THESIS - AN INVESTIGATION

OF U.S. NATIONAL ENERGY POLICY

SUPPORTNG THE BIOFUEL INDUSTRY

INCLUDING A CASE STUDY OF ILLINOIS SOY OIL AND BIODIESEL PRODUCTION

by

Allyce Marie Ramadan

A thesis submitted to the Faculty of the University of Delaware in partial fulfillment of the requirements for the Master in Energy and Environmental Policy

Spring 2014

ProQuest LLC.
789 East Eisenhower Parkway
P.O. Box 1346
Ann Arbor, MI 48106 - 1346

THESIS - AN INVESTIGATION

OF U.S. NATIONAL ENERGY POLICY

SUPPORTING THE BIOFUEL INDUSTRY

INCLUDING A CASE STUDY OF ILLINOIS SOY OIL AND BIODIESEL

PRODUCTION

by

Allyce Marie Ramadan

Approved: _____

William F. Ritter, Ph.D., P.E.
Professor in charge of thesis on behalf of the Advisory Committee

Approved: _____

John Byrne, Ph.D.
Director of the Center for Energy and Environmental Policy

Approved: _____

Babatunde A. Ogunnaike, Ph.D.
Dean of the College of Engineering

Approved: _____

James G. Richards, Ph.D.
Vice Provost for Graduate and Professional Education

ACKNOWLEDGMENTS

I am indebted to so many people who have helped me with my research. I would first like to thank my thesis chair, Dr. Ritter, for his patience and guidance throughout the planning and writing process of my thesis. Dr. Ritter was always available to discuss my ideas from the very beginning, as well as offered insight as my research progressed and the methodology developed. He offered invaluable insight to my writing to help me overcome challenges as the content of my thesis was being organized. I would also like to thank my thesis review board members, Dr. Corbett and Dr. Kurdgelashvili for putting before me important quantitative questions which enabled me to prepare a more complete analysis for my final thesis.

I am grateful to Dr. Byrne and Dr. Wang, and the University of Delaware for giving me this opportunity to study at the Center for Energy and Environmental Policy. The entire CEEP family has been very supportive to me not only as I prepared my thesis, but also as a wonderful community as we studied together for coursework and through research teams during my master's program. I have learned the benefit of team work and the value of a support network working side by side with my colleagues at CEEP.

Lastly, I would like to thank my daughter, Layne, who is my inspiration and my true reason for wanting to work so hard for a better tomorrow…not just for us personally, but for our Mother Earth and a more sustainable future for us all.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABSTRACT

This thesis reviews U.S. national energy policy and the Renewable Fuel Standards (RFS) to project the future of soybean oil for food and biodiesel use in local industry. The research issues include whether the food and fuel industries are in balance locally and nationally and if the U.S. blenders' tax credit has increased foreign imports and if so, could an increase in import tariffs better control the domestic biodiesel market if local producers are in jeopardy due to the increase in imports. Linear programming is used for optimization by location analysis of soybean processing and refining in the state of Illinois. A model is developed that found at the Illinois boundaries, processors are exporting soy oil outside the state whether for food and/or biodiesel as Illinois is able to meet their local demand for biodiesel. One significant implication of this study is the proven Energy Title programs which support the biodiesel production for a reduction in greenhouse gases to meet the RFS with 1.2 billion gallons of biodiesel by 2022. This thesis explores the need for consistent and long-term collaboration such as the Energy Title, increased import tariffs and the biodiesel blenders' tax credit to show true congressional support to supply economic growth, jobs and environmental health in the United States. This research also explores the benefits of biodiesel concerning reduction of greenhouse

gas emissions, petroleum imports for energy security and fuel efficiency, as well as ways and means in which the biodiesel industry may be growing in the United States.

Chapter 1

INTRODUCTION

"Misconceived or badly designed business systems, population growth, and wasteful patterns of consumption are the primary causes of the loss of natural capital, and all three must be addressed to achieve a sustainable economy" (Hawken, Lovins, & Lovins, 2000, p. 9). There is an increased interconnection developing in the world among food, fuel and valuable land due to the biofuel industry and success depends on economics keeping this paradigm in harmony. The United States can tackle this concern from a bottom up approach of successful national energy policy such as the Energy Title programs which recognize the tradeoffs by keeping social costs and smart decision- making for local and community affects of our national policy in the forefront. The purpose of this thesis is to close the gap between theory and application by recognizing proven energy programs and best management practices to demonstrate economic gain and social equity.

.

1.1 **Significance of this Research**

There is some controversy as to whether food stocks should be used to manufacture fuel sources such as in the biofuel industry considering growing populations and increasing food prices. Some may argue that valuable farmland that was once used to produce food is now being converted to biofuel crops due to the renewable fuel standards increasing demand of biofuel blending.

This thesis will demonstrate the benefits of biofuel including reduction of greenhouse gases in an effort to change this attitude, that is: food *versus* food, but rather, a food *and* fuel. This topic will also show market growth for soy oil for food and biofuel and also demonstrate there is sufficient supply of soybeans in the United States for soybeans for animal feed, soy oil processing, biodiesel and exports of soybeans.

This research investigates policy that supports biodiesel production in the United States. I hope to bring to light some areas that may jeopardize American industries such as some foreign imports that produce millions of gallons of biodiesel but are clearing trees for the crops to produce even more of this fuel, with a major intention of exporting.

After establishing a sound American market, this research hopes to uncover U.S. National policy strategies that can aid the American Biodiesel industry to meet future demands as this growing industry has much opportunity waiting. This thesis

will show many paths that biodiesel is forecasted to be used by means of diesel blending applications.

This thesis will offer recommendations to protect the American biodiesel producer and to support the local biodiesel industry. Awareness for permanent national energy policy for renewable energy programs is an objective as this industry lowers greenhouse gases, increases our energy security by reducing petroleum imports, and stimulates the economy.

The intent also shows unification of local industries working together and establishing a sense of community. A point is to recognize that green incentives should go to assist local companies, rather that foreign companies, and that it is good business practice and socially responsible to employees and communities working together in "green development". The benefits of investing in natural capital, that is biodiesel, are shown in this thesis with examples such as increased numbers of projects started through Energy Title programs, many jobs and refineries in the biofuel industry and the expected growth over the next 25 years.

Another benefit of this thesis is the importance of the renewable fuel standards (RFS) and the opportunity for biodiesel potential growth as it is classified not only to meet it Biomass Biodiesel quota volume, but also assist with the Advanced Biofuel quota. This analysis should analyze if the United States has sufficient capacity to meet the demand of the RFS and without putting a strain on soy oil for the food supply.

1.2 **Background**

1.2.1 Natural Capitalism - Theoretical Framework

According to Natural Capitalism school of thought by Hawkins, Lovins and Lovins, the primary causes of losses of natural resources are due to over consumption, population growth, lack of communication and bad business practices, and these areas must be dealt with in order for an economy to become sustainable (Hawken, Lovins, & Lovins, 2000, p. 9). In a sustainable - market economy, prices reflect the scarcity of the supply of the natural resource and the grossness of the demand of the natural products in order to keep the market in balance. But a sustainable system must be free of wasteful flows in manufacturing, production and consumption by being as efficient as possible in the downstream and upstream of the product. Such a system must also be self- sufficient in maintaining itself and never depleting the industry of profit due to negligence.

The current market system does not reflect true prices due to taxes and subsidies, and inefficient handling of energy policy incentives has led to near industry collapse in the renewable marketplace for biodiesel. Although higher import tariffs are being imposed on the U.S. and other counties for biodiesel, the U.S. continues with a low biodiesel import tariff which may affect local U.S. biodiesel production. The U.S. has included Renewable Fuel Standards (RFS) and Corporate Average Fuel Standards (CAFÉ) in an effort to reduce patterns of consumption and waste. These efforts have increased biodiesel production in the U.S. But care must be taken as populations increase, as current feedstock of biodiesel processing is soybeans, and 30% of U.S.

soybeans are currently being used for biodiesel production (USDA, Soybeans: Annual U.S. Supply and Disappearance, 2013).

In "Making Markets Work", Natural Capitalism suggests that we use market economics as a "tool for solving problems, while understanding markets' boundaries and limitations", (Hawken, Lovins, & Lovins, 2000, p. 260). The book, *Natural Capitalism* argues that most of the earth's natural resources, which are necessary for basic life and economic activities, are not accounted for by conventional economics. To promote markets to work to fulfill their potential, we must dedicate ourselves to remember the true purpose: "Markets are meant to be efficient, not sufficient" (Hawken, Lovins, & Lovins, 2000, p. 262). In other words, we have to pay attention when resources become so scarce they should be taken off the market and conserved and protected, or rather initially harvested for a sustainable market economy.

Hunter Lovins' book complements what I learned in my MBA program as I had a concentration in environmental stewardship, where I was introduced to the 'triple bottom line concept': a business should be economically viable, socially responsible, and environmentally sound (Nordisk, 2008). *Natural Capitalism* also introduces a visionary concept that regards business, social and environmental interests as an integral, harmonious system (Hawken, Lovins, & Lovins, 2000). Lovins' book establishes a framework for today's economic and natural resources including the energy, food and valuable land paradigm (shared resources) that the United States is striving to keep in balance.

A case study is done within the state of Illinois based on a location analysis of soy oil processing plants capacities and the demand of biodiesel refineries. The results of this analysis can be used to determine the most efficient expansion of biodiesel

industry in Illinois based on the current supply of processed soy oil and biodiesel refinery demand in Illinois.

1.2.2 Food and Fuel in the Marketplace

Soy is used for both human and animal food uses. In 2011, of three billion bushels, over 30 million tons of soybean meal was consumed as livestock feed in the U.S. (Major Crops Grown in the U.S., 2014). Soybeans are second only to corn as the most planted field crop in the U.S. The U.S. represents 50 percent of the world's oilseed production, the world's largest producer and exporter with soy oil the number one edible oil in the U.S. The hulls from soy oil processing, whether for biodiesel or for food industry can be used for animal feed because of its high protein.

Food commodities include grains, dairies, meats, oils and sugar. The rising price of food overall cannot be attributed to the production of biofuels – ethanol or biodiesel. Like food commodity prices in general, corn and soybean prices are closely correlated with energy prices (Qata's Comments on Biofuels are Self Serving: GRFA, 2011). This concept is further discussed below.

The renewable fuel standards are part of federal policy that establishes minimum volume of biofuels to be used (blended) in the national transportation fuel supply each year (Schnepf & Yacobucci, 2013, p. 1). In addition to the volume requirement, the biofuels qualifying for the renewable fuel standard must achieve a certain amount of lifecycle greenhouse gas emission reductions. One of the four categories listed in the renewable fuel standards is biomass-based diesel and is a topic of this thesis. All renewable fuel must be made from feedstocks that meet an amended

definition of renewable biomass, including certain land use restrictions. The scope of this thesis includes a case study of soy oil production within the boundaries of Illinois to determine what to do with the next gallon of soy oil. Should soy oil be sold for biodiesel refining or be used in the food industry? Does Illinois have the capacity to meet the demands of both of these industries within the state?

There has been controversy over increased food prices as related to biofuel made from food crops that began with corn ethanol. A study was done by an agriculture and economics consulting firm, Applied BioFuels Corporation (ABF Economics) as reported by Forbes providing evidence which found no direct correlation between the Renewable Fuel Standards for corn ethanol and increased corn ethanol production and increased corn prices (Mackinnon, 2013). This study was consistent with the World Bank study done in 2010 which cited that higher oil prices were the leading cause of increased food prices, worldwide. This is related to higher operating and transportation costs of the food industry.

