.gov/new.items/d02810t.pdf.

WIlson, J. (2006). Study Doubles Estimate of Smog Deaths. *L.A. Times* , p. B1.

World Bank Group. (1998). *Pollution Prevention and Abatement Handbook 93.*

APPENDIX

Appendix A

Flexible Fuel Vehicle

Flexible Fuel Vehicles
National Ethanol Vehicle Coalition
Last updated 09.29.06

Nissan
2007
5.6L Armada
2005 – 2007
5.6L Titan King Cab & Crew Cab

Mercury
2006 – 2007
4.6L Mercury Grand marquis (2- valve)
2002 – 2005
4.0L Selected Mountaineers
2001 – 2005
3.0L Selected Sables
(look for "Road & Leaf")
2007
2.5L C230 Sedan automatic AND manual transportation
2005
3.2L C320 luxury & sport sedan & sport coupe

Mercedes-Benz
2004
3.2L C320 sport sedan, wagon &sport coupe
2003
3.2L C320 sport sedan
1999, 2001 – 2002
3.0L Selected B3000 pickups

Mazda
2000, 2001
2.2L Hombre pickup 2WD

Isuzu
2007
3.9L Buick Terrazza
5.3L Chevrolet Avalanche SUVs

3.9L Chevrolet Express
5,3L Suburban, Tahoe, Yukon, Yukon XL
3.9L Chevrolet Uplander
3.9L Saturn Relay
3.9L GMC Savana

General Motors

3.9L Pontiac Montana SV6 (Canada only)
5.3L Sierra & Silverado truck
2006-2007
3.5L Chevrolet Impala & Chevrolet Monte Carlo
2005-2006
5.3L Sierra & Silverado truck
5.3 Vortec-engine Chevrolet Avalanche,
Suburban, Tahoe, GMC Yukon & Yukon XL

Ford/ Lincoln

2006 – 2007
4.6L Ford Crown Victoria (2 valve, excluding
Taxi and police units)
5.4L Ford F-150
4.6L Lincoln Town Car (2-valve)
2006
3.0L Taurus sedan and wagon
2005
4.0L Explorer Sport Trac
4.0L Explorer
3.0L Taurus sedan and wagon
2004
4.0L Explorer Sport Trac
2002 – 2004
4.0L Explorer (4-door)
1999 – 2004
3.0L Taurus LX, SE & SES sedan
2001 – 2003
3.0L Supercab Ranger pickup 2WD
1999 – 2000
3.0L Ranger pickup 4WD & 2WD
3.0L Taurus LX, SE & SES sedan
2005 – 2006
4.7L Dodge Ram Pickup 1500 Series
2.7L Dodge Stratus Sedan
2.7L Chrysler Sebring Sedan
2004 – 2005
4.7L Dodge Ram Pickup 1500 Series
2.7L Dodge Stratus Sedan

2.7L Chrysler Sebring Sedan
2003 – 2004
2.7L Dodge Stratus Sedan
2.7L Chrysler Sebring Sedan

Daimler Chrysler
2007
4.7L Chrysler Aspen
4.7L Jeep Commander
4.7L Jeep Grand Cherokee
4.7L Dodge Dakota
3.3L Dodge Caravan, Grand Caravan &
Caravan Cargo
2.7L Chrysler Sebring Sedan
2006 – 2007
4.7L Dodge Durango
3.3L Caravan & Grand caravan SE
2003
3.3L Dodge Cargo Minivan
2.7L Chrysler Sebring Conv. & Sedan
2000 – 2003
3.3L Chrysler Voyager minivan
3.3L Dodge Caravan minivan
3.3L Chrysler Town & Country minivan
1998 – 1999
3.3L Dodge Caravan minivan
3.3L Plymouth Voyager minivan
3.3L Chrysler Town & Country minivan
Many 1995-98 Taurus 3.0L Sedans are also FFVs.
2002 – 2004
5.3L Sierra & Silverado truck
5.3L Vortec-engine Suburban,
Tahoe, Yukon & Yukon XLs
2000 – 2002
2.2L Chevrolet S-10 pickup 2WD
2.2L Sonoma GMC pickup 2WD

Foreign manufacturers that produce FFVs include Isuzu, Mazda, Mercedes and Nissan.