1.2.2.1 Increased Uses of Biodiesel - The American Automotive Industry

There are a number of new American four and six cylinder passenger cars on the market today providing more options for fuel efficiency and tougher emission standards. Diesel engines have the highest thermal efficiency of any regular internal or external combustion engine due to its high compression ratio- 14:1 to 23:1 for a typical diesel engine vs. 7:1 to10:1 for a typical gasoline engine (Difference Between Diesel and Gasoline Engines, 2010). Although diesel costs more compared to regular gasoline, the fuel has 25-30% more energy per gallon and therefore, diesel is more

fuel efficient (Transportation, 2013). Diesel costs about the same as premium gasoline. Today's blended diesel is cleaner than regular diesel by using ultra-low sulfur diesel and new engine technology has quieter engines. Finally, diesel and diesel engines provide more torque and power, a reason why class 8 trucks, trains and ships run on diesel.

It is estimated that by 2018, the number of diesel automobiles in America will double provided through Audi, BMW, Mercedes Benz and GM, and others with the number of models tripling by 2017. Audi has three diesel sedans available, and BMW has a diesel sedan and wagon (Lloyd-Miler, 2013). Chevrolet has a diesel compact sedan and Jeep offers the return of the Jeep Grand Cherokee EcoDiesel in 2014. Dodge has a diesel pickup truck and Volkswagen, and Mazda anticipate models very soon.

1.2.2.2 Increased Uses of Biodiesel - Department of Defense

Military fuel specifications are very restrictive as to the quality of the product and the materials that are allowed to be added to any diesel fuel at ambient and at low temperature, flash point, effect on cetane number, and storage stability (Frame, Bessee, & H.W., 1997, p. 21). The Cetane number measures the "ignition quality of diesel fuel". Cetane is defined as the period of time between the start of injection of the fuel and the start of combustion (ignition) in the diesel engine. A higher number cetane fuel will have shorter ignition delay periods than a lower number cetane fuel (The Importane of Cetane in Diesel Fuels, 2014). Consequently, considerable care must be used when blending stocks are considered (Frame, Bessee, & H.W., 1997).

Military stipulations include solubility, storage and chemical stability in soy fuels that are tested. More recently, the use of biofuel blends blended with diesel fuels is becoming more common.

Fuels used by the Department of Defense mandates that military fuels must remain stable for a year or more in bulk storage tanks. The Department of Defense has now authorized the purchase of petroleum diesel fuel that contains up to a maximum of 5% biodiesel for usage in any vehicle. However, for non-tactical vehicles only, an 80% petroleum diesel and 20% biodiesel blend will be permitted (Mushrush, Willauer, Wynne, Lloyd, & Bauserman, 2005). Furthermore, the Navy plans to add biofuels into its purchases of approximately 77 million gallons of jet fuel (JP-5) and marine diesel (F-76) (USDA, U.S. Navy Unveil Farm to Fleet Program: as Shift to Biofuels Blends Begins, 2013).

1.2.2.3 Increased Uses - Diesel Locomotive

With the EPA emission standards coming into effect in 2015, diesel locomotive companies can look to biodiesel to reduce carbon dioxide emissions. The two largest locomotive companies in the U.S. are GE Transportation and Electromotive Diesel Inc (EMD) (Bergstrom, 2012). Although orders for new locomotives in the U.S. have been down by 2/3, these companies are making advances in technology to comply with new EPA regulations and are successful in the international market. GE reported third quarter orders of $1.2 billion last year for locomotive orders for their new model. With the added benefit of biodiesel blended

with EPA specifications, these locomotives have added environmental benefits to the already efficient means of public and freight transport.

1.2.2.4 Sales of Distillate (Diesel) by End Use

Table 1.1 End Uses Diesel -Distillate (Petroleum and Other Liquids, 2013)

End Use 2012	Amount (thousand gallons)
Farm	3,031,878
Railroad	3,118,150
Vessel Bunkering	1,768,324
On-highway	36,343,072
Military	142,696
Residential	3,473,310
Commercial	2,557,543
Industrial	2,325,503
Oil Company	1,710, 510
Electric Power	461, 694
Off-highway	2,088,157
Total	57,020,840

Diesel fuel is used by a number of modes of transportation (Table 1.1). There has been an increase in the railroad sector from coal-fired steam to diesel and diesel-electric. Diesel is also used in the ship industry, but the majority is in large commercial trucks. The table also shows a large market for farm equipment. Diesel consumption for transportation use rose by 20% in recent years since 1975 (Behrens &

Carol, 2012, p. 15). Biodiesel blending opportunities exist for each of these uses, including electric power.

Most users in the United States buy B20, 20% biodiesel, 80% diesel, or lower although B20 or higher blends qualify for biodiesel fuel use credits under the Energy Policy Act of 1992 (Alternative Fuels Data Center, 2013).

1.2.3 Proven Energy Title IX Programs

The Food, Conservation, and Energy Act of 2008 has become to be known as the 2008 Farm Bill. This bill became law six months after the enactment of the Energy Independence and Security Act of 2007 (EISA, P.L. 110-140) (Schnept, 2013, p. 2). A key component of the EISA was to increase the renewable fuels standards (RFS), which mandates non-corn starch based biofuels. Reasons for RFS were to increase energy security and reduce lifecycle greenhouse gas emissions due to global warming. The minimum use must grow from zero in 2008 to 21 million gallons by 2022. One of the main focuses concerning energy in the 2008 Farm Bill was to encourage growth in EISA's programs such as the Energy Title incentives of non-corn based feedstocks of renewable energy (Schnept, 2013).

The Energy Title first began with the 2002 Farm Bill (Farm Security and Rural Investment Act of 2002, P.L. 107-171 (Olson, 2011) (Schnept, 2013). At that time, there was bipartisan support and a stronger federal commitment to farm-based crops for energy. There were many expansions to the original Energy Title in the 2008 Farm Bill including $1.2 billion in mandatory funding for a variety of renewable energy programs such as advanced biofuels, diversified crops and energy efficiency

programs. One of main objectives for the Energy Title of the 2008 Farm Bill, was to design and to provide encouragement and pathways for "the research and development of new agriculture-based renewable fuels, especially second-generation biofuels, based on non-food crop biomass such as cellulose and algae, and to expand their distribution and use" (Schnept, 2013, p. 4).

The American Soybean Association (ASA) also believes in farm bill programs that would not "distort planting decisions but protect for risk management" (American Soybean Association, n.d.). ASA supports the reauthorization and increased mandatory funding of the Biodiesel Fuel Education Program (Section 9006) and the Biobased Market Program (Section 9002) in the Energy Title of new farm legislation. They feel the benefits provided by the Biodiesel Fuel Education Program and the Biobased Market Program have been "worth their relatively low cost" which is about 1 % of total Energy Title funds, and "warrant continuation with an increased level of mandatory funding" (American Soybean Association, n.d.).

Furthermore, the Renewable Energy for America Program (REAP) within Energy Title IX supports every type of renewable energy technology, including wind, solar, biomass (biodiesel) refining, and biogas in all fifty states (Farm Bill Advances Toward Passage, 2014). Since the 2008 Farm Bill passing of REAP, this program has assisted with 6600 projects in the United States with 15,000 employees "generating or saving more than 7.3 billion kilowatt hours of electricity." The program requires at least a $3 match for every $1 of federal funds appropriated. In the 2008 Farm Bill, REAP received nearly 25% of the mandatory funds allocated to the Energy Title programs.

1.2.4 Taxes, Tax Credits and Subsidies

The United States federal excise tax on gasoline is 18.4 cents per gallon and 24.4 cents per gallon for diesel fuel (Gas Taxes, 2014) On average, as of January 2013, state and local taxes add 30.4 cents to gasoline and 30.0 cents to diesel, for a total US average fuel tax of 49.5 cents per gallon for gas and 54.8 cents per gallon for diesel (Gas Taxes, 2014).

Fuel taxes on fossil fuels used for transportation can be used to reduce pollution and to conserve our natural resources because it increases the cost of the product used. They can also be used to reduce imports using an import tax as the price of fuel increases less will be purchased by consumers – less supply and demand based on increased prices. Fuels used for agriculture or to heat the home are taxed at a lower rate (What are the projected diesel fuel prices for 2014 and 2015?, 2014).

1.2.4.1 Blenders Tax Credit

Just as the transition from 2012 to 2013, there was no blenders' tax credit for biodiesel; again from 2013 to 2014 the blender's tax credit has been allowed to expire (Wagner, 2014). Early in 2013 the tax credit was reinstated and made retroactive for 2012 as it was expired a full year (Wagner, 2014). There were expectations that the blenders' tax credit would be reinstated and the market moved at a slower pace waiting for this event in order to collect the tax incentive in the amount of $1/gallon for pure biodiesel, agri-biodiesel or renewable diesel blended with

petroleum diesel to produce a mixture containing at least 0.1%, according to forecasters (Wagner, 2014).

Resources state that “margins are strong” with the biodiesel “blenders’ tax credit” is in effect, but the biodiesel market collapsed again “when there is a rush to produce if the tax credit is allowed to expire then is reinstated which results in overproduction as this distorts prices in producers’ effort" (Alternative Fuels Data Center: Biodiesel Mixture Excise Tax Credit, 2014).

1.2.4.2 The Renewable Identification Numbers

The RFS has implemented Renewable Identification Numbers (RIN) issued by the EPA according to the Energy Policy Act of 2005 for the purpose of tracking renewable fuel usage (Methodology and Specificactions Guide, 2013). The RIN is a serial number assigned to each batch of biofuel to track its production, use, and trading as required by the EPA's RFS throughout the supply chain: refinery, import and blending to see how the mandated quotas have been fulfilled. "Obligated" parties meet certain RFS quotas and use RINs. These obligated parties are defined as the companies that refine, import or blend fossil fuel based on the volume they introduce into the market.

RINs ensure compliance and obligated parties are periodically required to demonstrate they have met their RFS quota by submitting their RIN to the EPA as a quantitative representation of the amount of biofuel that has been blended into the

fossil fuel they have supplied to the market. If the obligated party has not used enough physical product, it can purchase RINs to satisfy the quota. The "EPA calendar-year RINs expire two years forward on the last day of February" (Methodology and Specificactions Guide, 2013, p. 8).

Under the Clean Air Act (CAA), as amended by the Energy Independence and Security ACT EISA), the Environmental Protection Agency (EPA) has sets RFS standards (Renewable Fuels: Regulations & Standards, 2014, p. 1). The RFS include percentage standards in our fuel supply and national volumes of biofuels including biodiesel. The EPA has proposed to maintain the 2013 volume levels of biodiesel for 2014 and 2015 and reduce the RFS volumes for ethanol and advanced biofuel for gasoline blending due to the blending wall and the decrease in gasoline consumption due to more efficient cars. Based on the assessment of cellulosic volumes, The EPA is proposing a lower target and biodiesel can be increased to meet the volume requirement for advanced ethanol (Renewable Fuels: Regulations & Standards, 2014, p. 2).

1.2.4.3 Renewable Volume Obligations

"The EPA uses Renewable Volume Obligations (RVO) as mechanisms To implement the RFS program. RVOs are the targets for each refiner or

importer of petroleum-based gasoline or diesel fuel, while RINs allow for flexibility in how each of them may choose to comply" (Today in Energy, 2014).

"The volumes for the four RFS targets (cellulosic, biodiesel, advanced, and total) are assigned to the obligated parties—refiners and importers of gasoline and diesel fuels—by way of RVO percentages. The RVOs are calculated by dividing each RFS target by the total estimated supply of nonrenewable gasoline and diesel fuel in each year" (Today in Energy, 2014).

There are four separate RVOs that represent the four different RFS targets.

For 2013, the four proposed RVO targets are:

- cellulosic biofuels, 0.008%
- ethanol equivalent for biomass-based diesel, 1.12%
- advanced biofuels, 1.6%
- total renewable fuels, 9.63%

"The RVOs are applied to each obligated party's actual supply of gasoline and diesel fuel to determine its specific renewable fuel obligation for that calendar year. Obligated parties must cover their RVOs by surrendering RINs within 60 days after the end of each calendar year " (Today in Energy, 2014).