Appendix B

Current Alternative Fuel Producing Companies

Company	Location	Feedstock	Current Capacity (mmgy)	Under Construction/ Expansions (mmgy)
Abengoa Bioenergy Corp.	York, NE	Corn/milo	55	
	Colwich, KS		25	
	Portales, NM		30	
	Ravenna, NE			88
ACE Ethanol, LLC	Stanley, WI	Corn	39	
Adkins Energy, LLC*	Lena, IL	Corn	40	
Advanced Bioenergy	Fairmont, NE	Corn		100
AGP*	Hastings, NE	Corn	52	
Agra Resources Coop. d.b.a. EXOL*	Albert Lea, MN	Corn	40	8
Agri-Energy, LLC*	Luverne, MN	Corn	21	
Alchem Ltd. LLLP	Grafton, ND	Corn	10.5	
Al-Corn Clean Fuel*	Claremont, MN	Corn	35	
Amaizing Energy, LLC*	Denison, IA	Corn	40	
Archer Daniels Midland	Decatur, IL	Corn	1,070	
	Cedar Rapids, IA	Corn		
	Clinton, IA	Corn		
	Columbus, NE	Corn		
	Marshall, MN	Corn		
	Peoria, IL	Corn		
	Wallhalla, ND	Corn/barley		
Aventine Renewable Energy, LLC	Pekin, IL	Corn	100	57
	Aurora, NE	Corn	50	
Badger State Ethanol, LLC*	Monroe, WI	Corn	48	
Big River Resources, LLC*	West Burlington, IA	Corn	40	
Broin Enterprises, Inc.	Scotland, SD	Corn	9	
Bushmills Ethanol, Inc.*	Atwater, MN	Corn		40
Cargill, Inc.	Blair, NE	Corn	85	

	Eddyville, IA	Corn	35	
Central Indiana Ethanol, LLC	Marion, IN	Corn		40
Central MN Ethanol Coop*	Little Falls, MN	Corn	21.5	
Central Wisconsin Alcohol	Plover, WI	Seed corn	4	
Chief Ethanol	Hastings, NE	Corn	62	
Chippewa Valley Ethanol Co.*	Benson, MN	Corn	45	
Commonwealth Agri-Energy, LLC*	Hopkinsville, KY	Corn	24	9
Corn, LP*	Goldfield, IA	Corn	50	
Cornhusker Energy Lexington, LLC	Lexington, NE	Corn		40
Corn Plus, LLP*	Winnebago, MN	Corn	44	
Dakota Ethanol, LLC*	Wentworth, SD	Corn	50	
DENCO, LLC*	Morris, MN	Corn	21.5	
E3 Biofuels	Mead, NE	Corn		24
East Kansas Agri-Energy, LLC*	Garnett, KS	Corn	35	
ESE Alcohol Inc.	Leoti, KS	Seed corn	1.5	
Ethanol2000, LLP*	Bingham Lake, MN	Corn	32	
Frontier Ethanol, LLC	Gowrie, IA	Corn		60
Front Range Energy, LLC	Windsor, CO	Corn		40
Glacial Lakes Energy, LLC*	Watertown, SD	Corn	50	
Golden Cheese Company of California*	Corona, CA	Cheese whey	5	
Golden Grain Energy, LLC*	Mason City, IA	Corn	40	
Golden Triangle Energy, LLC*	Craig, MO	Corn	20	
Grain Processing Corp.	Muscatine, IA	Corn	20	
Granite Falls Energy, LLC	Granite Falls, MN	Corn	45	
Great Plains Ethanol, LLC*	Chancellor, SD	Corn	50	
Green Plains Renewable Energy	Shenandoah, IA	Corn		50
Hawkeye Renewables, LLC	Iowa Falls, IA	Corn	50	50
	Fairbank, IA	Corn		100
Heartland Corn Products*	Winthrop, MN	Corn	36	
Heartland Grain Fuels, LP*	Aberdeen, SD	Corn	9	