1.3 **Statement of the Problem**

An objective of this thesis is to investigate national energy policy supporting the biofuel industry. When Biofuel Blending Tax Credits expire and markets expect these credits to be reinstated at some later time, this can create chaos in the biofuels industry (Wagner, 2014). Such was the case with the biodiesel industry in 2012 transitioning to 2013 when the tax credit was not in place but it was anticipated that it would be reinstated (Wagner, 2014). "The markets discounted the reinstatement early, so the margins in the biodiesel industry went negative for the second half of 2012." This forced firms to "either do the financially responsible thing" and close their refineries down while they were in the negative margin period, or "gamble and keep producing and keep taking a loss" not only expecting the tax credit extension to pass, but only that it would be made retroactive (Wagner, 2014).

Small refineries did not have the capital resources to gamble and had to shut down but larger companies capitalized on the opportunity. Renewable Energy Group (REGI) is one such company that showed nice gains and bought out a smaller producer, Syntroleum (SYNM).

The 2013 Biodiesel Blenders Tax Credit has again expired at the transition into 2014. The $1 per gallon tax credit is split 50/50 between the biodiesel producer and blender (Gefvert, 2013) . The blenders' tax credit has caused an oversupply of biodiesel to the market with foreign producers shipping biodiesel into the country to get the tax credit for every gallon of biodiesel produced according the REGI. There is no real concern for the foreign producers to meet the RFS mandates or for local carbon reduction, but merely just the financial incentive.

Second, U.S. Renewable Fuel Standard for biomass-based diesel is 1.28 billion gallons for 2014 as well as for 2015, and the U.S. biodiesel production capacity is currently 2.2 billion gallons per year. Therefore how much capacity does this leave for foreign imports that may have cost advantage through cheaper inputs and subsidies that can sell the biodiesel at a lower price? U.S imports tariffs on Biodiesel are much lower than Europe's: U.S at 5% compared to Europe currently at 25% for biodiesel (Steams, 2013). Europe has recently imposed a duty on all biodiesel imports, including on the United States, to protect their local producers from outside interests that have a cost advantage from tax breaks and government subsidies and having an unfair advantage over local businesses in their market economy.

Third, the 2013 Energy Title IX of the Farm Bill does not have consistent support in energy programs that shows a continued government commitment for the reasons the Renewable Fuel Standards were established: energy security and reduced lifecycle greenhouse gas emissions due to global warming. (Jalonick, 2013). The Farm Bill was allowed to expire twice and with it, the Energy Title and its programs. It expired in 2012 but was given an extension which expired again December 31, 2013 (Monke & Stubbs, 2013). Finally, the Farm Bill was finally signed by President Obama in February, 2014 after having no policy in place since it expired in 2013 because of the debate on unrelated issues in the Farm Bill with the SNAP food stamp program and crop insurance.

1.4 **Research Issues**

The research issue of this paper will examine the balance of soy oil in the food and fuel as related to soy oil supply in the United States. The scope of the case study model of the analysis will be confined within the boundaries of the state of Illinois and consist of six major soybean processing plants and six major biodiesel refineries. More details of the research issue will be discussed in the methodology section as the description of optimization for location analysis. The analysis will determine if there is opportunity for growth of the biodiesel industry within the state of Illinois based on the model. The analysis will then broaden to take a look at the entire U.S. and the demand for soy oil, soybeans and biodiesel industry on a larger scale to see if there are shortages or if the markets are stable based on U.S. soy oil supply.

Once the U.S. soy oil markets for food and biodiesel are analyzed, the next step is to examine national energy policy related to biodiesel. What national energy policy is helping or hurting the balance in this biofuel industry? What recommendations can be offered that can aid biodiesel production to help the United States meet the Renewable Fuel Standards without causing any imbalance for the demand for soy oil for food needs?

1.5 **Roadmap of Remaining Paper**

The Literature Review begins with a brief discussion of Natural Capitalism which was chosen for the theoretical framework perspective for this thesis. Then, the Renewable Fuel Standards are reviewed and with mention of current markets for the

biodiesel blending. The Energy Act is mentioned with definitions as they relate to current biodiesel tax credit and recent history. Energy Title IX programs are listed which have an impact on the soybean biodiesel industry. Next, the processing of soybean to produce soybean oil is briefly described which sums up the Literature Review chapter.

The Theoretical Framework chapter begins with annotations from Hawkins and Lovins book on the benefits of investing in natural capital with the objective to reduce consumption of natural resources. Next, a question is asked if the United States "green incentives" such as blenders' tax credits should go directly to help local industries in the United States. Innovation is then mentioned as a driver for the American biodiesel industry enabling it to be a learning organization. "Buildings Blocks" from the Hawkins and Lovins book are discussed as part of successful business practices and proven Energy Title programs are reviewed. And finally, free markets and the future of the biodiesel industry are discussed.

The scope of the Methodology utilizes six processing plants and six refineries within the state of Illinois using a linear programming model to determine whether if the demand for soy oil for food or biodiesel in Illinois is being met. There is a review of soy oil demand for food and biodiesel in the United States. The task is to see if the food and biofuel industries are in harmony. A Geographical Information Systems program was used to map the refineries and processors in the state of Illinois and give a visual representation of the model's results. Excel Solver provided a tool for linear programming and produced a sensitivity report with shadow prices and the definitions are describes and the results are discussed in the Results and Analysis chapter. The

purpose is to find the most efficient delivery methods to meet the demand of the refinery plants.

The Results and Analysis include is a discussion of policy analysis for the biodiesel industry. The discussion includes import tariffs and the blenders' tax credit for biodiesel and discusses U.S. support of the biodiesel industry. The U.S. production of soybeans for biodiesel, soy oil, and exports is graphed, as well as discussed in this chapter. In addition, the case study model results of local soybean processing and biodiesel supply and demand in Illinois are given here.

The Conclusions and Recommendations chapter closes the thesis with deductions based on analysis and data from the research. This last chapter covers the research issues and problem statement as described in the Introduction and offers ideas for solutions to aid renewable energy growth in a competitive energy marketplace.

Chapter 2

LITERATURE REVIEW

2.1 Natural Capitalism

> "We need...to transform the sticks and carrots that guide and motivate business.....revisiting the tax and subsidy system - the mechanism that is most responsible for the constant rearrangement of monetary flows and that determines social, economic and ecological outcomes by applying politically selected subsidies and penalties " (Hawken, Lovins, & Lovins, 2000, p. 159).

Fuel taxes are necessary to increase the price of petroleum in an effort to reduce consumption of fossil fuel. But there needs to be stability with the blenders' tax credit and increased import tariff due to foreign importers such as Argentina and Indonesia shipments oversupplying the United States biodiesel market and possibly putting US biodiesel producers in the negative (Kotrba, U.S. biodiesel exports surge in August, 2013).

Currently, the United States duty is only 5% for biodiesel imported into the United States (Kotrba, U.S. imports, 2013). Europe imposes much higher tariffs: $300-$340 per metric ton, or 25% on Argentina in order to halt imports (Stearns, 2014). The U.S. also imports biodiesel from Germany, Canada, Finland and

Singapore. " Taxes make something more expensive to buy, subsides artificially lower prices " (Hawken, Lovins, & Lovins, 2000, p. 164).”A tax shift is not intended to redefine who pays the taxes but only what is taxed" (Hawken, Lovins, & Lovins, 2000, p. 164). " Ideally, subsidies are supposed to exert a positive outcome by helping people, industries, regions, or products that need to overcome cost, pricing, or market disadvantages" (Hawken, Lovins, & Lovins, 2000, p. 160). The foreign producers are collecting on the United States tax credit that was meant to assist the growth of the new American industries. These local industries have a vested interest to reduce greenhouse gas emissions in the United States, conserve natural resources and reduce imports. It is "advantageous to use fewer virgin materials, save resources...living systems are the supplier of key components for the life of the planet...on the road to efficiency" (Hawken, Lovins, & Lovins, 2000, p. 27) .

2.2 **Renewable Fuel Standard**

> “Congress first established the RFS with the enactment of the Energy Policy Act of 2005 (EPAct, P.L. 109-58). This initial RFS (referred to as RFS1) mandated that a minimum of 4 billion gallons be used in 2006, rising to 7.5 billion gallons by 2012. Two years later, the Energy Independence and Security Act of 2007 (EISA, P.L. 110-140) greatly expanded the biofuels mandate volumes and extended the date through 2022. The expanded RFS (referred to as RFS2) required the annual use of 9 billion gallons of biofuels in 2008, rising to 36 billion gallons in 2022, with at least 16 billion gallons from

cellulosic biofuels, and a cap of 15 billion gallons for corn-starch ethanol" (Renewable Fuel Standards, 2013).

> "In addition to the expanded volumes and extended date, RFS2 has three important distinctions from RFS1. First, the total renewable fuel requirement is divided into four separate, but nested categories—total renewable fuels, advanced biofuels, biomass-based diesel, and cellulosic biofuels—each with its own volume requirement. Second, biofuels qualifying under each category must achieve certain minimum thresholds of lifecycle greenhouse gas (GHG) emission reductions, with certain exceptions applicable to existing facilities. Third, all renewable fuel must be made from feedstocks that meet an amended definition of renewable biomass, including certain land use restrictions" (Schnepf & Yacobucci, 2013, p. 2). (See Table 2.1)

Table 2.1 RFS 2014-15 (EPA, 2013)

Category	Volume	Range
Cellulosic	17 mill gal	8-30 mill gal
Biomass-based diesel	1.28 bill gal	1.28 bill gal
Advanced biofuel	2.20 bill gal	2.0-2.51 bill gal
Renewable fuel	15.21 bill gall	15.00-15.52 bill gal

2.3 **Biodiesel Imports**

The U.S. imported more than 46 million gallons of bio-massed diesel October, 2012, which was an increase of 28.7 million gallons from September (Biodiesel Production, Imports Records for October, 2013). October's imports were more than

triple that of Augusts import volumes which only 15 million gallons were. Imports from Argentina were 23 million gallons, imports from Indonesia were 8.5 million gallons, and imports from Germany were more than 6 million in October. As Europe has enforced anti-dumping duties on Indonesia and Argentina, imports to the U.S. have been steadily increasing.

For example, Indonesia's biodiesel production increased from 781 million liters (206.3 million) to 1.52 billion liters (400 million gallons) in 2011 (Slette & Wiyonp, 2012). Exports were expected to increase 1.5 billion liters (390 million gallons) in 2013. Predictions for biodiesel production in Indonesia for 2012 and 2013 were 1.8 billion liters and 2.2 billion liters (475.5 million gallons and 581.2 million gallons) with 90% of Indonesia's subsidized production going to overseas exports, 10% being used domestically (USDA GAIN: Biofuels, 2012) . The Indonesian subsidy is 3,000 rupiah per liter or approximately $1 per gallon of biodiesel (Slette & Wiyonp, 2012). Indonesia's biggest refineries are state owned. U.S. Biodiesel refineries such as Keystone and KBI at Camp Hill, which produced more than 5.6 million gallons of biodiesel at their plants last year, have filed Chapter 11 bankruptcy this year due to the competitive biodiesel marketplace in the United States (Veronikis, 2014).

2.4 **Indonesia's Biodiesel Development**

Indonesia's biofuel industry is less than ten years old, starting in 2006 (Silviati, 2008). Indonesia uses palm oil to produce biodiesel and faces allegations that biofuel development causes damages to Indonesia's forests due to deforestation (Environmnetal and Social Impacts of Palm Plantations and their Implications for

biofuel Production in Indonesia, 2012). The benefits of employees and investors that report significant gains were not evenly distributed as the economic gains were at the expense of environmental losses. There were significant impacts such as soil erosion, water pollution and air pollution, increasing land scarcity, rising land prices and conflicts over land as well as unevenly distributed economic benefits. By 2001, Indonesia accounted for 46% of the world's crude palm oil and was the second largest producer of biodiesel in the world, a well.

The Indonesian government made it mandatory to blend biofuels in transportation fuels with targets set at 5% for in 2006 and 10% in 2010, increasing to 25% by 2025. Consumption of biodiesel in Indonesia was forecasted to increase by 700 liters in 2013, (180 million gallons). The largest state-owned oil company PERTAMINA, and the Ministry of Energy and Mineral Resources' Directorate General of New and Renewable Energy and Energy Conservation (EBTKE) enforce mandatory biodiesel consumption.

Biodiesel exports from Indonesia increased by almost 117 percent from 2010 to 2011 with Europe as the target. The blending rate for Indonesia's subsidized biodiesel was increased from 5% to 7.5% in early 2012 by PERTAMINA. The Indonesian Ministry of Energy and Mineral Resources (MEMR) and Parliament subsidize approximately $1 per gallon of biodiesel produced. Because domestic biodiesel consumption is slow, there is strong incentive for producers to export.

As Europe has recently imposed an import tax, Indonesia is now looking to export to the U.S. It was noted in Biodiesel Magazine that the EPA published an analysis determining that palm oil biodiesel did not meet the minimum greenhouse reductions for the renewable fuel standards (Kotrba, Palm Oil Biodiesel and the

Renewable Fuel Standard, 2012). "Palm oil biodiesel has a greenhouse reduction rating of only 17 percent....it does not meet the minimum 20 percent to qualify as a renewable fuel, let alone the 50 percent needed to meet the biomass-based diesel or advanced biofuel standard" (Kotrba, Palm Oil Biodiesel and the Renewable Fuel Standard, 2012).

2.5 **Argentina's Biofuel Development**

In 2006, Argentina passed a law that mandated 5% domestic biodiesel blending beginning in 2010, then increased to 7% during the same year (USDA GAIN: Biofuels, 2012). Argentina uses diesel at a 2:1 ratio to gasoline. The majority of Argentina's diesel locomotive railway system has been dismantled and now only represents 10-15 percent of transportation for commodities, but diesel trucking for supplies is used. Argentina has no greenhouse gas sustainability requirements for its domestic biodiesel, but this is an important issue for the export market. However, this country does have biofuel laws which establish a Secretary of Energy to promote the use of biofuels. Argentina is also a member of the global Bioenergy Partnership and Global Research Alliance on agriculture greenhouse gases to increase international cooperation to reduce emissions intensity and for soil carbon sequestration (USDA GAIN: Biofuels, 2012)..

Domestic consumption of biodiesel was projected at 1.3 billion liters or 340 million gallons. Argentina's production capacity by the end of 2013 was projected at 5.2 billion liters or 1.4 billion gallons (USDA GAIN: Biofuels, 2012). However, diesel automobile sales are falling due to their increase and the market share of gasoline cars

increased in 2013. Hybrid cars are very limited due to the high price of these vehicles, and although Argentina manufactures flex-fuel vehicles, these automobiles are all exported to Brazil and none are used domestically.

Another primary factor that has played a key role in the development of the biodiesel export market in Argentina is a differential export tax of biodiesel versus soy bean oil. Soybean oil is taxed twice the percentage at 32 % compared to biodiesel exports at 16.6 percent (USDA GAIN: Biofuels, 2012). There is also a benefit of a 2.5 percent rebate for the biodiesel export.

2.6 **Biodiesel in the U.S.**

Although EIA reports that the United States had the capacity to produce 2.2 billion gallons of biodiesel from 155 biodiesel plants last year, the EPA reported that only 1.1 billion gallons were produced as of September 30, 2013 (Caparella, 2013). The biomass-based diesel RFS volume is made up of biodiesel and renewable diesel. The difference between biodiesel and renewable diesel is in the chemistry of the feedstock. Biodiesel is also referred to as FAME (fatty acid methyl ester) or RME (rape seed methyl ester. Renewable diesel will refer to fuels made from biomass that meet ASTM standards which are not monoalkyl esters (Yoon, 2011). The National Biodiesel Board (NBB) released numbers stating a study showed the biodiesel industry supports more than 62,000 jobs in by 2013 and $2.6 billion in wages in their effort to debate the EPA's decision to limit the RFS requirements for biodiesel to 1.28 billion gallons for 2013. The NBB argued 600 jobs would be lost and $300 million in

wages would be reduced with no increase in renewable fuel standards for the biodiesel volume quota in 2014-2015 (Caparella, 2013).

As mentioned above, U.S. imports increased in 2013, but according to U.S. Energy Information Administration (EIA), U.S. exports of biomass-based diesel increased (Kotrba, U.S. biodiesel exports surge in August, 2013). The U.S. went from exporting 16.4 million gallons of biodiesel in July to 29 million gallons in August. Canada received about 12.3million gallons, and Malaysia imported approximately 10 million gallons. More than 5.5 million gallons went to Spain, 924,000 gallons went to Taiwan, and Australia received over 250,000 gallons.

2.7 **Biodiesel Sustainability in the U.S.**

There exists the Sustainable Biodiesel Alliance in the Unites States founded in 2006 to "support and encourage sustainable production and use" of biodiesel (Sustainable Biodiesel Alliiance, n.d.).This nonprofit develops tools for stakeholders so that the fuel can be evaluated and a certification system has been created for sustainable biodiesel. The certification system is based on the feedstocks of the biodiesel, the production systems, the distribution system and the end use fuel. Also, the Sustainable Biodiesel Alliance (SBA) provides tools for biodiesel consumers as well as to the biodiesel industry through a website and through membership to promote the value of community-based biodiesel which provides certification of sustainably produced biodiesel (Sustainable Biodiesel Alliiance, n.d.).

The SBA promotes sustainable practices including harvesting soybeans and includes family farmers and farm organizations, environmental organizations,

renewable energy experts and a wide variety of non-governments organizations. The SBA works with the farmer who grows the feedstock, the producers who process the biodiesel, the large fleet biodiesel user and communities" (Sustainable Biodiesel Alliiance, n.d.). The SBA unites these efforts for a "sustainable energy future to "benefit all sectors of society" (Sustainable Biodiesel Alliiance, n.d.).

2.8 **Biodiesel Blends**

B20 - (20% biodiesel, 80% petroleum diesel), is the most common blend in the United States (Alternative Fuels Data Center, 2013). As previously mentioned, blends of B20 or higher qualify for biodiesel fuel credits under the Energy Policy Act of 1992. The goal of the Energy Policy Act of 1992 (EPAct 1992) is to "reduce U.S. dependence on imported petroleum and improve air quality by addressing all aspects of energy supply and demand, including alternative fuels, renewable energy, and energy efficiency (Alternative Fuel Data Center, 2013).

Under EPAct1992, the American Taxpayer Relief Act of 2012 extended and reinstated several alternative fuel incentives such as a biodiesel income tax credit, biodiesel mixture excise tax credit and Biodiesel Education grants through December 31, 2013.

Low level blends, B5 (5% biodiesel, 95% petroleum diesel) are approved for safe operation on any compression ignition diesel engine including "light-duty and heavy duty cars and trucks, tractors, boats, and electrical generators (Alternative Fuel Data Center, 2013). B20 also does not require engine modifications. However, not all

engine warranties cover biodiesel use and biodiesel blends must meet quality standards.

B100 is also known as "neat biodiesel" and "contains about 8% less energy per gallon than petroleum diesel" (Alternative Fuel Data Center, 2013). B20 has 20% the benefit of B100. B100 is less common than B20 or B5 due to lack of incentives and pricing, and the fact that engines must be equipped with compatible hoses and gaskets due to B100 having a solvent effect on the vehicle's fuel system and releasing deposits from previous diesel use which can clog filters. In addition, there is an issue with increased nitrogen oxides emissions with high biodiesel blends, although it greatly reduces other toxic emissions (Alternative Fuel Data Center, 2013). B110 requires special handling and equipment modifications to meet ASTM requirements.

2.9 **Energy Policy Act of 2005**

The Energy Policy Act of 2005 is major energy law enacted by the Federal Energy Commission. This Act includes RFS and renewable energy production incentive or the Blenders' Tax Credit (FERC, 2006, p. 1).

The EPA Act had three policy goals:

> "(1) it reaffirmed a commitment to competition in wholesale power markets as national policy, the third major federal law in the last 30 years to do so; (2) it strengthened the Commission's regulatory tools, recognizing that effective regulation is necessary to protect the consumer

from exploitation and assure fair competition; and (3) it provided for development of a stronger energy infrastructure" (FERC, 2006, p. 1).

According to resources mentioned prior, the biodiesel foreign imports taking advantage of the tax credit have hurt the American biodiesel industry and the commitment to fair competition has been overlooked due to the oversupply of biofuel by these imports.

2.10 **Biodiesel Emissions**

Biodiesel can be used to help meet the advanced biofuel quota according to federal policy, range 2.0-2.51 billion gallons (EPA, 2013). Pure biodiesel (B100) is being classified as an E2 advanced biofuel as it reduces hydrocarbons by more than 50% over regular diesel (How Much Does Biodiesel Reduce Air Pollutants, 2007). B100 biodiesel emits 40% less carbon monoxide than regular diesel, reduces particulates by over 55%, and air toxins up to 90% less than with pure diesel. A 20% blend (B20) reduces hydrocarbons by 11% and carbon monoxide by over 12%. B20 reduces particulate matter by 18% over regular diesel and air toxins by up to 20%. Biodiesel fuels made from vegetable fats and alcohol are non toxic and are quickly and fully biodegradable.

2.11 **2008 Farm Bill Energy Title Programs**

2.11.1 Background

The Food, Conservation, and Energy Act of 2008 has become to be known as the 2008 Farm Bill. This bill became law six months after the enactment of the Energy Independence and Security Act of 2007 (EISA, P.L. 110-140) (Schnept, 2013). A key component of the EISA was to increase to renewable fuels standards (RFS) which mandates non-corn starch based biofuels. Reasons for RFS were to increase energy security and reduce lifecycle greenhouse gas emissions due to global warming. The energy provisions of the 2008 Farm Bill were focused to emphasize EISA's program goals of federal incentives of non-corn based feedstocks of renewable energy.

The 113th Congress faced challenges to reauthorize the five-year Farm Bill that the 112th Congress actually did not come to terms with in 2012. Instead it was put off with extension through the American Taxpayer Relief Act of 2012 (ATRA; P.L. 112-240) signed into law by President Obama on January 2, 2013, which extended the 2008 Farm Bill until September 30, 2013, or in the case of commodity programs, through the 2013 crop year (Schnept, 2013). This extension was also allowed to expire except for the farm commodity programs, and dairy prices through December 31, 2013. Crop insurance is permanently authorized and did not expire (Monke & Stubbs, 2013) (The Farm Bill, n.d.). (HOR, The Food, Conservation, and Energy Act of 2008, 2008).The Farm Bill includes many U.S. Department of Agriculture (USDA) programs that are listed under Energy Title IX. On May 14, 2013, the Senate Agriculture Committee approved S. 954, the Agriculture Reform, Food, and Jobs Act of 2013.

Similarly, the next day the House Agriculture Committee approved H. R. 1947, the Federal Agriculture Reform and Risk Management Act of 2013, but only a number of the amendments were adopted; the bill itself was defeated on June 20. However, a variation of this bill was passed by the House, H.R. 2642 that excluded elements not of the topic of this thesis. In addition, H.R. 3102, the Nutrition Reform and Work Opportunity Act of 2013 was passed on September 19 and a resolution H.Res. 361 was subsequently adopted which combined the H.R. 2642 and H.R. 3102 into one bill (H.R.2642) in order to pursue further resolutions with the Senate (The Farm Bill, n.d.) .