	Huron, SD	Corn	12	18
Heron Lake BioEnergy, LLC	Heron Lake, MN	Corn		50
Horizon Ethanol, LLC	Jewell, IA	Corn		60
Husker Ag, LLC*	Plainview, NE	Corn	26.5	
Illinois River Energy, LLC	Rochelle, IL	Corn		50
Iowa Ethanol, LLC*	Hanlontown, IA	Corn	50	
Iroquois Bio-Energy Company, LLC	Rensselaer, IN	Corn		40
James Valley Ethanol, LLC	Groton, SD	Corn	50	
KAAPA Ethanol, LLC*	Minden, NE	Corn	40	
Land O' Lakes*	Melrose, MN	Cheese whey	2.6	
Lincolnland Agri-Energy, LLC*	Palestine, IL	Corn	48	
Lincolnway Energy, LLC*	Nevada, IA	Corn		50
Liquid Resources of Ohio	Medina, OH	Waste Beverage	3	
Little Sioux Corn Processors, LP*	Marcus, IA	Corn	52	
Merrick/Coors	Golden, CO	Waste beer	1.5	1.5
MGP Ingredients, Inc.	Pekin, IL	Corn/wheat starch	78	
	Atchison, KS			
Michigan Ethanol, LLC	Caro, MI	Corn	50	
Mid America Agri Products/Wheatland	Madrid, NE	Corn		44
Mid-Missouri Energy, Inc.*	Malta Bend, MO	Corn	45	
Midwest Grain Processors*	Lakota, IA	Corn	50	45
	Riga, MI	Corn		57
Midwest Renewable Energy, LLC	Sutherland, NE	Corn	17.5	4.5
Minnesota Energy*	Buffalo Lake, MN	Corn	18	
Missouri Ethanol	Laddonia, MO	Corn		45
New Energy Corp.	South Bend, IN	Corn	102	
North Country Ethanol, LLC*	Rosholt, SD	Corn	20	
Northeast Missouri Grain, LLC*	Macon, MO	Corn	45	
Northern Lights Ethanol, LLC*	Big Stone City,	Corn	50	

	SD			
Northstar Ethanol, LLC	Lake Crystal, MN	Corn	52	
Otter Creek Ethanol, LLC*	Ashton, IA	Corn	55	
Panhandle Energies of Dumas, LP	Dumas, TX	Corn/Grain Sorghum		30
Parallel Products	Louisville, KY R. Cucamonga, CA	Beverage waste	5.4	
Permeate Refining	Hopkinton, IA	Sugars & starches	1.5	
Phoenix Biofuels	Goshen, CA	Corn	25	
Pine Lake Corn Processors, LLC*	Steamboat Rock, IA	Corn	20	
Platte Valley Fuel Ethanol, LLC	Central City, NE	Corn	40	
Prairie Ethanol, LLC	Loomis, SD	Corn		60
Prairie Horizon Agri-Energy, LLC	Phillipsburg, KS	Corn		40
Pro-Corn, LLC*	Preston, MN	Corn	42	
Quad-County Corn Processors*	Galva, IA	Corn	27	
Red Trail Energy, LLC	Richardton, ND	Corn		50
Redfield Energy, LLC	Redfield, SD	Corn		50
Reeve Agri-Energy	Garden City, KS	Corn/milo	12	
Siouxland Energy & Livestock Coop*	Sioux Center, IA	Corn	25	
Siouxland Ethanol, LLC	Jackson, NE	Corn		50
Sioux River Ethanol, LLC*	Hudson, SD	Corn	55	
Sterling Ethanol, LLC	Sterling, CO	Corn	42	
Tall Corn Ethanol, LLC*	Coon Rapids, IA	Corn	49	
Tate & Lyle	Loudon, TN	Corn	67	
The Andersons Albion Ethanol LLC	Albion, MI	Corn		55
Trenton Agri Products, LLC	Trenton, NE	Corn	35	10
United WI Grain Producers, LLC*	Friesland, WI	Corn	49	

US BioEnergy Corp.	Albert City, IA	Corn		100
	Lake Odessa, MI	Corn		45
U.S. Energy Partners, LLC	Russell, KS	Milo/wheat starch	48	
Utica Energy, LLC	Oshkosh, WI	Corn	48	
Val-E Ethanol, LLC	Ord, NE	Corn		45
VeraSun Energy Corporation	Aurora, SD	Corn	230	
	Ft. Dodge, IA	Corn		
Voyager Ethanol, LLC*	Emmetsburg, IA	Corn	52	
Western Plains Energy, LLC*	Campus, KS	Corn	45	
Western Wisconsin Renewable Energy, LLC*	Boyceville, WI	Corn		40
Wind Gap Farms	Baconton, GA	Brewery waste	0.4	
Wyoming Ethanol	Torrington, WY	Corn	5	
Xethanol BioFuels, LLC	Blairstown, IA	Corn	5	
Total Current Capacity			**4336.4**	
Total Under Construction/Expansions				**1746**
Total Capacity			**6082.4**	