2.11.2 Brief History

The Energy Title first began with the 2002 Farm Bill (Farm Security and Rural Investment Act of 2002, P.L. 107-171 (Olson, 2011) (Schnept, 2013). At that time there was bipartisan support and a stronger federal commitment to farm-based crops for energy. There were many expansions to the original energy title in the 2008 Farm Bill including $1.2 billion in mandatory funding for a variety of renewable energy programs such as advanced biofuels, diversified crops and energy efficiency programs. As stated earlier, "The role envisioned for the Energy Title of the 2008 farm bill was designed to provide incentives for the research and development of new agriculture-based renewable fuel"… "and to expand their distribution and use" (Schnept, 2013, p. 6).

All of the major Farm Bill energy programs expired at the end of FY 2013, September 30, 2013, due to lack of funding when the 2008 Farm Bill was allowed to

expire. The Senate and the House had each passed their own bills to extend half of the 2008 energy provisions, but many of the much needed funding had not been established in a bi-partisan agreement. Of the programs discussed in this thesis, there are six with major funding differences: the Senate has set aside a merger of mandatory and discretionary funds whereas only discretionary moneys were being offered by the House of Representatives for the investment in the 2008 programs.

2.11.3 Key Biofuels-related provisions – 2008 Farm Bill

There are three sections to the 2008 Title IX energy title. The first section, 9001 contained 13 new provisions (subsections) that effectively replaced the provisions of the 2002 bill (Schnept, 2013). "Sections 9002 and 9003 directed studies and reports on biofuels infrastructure and renewable fertilizer, respectively".

- Expansion of existing bio-based marketing program to support federal procurement of bio-based products (§9002);
- Expansion of the federal bio-products certification program (§9002);
- Additional support for biorefinery development (§9003);
- Grant and loan guarantees for advanced biofuels, especially cellulosic production (§9005);
- A biodiesel education program to promote the understanding and use of biodiesel (§9006);
- Support for the biofuels marketing infrastructure of rural energy efficiency and self-sufficiency (§9007);
- Reauthorize Department of Energy (DOE) and USDA research programs for biofuels (§9008);
- A new program to incentivize the production, harvesting, storage, and transportation or cellulosic ethanol feedstock (§9011);

- Reauthorize “Sun Grant Initiative” programs that coordinate research on advanced biofuels at land-grant universities and federally funded laboratories (§7526);
- Establish a new cellulosic ethanol tax credit (§15321);
- Reduce the blender tax credit for corn-based ethanol (§15331);
- Study the market and environmental impacts of increase use of biofuels (§15322); and
- Continue the tariff on ethanol imports (§15333)
  (Schnept, 2013, p. 11)

2.11.4 Energy Title Programs Currently with Mandatory Funding

When the 2008 Farm Bill expired, eight programs had mandatory funding totaling $1.12 billion energy title budget, six of which were debated in 2014 between the House and the Senate for these same mandatory funds (Olson, 2011): (See Figure 2.1)

The Rural Energy for America Program was provided $225 million in incentives for on-farm and business renewable energy and energy efficiency systems and/or audits. The Biomass Crop Assistance Program was provided sums as needed to encourage new energy crops. The Repowering Assistance Program was provided $35 million in incentives to encourage conversion to existing ethanol plant boilers from fossil fuel to renewable biomass (Olson, 2011) .

The Biorefinery Assistance program received $320 million incentives of loans and grants to develop and construct pre-commercial and advanced biofuels production plants including algae, digesters, cellulosic, biodiesel and organic waste energy supply systems. This funding was for used for the first two years of start-up with an emphasis of moving quickly (Olson, 2011).

The Biomass Research and Development program received $118 million which focused its research primarily on advanced biofuels. The Biobased Markets Program received $9 million for improvements to its existing program. The Biodiesel Fuel Education program received $5 million to continue its existing program. The Bioenergy Program for Advanced Biofuels received $300 million for incentives for non-corn starch biofuels (Olson, 2011).

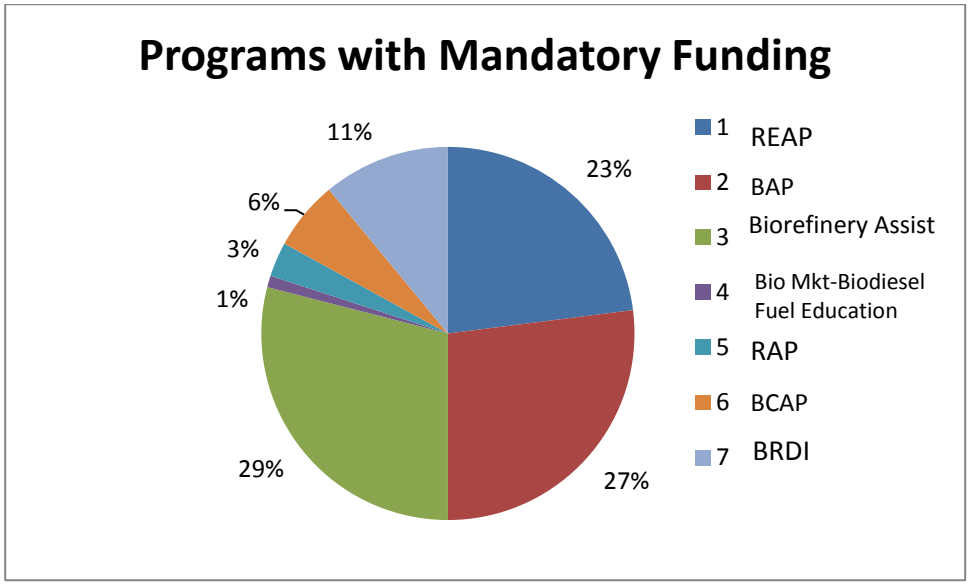

Figure 2.1 2008 Programs (USDA ERS, 2012)

Within the Title IX: Energy of the 2008 Farm Bill, United States Department of Agriculture (USDA) has renewable energy programs which have been used to incentivize clean and renewable energy and efficiency projects such as solar, wind, anaerobic digesters and biodiesel development. Although in the past, the USDA programs have been to promote production and use of biofuels, with corn ethanol

currently dominating the biofuels industry. The goal of the 2008 Farm Bill was to refocus U.S. initiatives in favor of non-corn based feedstocks by introducing programs such as the Biomass Crop Assistance Program (BCAP), crops for cellulosic biofuels from nontraditional crops, and Rural Energy for America Program (REAP), various biofuels-related projects to help avoid the blend wall of the domestic ethanol consumption the industry has been dealing with (The Farm Bill, n.d.). These two programs will be discussed later.

2.11.5 What was the Cause of the Debate? Mandatory Funding – 2008 Programs

One of the first differences between the Senate and the House bill was The **Biorefinery Assistance Program** (**BAP)** (S9003) established in the 2008 Farm Bill. This program assists new technologies to develop for advanced biofuels by providing up to 30% of projected costs through competitive grants and 80% of project costs by guaranteeing loans limited to $250 million. These funds can be used for construction or retrofitting pilot scale refineries to test if the commercial refinery is a worthwhile venture of converting biomass such as cellulosic to advanced biofuels. Mandatory funding of $75 million was set in the initial bill for FY2009 and increased to $245 million FY2010 for loan guarantees, with $150 million annually FY2009-13 for grants (The Farm Bill, n.d.).

The Senate renamed this program Biorefinery, Renewable Chemical, and Biobased Product Manufacturing Assistance Program. As extended and described in Senate Bill 954 (S.954, 2013-2014). The program was expanded to include renewable

chemical, defined in section 900 of the Senate Bill. It now also includes biobased product development, defined as "development, construction, and retrofitting of technologically new commercial-scale processing and manufacturing equipment and required facilities used to convert renewable chemicals and other biobased outputs into commercial-scale end products" (The Farm Bill, n.d.). The Senate extended grants and loans and authorized increases mandatory funding to $100 million for FY2014 and $58 million for each year FY 2015 -FY2016, but not more than $25 million for biobased product manufacturing. The bill authorized appropriated funds of $150 million annually for FY 2014-2018 and discretionary funding was $750 million was all appropriated annually.

The House of Representatives eliminated mandatory funding for the Biorefinery Assistance Program (HOR, H.R. 3102: Nutrition Reform and Work Opportunity Act of 2013, 2013). However, $75 million discretionary funds were allocated annually FY2014-2018 in House's Bill. The bill repealed the cost-sharing grants for start-up costs of the demonstration-scale biorefinery.

The **Repowering Assistance Program (RAP)** (S9004) is a USDA grant program for eligible biorefineries in order to reduce or eliminate the use of fossil fuels for processing or power in the refinery such as means of anaerobic digestion, combined-heat-and-power, wind, solar, pyrolysis or gasification when using biomass (Aubrey, 2012) . The 2008 Energy Title had provided funds up to $25 million by June 1, 2008, application deadline to eligible refineries for the energy improvement upgrades. The House Bill had no provision for mandatory funding for the Repowering Assistance Program in the in H.R. 2642 bill, which was passed in 2013. The Senate bill had no provision for RAP.

The **Biodiesel Fuel Education Program** (S9006) provides $1 million dollar grants through mandatory funding annually to nonprofit organizations that educate fleet operators and the public on the benefits of biodiesel FY2008-2012, and was extended through FY 2013. Isabel Lane from Biofuels digest reports that Gary Haer, chairman of National Biodiesel Board testified at a House Agriculture hearing in favor of biofuels' benefits for rural economies. Key Programs such as Biodiesel Education Program and Bioenergy Program for Advance Biofuels in the 2008 Farm Bill was estimated to be responsible for 39,000 jobs in the U.S. economy in 2011 alone (Lane J. , The Farm Bill: Biofuels Digest's 5-Minute Guide to the Energy Title, 2013).

The Senate increased the Biodiesel Fuel Education Program resources dividing income by authorizing $1million to be appropriated through mandatory funds and $1million through discretionary moneys for FY 2014-2018. However, although the House Bill, also, provided for program increases of $2 million; all funds were made discretionary (The Farm Bill, n.d.).

The **Biobased Markets Program** (S9002) requires federal agencies and contractors to establish a program for procuring biobased products with a testing center and labeling program unless items are not available that meet reasonable performance standards (Schnept, 2013). The Mandatory Commodity Credit Corporation (CCC) authorized $9 million in funds for FY2008 and $2 million every year FY2009-FY2012 for biobased products testing and labeling. No discretionary funds were appropriated during this time. Both the Senate and House bills extended the Biobased Program; S.954 authorized $3 million in mandatory funds but the House bill included no mandatory funding.

The next program of the 2008 Farm Bill showing much debate between the House and Senate is the **Biomass Research and Development Initiative (BRDI)** (S9008). This program was originally created under the Biomass Research and Development Act (HOR, Biomass Research and Development Act of 2000, 2000). The 2008 Farm Bill extended this program by providing incentives using grants, contracts and other financial assistance to research and development pilot programs used as starts for commercial scale production of biofuels and other biobased products. United States Department of Agriculture and the Department of Energy work together through the Biomass Research and Development Board. Mandatory funding was provided beginning FY2009 at $20 million and increased gradually annually to $40 million FY 2014.

The Senate authorized $26 million annually in mandatory funding for the BRDI program for FY 2014-2018, and appropriates $30 million annually in discretionary funds FY2014-2018. The House also extended the BRDI program through FY 2018 but has not re-authorized any mandatory funds. Only $20 million annually has been authorized each year in discretionary moneys for FY2014-2018.

The Rural Energy for America Program (REAP) (S9007) provides financial assistance for farm producers and rural small business owners to perform energy audits, make renewable energy upgrades and purchase and install other energy efficiency improvements to nonresidential buildings to reduce energy consumption (Rural Energy for America Program - Renewable Energy System and Energy Efficiency Improvement Guaranteed Loan and Grant Program, 2013). Renewable energy system (RES) grants are limited to $500,000 and energy efficiency improvement (EEI) grants have a limit of $250,000, both up to 25% of the cost of the

project. The loan qualifying limits have a maximum of $25 million up to $75 million of the cost of the project. The REAP program provided $55 million in mandatory funding in FY2008 increasing to $70 million by FY2012. The 2008 farm bill authorized $25 million is discretionary be appropriated, as well.

The Senate Bill extended REAP through FY2014-2018 with a grant ceiling of $500,000 or 25% of the project cost. Feasibility studies were also repealed. A three tier grant and loan guarantee process was established by the Senate for RES and EEI projects based on the project costs. The Senate bill authorized $68.2 million annually in mandatory funding for FY2014-2018 and appropriated $20 million in discretionary funds annually. The House approved this program, as well but had not authorized mandatory funding for REAP (The Farm Bill, n.d.).

REAP turned consumers into producers though programs such as rural electric cooperative programs. These Programs allowed investment within their own communities and the project planning for distributed generation for home grown power reduced harmful greenhouse gases and increased energy security. By reviewing a report publishing the success of energy title programs, it stated these programs and upgrades such as the REAP program outpaced the REAP resources and, therefore, mandatory funding is needed for investment security (Curran, Olsen, & Putz, 2014) .

The Biomass Crop Assistance Program (BCAP) of the 2008 Farm Bill was primarily for two reasons. One was to support the development of eligible crops to produce bioenergy in specified areas and the second was to assist farmers and forest land owners and operators with the assistance in preliminary steps of eligible materials to be used in biomass to energy facilities (Stubbs, 2014, p. 2).

Under agreement between USDA and contracted producers, up to 75% of the cost of establishment of perennial crops and up to five years for non-woody and fifteen years for woody perennial biomass crops. For collection, harvest, storage and transportation (CHST) of eligible material for use in a qualified biomass conversion facility, the program allowed for equal payments matched for two years. Mandatory funding was authorized as necessary for FY2008-2012 and $20 million was appropriated for FY2013 in discretionary funds.

The Senate authorized mandatory funding at $38.6 million annually for FY2014-2018. The House removed all CHST support and all mandatory funding. However, the discretionary funds in the amount of $475 million annually were appropriated for FY2014-2018 by the House Bill (The Farm Bill, n.d.) .

BCAP provides assistance to encourage new crops for energy in producing and using the "biomass crops for conversion to advanced biofuels or bioenergy" (USDA, Agriculture Reform, Food and Jobs Act of 2013, 2013). The Senate proposes $193 in mandatory funding include up to "50 percent of costs, plus annual payments in amounts to be determined by the Secretary to help compensate for lost opportunity costs until crops are established."

The Energy and Security Act of 2007 (EISA, P.L. 110-140) sets a target of 36 billion gallons of biofuels production by 2022, including 16 billion gallons of cellulosic biofuels. Without a continuous supply of biomass, investors will not build processors and refineries. As this is a new market, BCAP assists first by supporting the establishment and production of eligible crops for conversion to bioenergy in selected areas, and second with agriculture and forest land owners and operators with the collection, harvest, storage, and transportation (CHST) of eligible material for use

in a biomass conversion facility (Stubbs, 2014, p. 2) (Olson, 2011). Matching payments for purchasers under BCAP and assists land owners and operators with CHST at a rate of $1 per dry ton equivalent of biomass up to $45/ton for two years.

The establishment and annual payments creates a new supply of energy crops by paying up to 75% to assist farmers to establish and grow perennial biomass crops within the Qualified BCAP project areas, including woody biomass. The matching payments portion of this program offsets for delivery of the biomass to the processing plants. To be eligible the conversion must be to heat, power or a biobased product such as biofuels or bio-based chemicals.

2.11.6 The 2013 Farm Bill - Mandatory vs Discretionary Funds

The legislation provides certainty to producers and others who depend on farm programs and policies (American Soybean Association, n.d.). The ASA supports efforts to help farmers manage risk in any new long-term farm legislation including reauthorization and increased mandatory funding of the biodiesel Fuel Education Program (Section 9006) and the Biobased market Program (Section 9002) in the American Soybean Association (ASA) supports long-term farm Energy Title of new farm legislation. This organization makes a statement that although it "recognizes the energy programs do not have baseline funding in 2013…the benefits provided by the Biodiesel Fuel Education Program and the Biobased Market Program (are) worth their relatively low cost, and warrant their continuation with … mandatory funding" (The Farm Bill, n.d.).

The Farm Bill includes many U.S. Department of Agriculture (USDA) programs that are listed under Energy Title IX. The House version authorized $45 million per year in discretionary funding. The Senate offered $20 million in annual discretionary funds and $68 million in mandatory funds via the Commodity Credit Corporation (Lane J. , The Farm Bill: Biofuels Digest's 5-Minute Guide to the Energy Title, 2013).

With the 2014 Farm Bill targeted to shift the focus from corn based ethanol, both the House and the Senate bills had extended most of the renewable energy provisions as stated above. The primary difference between the two bills was the source of funding for the energy title programs (HOR, H.R. 3102: Nutrition Reform and Work Opportunity Act of 2013, 2013).

The Senate and the House have appropriated over $1 billion for various farm bill renewable energy programs, but the House had no mandatory funding for any of these Title IX programs. Furthermore, as the House eliminated Collection Harvest, Storage and Transportation component (CHST), this limits the effectiveness for BCAP to be used as an incentive for cellulosic ethanol feedstock in the BCAP program. Corn-based ethanol dominates the U.S. biofuels industry. (Cornell, 2013)

With discretionary funding, Congress must find time to meet annually and make a come to a decision each time after a five-year Farm Bill is decided upon whether to appropriate the funds to each of the energy programs discretionary funds has been allocated for. This is sometimes not efficient for proven programs. The funding is not guaranteed and investors and entrepreneurs in this industry have no projection for investors for the year ahead, as the moneys are not guaranteed.

2.11.7 Conflicting Views – Bio-crop Incentives

Some view that only those that benefit from energy crop incentives that are used for biofuels are the large-scale industrial (corn) growers and the oil companies (Good, 2010). But the economy has been stimulated as other crops and feedstocks have begun entering the bio-energy industries using these incentives and the overall cost and job creation need to be re-considered in the analysis. The lower greenhouse gases are the main objective, and United States energy security from foreign oil and rural development are also primary objectives. It is estimated that only 0.22% of 2008 Farm Bill funding was allocating for energy. (See Figure 2.4)

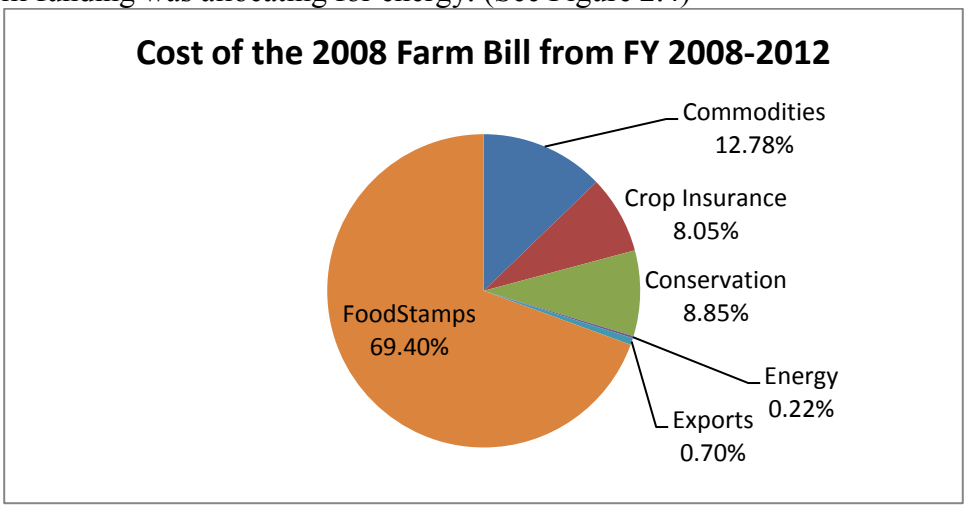

Figure 2.2 Cost of Energy programs in 2008 Farm Bill = .22% of the budget (USDA ERS, 2012)

The AgEC co-director, Lloyd Ritter said,

"Expiration of the 2008 Farm Bill already has created economic uncertainty for U.S. renewable energy companies, threatening to stop growth

of a vital segment of the U.S economy, strand private sector investments and eliminate good paying jobs. The five-year extension of the farm-bill with mandatory funding for the energy title is needed to keep these companies investing and creating jobs in the United States" (Agriculture Energy Coalition, 2012).

The bioenergy programs discussed are appropriated the mandatory funds that have been set aside at the levels authorized in the farm bill energy title unless Congress limits funding to a lower amount through the legislative process (Schnept, 2013, p. 9). Many of these programs are funded by borrowing through the USDA's Commodity Credit Corporation (CCC). Discretionary funding is determined each year through an annual governmental process.

For the energy title programs, the 2008 Farm Bill (FY2008-2012) authorized an increase in mandatory funding to over $1 billion in mandatory funding compared to $800 million in the 2002 Farm Bill (FY2002-2007).

2.12 **Soy Processing**

Soy oil is used in the food industry and for processing in biodiesel blending. The soy beans are crushed and the oil is extracted with solvents to the specifications of purity to the extent of final end-use by various chemical means. A common procedure for refining soybean oil into biodiesel involves a transesterification process, which combines, for example, 100 pounds of soybean oil with 10 pounds of methanol and a catalyst, such as a base such as sodium hydroxide (Wisner, 2009). The catalyst is first mixed with the methanol before the oil. It is important that the reaction is kept free

from water, and it is held at 150 degrees from one to eight hours yielding about 100 pounds biodiesel and 10 pounds glycerin, a byproduct which can be sold. Another important bi-product is a solid residue cake known as soybean meal which is widely used as a protein in animal feeds (Soybean Oil Meal, 2014). The soybean oil meal contains amino acids and mineral substances, calcium, phosphorus, zinc and iron. The high content of vegetable protein in soybean oil meal allows savings on costly animal feed. A portion of the methanol can be recycled by distillation. Food uses require the highest purity and more costly refining.

Chapter 3

THEORETICAL FRAMEWORK

3.1 Investing in Natural Capital

A good policy outcome may result for Illinois soy oil by reviewing programs and evaluating options that appear in the Energy Policy Act and Energy Title as previously discussed. One instrument that could assist is "investing in natural capital" (Hawken, Lovins, & Lovins, 2000, p. 159). According to Hawkins, Lovins and Lovins, "Today, abusers of ecosystem services are imposing costs on the rest of society, because everyone depends on those services and is harmed by their decrease" (Hawken, Lovins, & Lovins, 2000, p. 159) Conserving natural resources, such as using less petroleum such as diesel and ecosystems are less polluted by harmful emissions through investments in biodiesel using blending technology.

Possibly reinstating the tax credit for biodiesel can encourage development for local producers in the US biofuel industry, but care must be taken as bankruptcy can occur if investors are functioning solely on the forecast of this tax credit. If the tax credit is allowed to expire on and off again, and companies do not have the capital to carry them through gambling of a retroactive credit, smaller American companies have closed down possibly due to the blenders credit staggering in and out of activity (Wagner, 2014). Investing in a longer term production tax credit, a permanent

blenders' tax credit could help establish a window for newer producers to get their plants online and stabilize production.

There is a consistent stream of $14 billion to $52 billion in fossil fuel subsidies given annually by the United States to lower the cost of fossil fuel energy production (Fossil Fuel Subsidies in the U.S., n.d.). There is $775 billion worth of global fossil fuel subsidies estimated. Global warming is caused by carbon dioxide emissions from fossil fuels. Because biodiesel reduces carbon emissions and furthers energy security by reducing petroleum imports, it is worth investing in for the short term and especially the long term.

3.2 **Shouldn’t US Green Energy Incentives Help local Industry?**

There would be a benefit of an increase of the import tariff for imported biodiesel as the United States import tax for biodiesel is only 5%, but as mentioned, Europe has a levy of 25% on imports of soybean biodiesel to be blended with their transportation fuels (Kotrba, 2013). The US imported nearly 17.3 million gallons of biodiesel in March 2013, up from 2.2 million in February and approximately 21 million gallons imported per month throughout the summer. Demand for refineries in Illinois range from around 3 million to 60 million per year, and imports could be a threat to smaller refineries. It is cheaper to import the biodiesel than to produce it in the United States and local producers would benefit from an increased import tariff to deter imports. The foreign investors have taken advantage of the blenders' tax incentive and increased profit margin but is there a defining interest in the

environmental benefits? (Kotrba, 2013). What about the energy security federal policy intended for local economy?

Argentina produced 2.4 million tons or 739 million gallons of biodiesel last year and exported nearly 67 percent of the biofuel they produced (Reuters Summit-crisis hit Argentina biodiesel sector eyes U.S. market, 2013). Argentina hopes to greatly expand to the U.S. after a fifty percent reduction in its Europe market share due to anti-dumping duties which were recently put into place.

Shouldn't US green energy incentives help local industry? United States production of biodiesel in November, 2013 was 128 million gallons, down 4 million gallons from October (Summary of Weekly Petroleum Data for the Week Ending January 31, 2014, 2014). U.S. production came from 112 biodiesel plants with a capacity of 2.2 billion gallons per year, with approximately 66% from the Midwest sector of the Unites States (Alternative Fuels News and Commentary, 2013). The American companies have sufficient capacity to meet the annual RFS set for 2014 and 2015 of 1.28 billion gallons, and also have the capacity for one billion biodiesel gallons which American biodiesel refineries can assist the advanced biofuel to meet the RFS annual quota, as needed. Possibly we should take a look at the tax and subsidy system in America: "the mechanism that is most responsible for the constant rearrangement of monetary flows and that determines social, economic, and ecological outcomes by applying politically selected subsidies and penalties" (Hawken, Lovins, & Lovins, 2000, p. 159)

3.3 **Innovation**

Improvement in the biodiesel industry has been achieved through innovation, monitoring and measurement (Hawken, Lovins, & Lovins, 2000, p. 68). In the United States, diesel demand, approximately half that of gasoline, is used currently primarily to supply class 8 trucks and heavy duty vehicles, ships and locomotive trains in the U.S.

But as improvements in technology continue to bring increases efficiency, the demand for diesel is also increasing. There are newer models coming online for automobiles and other transportation vehicles in the United States (Transportation, 2013). Diesel is readily available at gas stations and diesel gets better gas mileage according to AAA. Research done by the Automotive Lease Guide (ALG) showed compact diesel cars held 63% of their value after 36 months and gasoline cars only 53% (Transportation, 2013). In 2011, the European market was 51.8% diesel according to the U.S Department of Energy but Americans are beginning to follow the idea of the benefits of diesel. Projections for diesel use increases from light-duty vehicles switching from gasoline to diesel by 2017 due to CAFÉ standards nearly doubling fuel economy by 2025 show innovation due to improvements (Transportation from Executive Summary, 2014) (U.S. announces tough new 54.5-mpg CAFE standard for vehicle fuel economy, 2012).

3.4 **Building Blocks**

Successful businesses and projects model a sense of community with resource efficiency, environmental sensitivity and have strong support giving attention to human well-being. This has become to be known as "green development (Hawken, Lovins, & Lovins, 2000, p. 85). By using natural resources efficiently, profits and growth are economically viable. By being environmentally sensitive, the external environment is sound. And a business is being socially responsible to employees and communities with attention to human well-being. In March, 2012, Rural Energy for America Program (REAP) within the 2008 Farm Bill assisted providing $1 in government funds for every $3 private (mandatory funding), for the opening up a biodiesel plant in Utah with a grant of approximately $500, 000 (Largest Biodiesel Plant in Utah, 2012). In addition, the Biodiesel Fuel Education Program offers $ 1 million dollar grants in mandatory funding and $1 million in discretionary funding to nonprofit organizations which educates fleet operators and the public on the benefits of biodiesel.

As mentioned, these key Energy Title programs were estimated to be responsible for 39,000 jobs in the US economy in 2011 alone. The government is showing strong support by following through with successful energy programs for biodiesel. Close to 25% of the Energy Title mandatory funding is allocated to the REAP program. These are examples of national energy policy that support local programs in local communities.

3.5 The Free Markets

Will the market keep prices of food and biodiesel in balance? – There is extra cost for purity in refining of soy oil used for food uses and added costs of fuel tax in the biodiesel sales. With populations increasing, it is important to make sure soybean fuel feedstock demands do not take away from soybean food supplies. The free markets depends on many conditions such as perfect information about the future, no subsidies, no taxes, unlimited capital, no monopolies, no externalities, prices are up to date, perfect competition, no barriers to market entry, no regulations, etc (Hawken, Lovins, & Lovins, 2000, p. 262). In my model, and in my research, there is no shortage of soybeans and the price does not seem to increase (unless due to weather or other environmental factors ***not within the scope of this paper***). There seems to be sufficient supply of soy oil and biodiesel. Competition of substitutes may keep current prices stable: soy, corn, wheat for animal feed; canola, soy, corn, sunflower for food oil; rapeseed, soybean and algae for biodiesel. These substitutes should help keep the price for soy oil from increasing to any extreme.

Chapter 4

METHODOLOGY

4.1 Case Study: Location Analysis

4.1.1 Illinois - Background

Illinois was chosen because it is located in the Midwest and this state has been growing soybeans for 100 years (Illinois Soybean Association, n.d.). It was estimated that 9.4 million acres of soybeans were grown in Illinois 2013 which was the largest acreage of any state (USDA, 2013). It was interesting to note that soybeans were first grown in Illinois in the 1920s first only for hay for dairy cattle and beef cattle. There still exists a processor plant in Decatur which was used in the case study model from right after WWII. Shortly thereafter, crops were harvested for seed which were began to be processed into soy oil as a commercial seed crop just as important as corn was at that time through the 1950s and 60s. Today, Illinois is a major soybean producer, South Central Illinois being the major soybean territory.

Illinois harvests approximately 9 million acres of soybeans every year (Illinois Soy, 2012). Illinois exports approximately $2.3 billion in soybeans annually, and ranks third nationally in agriculture exports. This state has their universities that do research to reduce their environmental footprint concerning soybeans while increasing

productivity. In 2013, Illinois produced 461 million bushels of soybeans, a 20% increase over 2012 (Illinois Farm Report, 2013). The Illinois Soybean Association publishes a report with their sustainability goals concerning soybeans soil conservation and farming practices. The five areas in the report are:

- Social responsibility
- Environmental Stewardship
- Labor Practices, Labor Relations and Worker Conditions
- Best Management Practices
- Good Business Practices

  (Illinois Soy, 2012)

Illinois Governor Blagojevich set a goal of offsetting 50 percent of Illinois transportation fuels consumption with instate production of biofuel by 2017 (IEPA, 2008). The state of Illinois encourages energy efficient traditional and next generation biofuel plants. This state has published documents with resources in a report “Building a Biofuel Plant in Illinois" which includes environmental controls and permit application information, available grants, demonstration projects, and other research resources. Interested parties are offered by following this step by step guide.

The Illinois Soybean Association (ISA) also offers support to Illinois farmers to increase productivity with a 2020 target to reach 600 million bushel of soybeans (ISA, 2012). In a report titled "Systematic Strategies to increasing Yields", best management practices are listed to increase the global market share for Illinois soybeans, including sustainability and high quality.

4.1.2 Applicable Illinois Energy Policy

Since 2003, in the state of Illinois, there is a full tax exemption sales tax incentive offered for the use of biodiesel blends of 11% or more which has increased the market for biodiesel in Illinois (Kotrba, Illinois supports state B11 tax incentive through 2018, 2011). This tax credit was renewed in 2011, which would have expired at the end of 2013. But the state renewed the fuel tax exemption through 2018 making B11 plentiful in the state of Illinois. Due to this tax exemption for biodiesel B11, Illinois became the top biodiesel blender in the United States in 2011. Since 2003 when the tax exemption went into effect, Illinois soybean capacity has increased from 20 million gallons to 188 million gallons by 2010 (Kotrba, Illinois supports state B11 tax incentive through 2018, 2011).

The president and CEO of another biodiesel refinery in my model, REG, the largest in the U.S. made a comment that since the B11 tax credit has been in effect, Illinois has blended more biodiesel than any other state. He also mentioned the 1500 green collar jobs in Illinois that went with this good news (Kotrba, Illinois supports state B11 tax incentive through 2018, 2011) .

In 2009, the blending mandate for state or local government owned diesel-powered vehicles when using a bulk central fueling facility increased from 2 to 5 percent (Davis, 2009).

Illinois has a state incentive for Alternative Fuel Vehicles (AFV) (Illinois Laws and Incenives for Biodiesel, 2013). The AFD must be purchased from an Illinois-based company or vendor to qualify for a rebate, except if it is a heavy-duty specialty

vehicle that is not sold in Illinois. For a fuel rebate, the majority of B20 or higher blends are for 80% of the incremental cost of the biofuel compared to regular diesel. The Illinois Green Fleets Program provides opportunities for fleets in Illinois that have a significant number of AFVs and use domestically produced fuels.

The Renewable Fuels Development Program provides grants for the construction of or expansion to existing biodiesel facilities that are five million gallons or larger (Illinois Laws and Incenives for Biodiesel, 2013) . The expansion must be by at least five million gallons per year to be eligible for this grant. New construction grants are awarded 10% or $4 million, whichever is less.

Among Illinois laws and regulations, it is stated that "agencies that operate medium- and heavy-duty vehicles must implement strategies to reduce fuel consumption through diesel emission control devices....and alternative fuel use's (Illinois Laws and Incenives for Biodiesel, 2013). Biodiesel blending reduces diesel consumption and diesel emissions.

4.1.3 Model details

To investigate the supply and demand of the Illinois Soybean Industry, (ISA) as allocated for soybean oil primarily for the food or biodiesel industries, the methodology chosen uses a model based on location analysis. Actual locations of soy bean processing plants and refineries were researched and used for the model using estimates for demand and capacities for these plants. The distance from processing plant to refinery was established, and put into an Excel spread sheet such that Excel Solver program optimization linear program could be used to solve for least miles

traveled to meet the needs of all refineries demand within the capacities of the processing plants. The Solver program went one step further and provided a sensitivity report which included shadow prices, the price to provide the next gallon of soy bean oil to the next refinery measured in miles.

A major research issue of this thesis will focus on soy oil processing and the balance within the food and biodiesel industries. As a case study, the scope of the analysis will be confined within the boundaries of the state of Illinois and consist of six major soy bean processing plants and six major biodiesel refineries within this boundary. The results of the analysis will conclude whether biodiesel expansion within the state of Illinois might be practical.

For the methodology to be analyzed, a linear programming model is developed. Linear programming, sometimes known as linear optimization, maximizes or minimizes the linear function known as the objective function. The model here uses inputs of the capacities of six soy processing plants and the demands of six biodiesel refineries as constraints of the linear programming model for the objective function to optimize the least miles possible, based on the demand of all refineries and the locations between all processors and all refineries.

The result is the minimized overall travel cost that satisfies the demand of biofuel refineries for soy oil in Illinois based on refinery demand. The task was to see if biodiesel refinery demand was being met by the Illinois processing plants' supply and the most efficient route based on transportation analysis the biodiesel demand was being met by the Illinois processing plants. A goal was to analyze if there was a surplus of soy oil in the Illinois' processing plants' capacities and where that surplus was based on location to see where expansion in the industry might occur in Illinois.

Figure 4.1 is a screen shot of the excel solver model spreadsheet using linear programming where the constraints used were less than or equal to the capacity of the processing plants and equal to the demand of the refineries and the sum product of the distances from each of the refineries to each of the processing plants to result to reach the objective function to minimize miles: optimization.

Below is the sensitivity report (Table 4.1) which includes for the processors, the negative Lagrange multiplier, or shadow prices which represent the marginal cost reduction in the system (in transportation miles) that an additional gallon of processing capacity would yield. The shadow price is the instantaneous change per unit of the constraints, in the objective value of the optimal solution. For the refineries, the positive shadow prices represent the marginal acquisition costs of obtaining an additional gallon of soy oil from the nearest processor with available capacity.

Also shown is a map (Figure 4.2) to represent an example of Geographical Information Systems (GIS) applications of location advantage, but also demonstrates surplus soy oil processing capacity, shown in the above sensitivity report (Table 4.1), which can be exported to either biofuels or food refinery markets across state lines. ArcMap 10.1 was used for GIS applications. Datasets were downloaded from USGS: US highways, US states Illinois, US Cities, Illinois, counties Illinois, and the Geocoding tool was used for the addresses of the soybean processing plants and refineries for the GIS analysis for the ArcGISMap. A legend, title and a scale were then added. Lastly, Quincy and Cairo were highlighted as processing plants from the attributes table because they are on the state boundary to show them in contrast to processing plants delivering at capacity within the state of Illinois (as shown by

nonzero shadow prices in the sensitivity report). The results of this data will be discussed by an analysis for location advantage for exporting and opportunities expansion of biodiesel refineries based on soy oil processing capacity and shadow prices.

A discussion will include analysis of processed and refined soy oil and that which is available for export from a working model based on estimated values obtained through public literature. The map and the sensitivity report show Cairo and Quincy processing plants export soy oil based on the Excel solver model and clearly this is due to their location to the refineries in Illinois. (See Table 4.1 to identify processor plant and city locations for Map Figure 4.2)

Table 4.1 Sensitivity Report

Constraints

Cell	Name	Final Value	Lagrange Multiplier
B21	Proc Sum Bloomington	201884.253	-89.9
C21	Proc Sum Cairo	5.68434E-14	0
D21	Proc Sum Decatur	403768.5061	-48.2
E21	Proc Sum Mattoon	174024.2261	-43.2
F21	Proc Sum Gibson City	74024.22611	-108.9
G21	Proc Sum Quincy	93375.71177	0
H15	Danville Ref Sum	173076.9	122.6
H16	Seneca Ref Sum	230769.2	161.2
H17	Midwest - Roxana Ref Sum	12461.5	125.0
H18	Kreido -Argo Ref Sum	230769.2	218.9
H19	National Train- Newton Ref Sum	126923.1	199.2
H20	BMI-Mapleton Ref Sum	173076.9	129.0

Solver in Excel was used for linear programming applications. Refineries are equal to demand and processors are less than or equal to capacity. The optimal minimized cost is measured in "gallon-miles". The demand was given by the actual refineries in gallons per year. The capacity was given in pounds and this was converted to gallons using density. The price of diesel is $4.36 gallon multiplied by the least miles required cost to least total of delivering biodiesel by including current transportation costs measured in $ diesel/mile as a result of this analysis (Cazzola, et al., 2013, p. 10). Three primary areas affect the final cost of biodiesel: 1) the procurement of the input stream of the feedstock to the refinery, 2) the prodution costs, processing, operation and maintenance of the conversion facility of the feedstock to make the biodiesel, and 3) transporation of the finished product and the infrastructure to the end user.

Input stream costs include all physical inputs to the refining/ conversion process including feedstocks, fertilizers, electricitiy and transportation to the conversion processing plant. In 2007, biodiesel from soybeans cost about $2.50 per gallon to produce and diesel was $3.34 per gallon (The Biofuels Facts, n.d.). Currently, biodiesel is at selling at $3.18 per gallon and soy oil food grade price is at 35.91 cents per pound or $2.77 per gallon (Center for Agriculture and Rural Development, 2014). Diesel is selling at $4.36 selling along the Central Atlantic Coast (Petroleum, 2014).

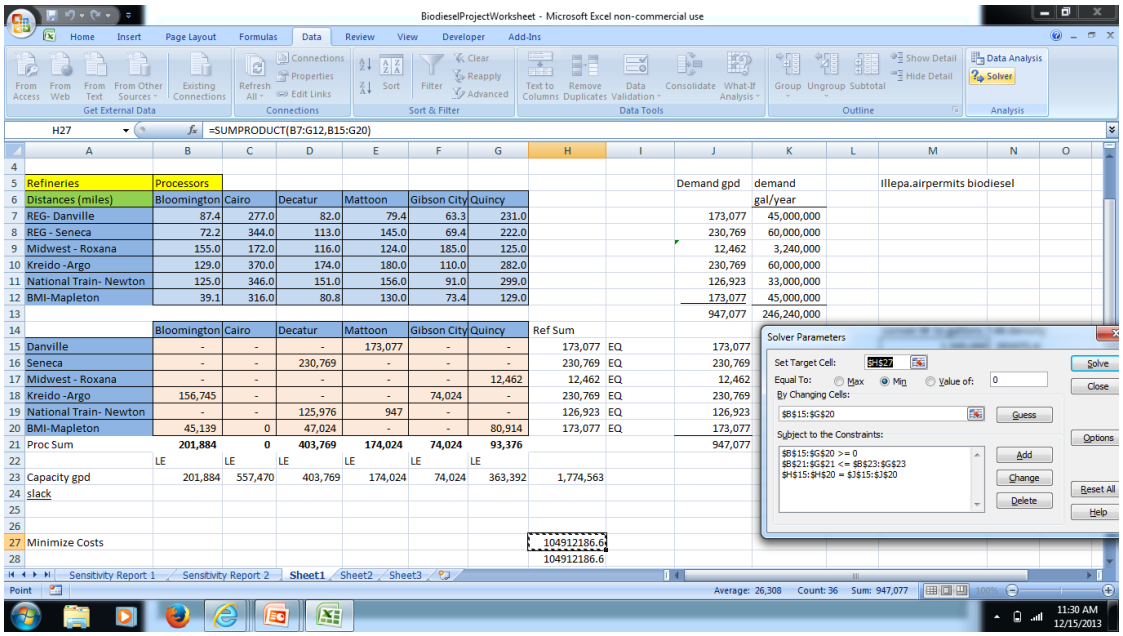

Figure 4.1 Excel Solver Spreadsheet

Table 4.2 Processor Locations

Processing Plant name	City
Cargill	Bloomington
Bunge	Cairo
ADM	Decatur
US Soy	Mattoon
Gibson City	Solae
Quincy	ADM

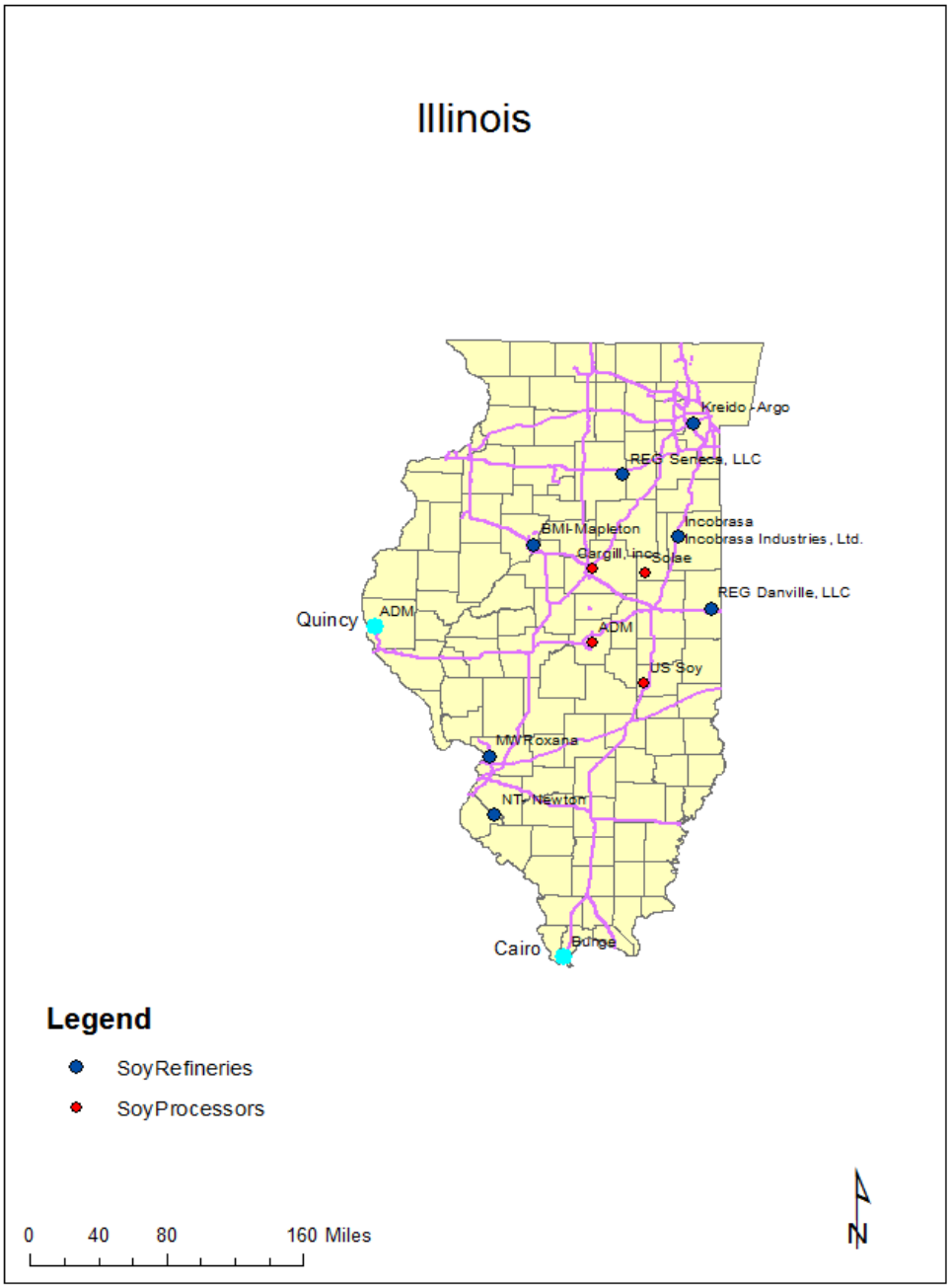

Figure 4.2 GIS Map- Illinois processors and refineries

Finally, data was analyzed from United States Department of Agriculture (USDA), Economic Research Service to evaluate percentage soy beans allocated to exports, crushed for processing soy oil and byproduct for feed. The goal was to determine if more soybeans oil was being shifted towards biodiesel which would be represented by crushed, or if the United States was able to maintain an export market of soybean oil for the food industry. Soy oil currently represents 50 percent of the world's oilseed production and the U.S. is the world's largest producer and exporter with soy oil the number one edible oil in the US, as mentioned in the Introduction. A key interest was to inquire if the RFS are currently imposing on the US food exports or on US production (See graphs in Chapter 5) in million bushels.

Although the quantity of imports relative to US production seems small, it does play a role in the American economy for instance, when the blenders' tax credit is in effect and new American companies are trying to become established. The imported biodiesel adds to the total for the year and there will be beginning stock which reduces US production the following year. Graphs presented in Results and Analysis Figure 5.1, 5.2 and 5.3 will provide visual representation that the U.S. has developed a stable market for soy oil in the food and biodiesel industries.

Chapter 5

RESULTS AND ANALYSIS

5.1 Additional Research Results

The price of diesel is forecasted to decline to $3.50 per gallon in 2017 then rise again to $4.73 per gallon by 2040 (Petroleum, 2014). The share of diesel is forecasted to rise in the fuel market, and that of gasoline to fall, due of light duty vehicles models transitioning to diesel in 2017. This increase affects diesel prices between 2017 and 2025 due to demand being put on the biodiesel refineries. Here is opportunity for growth for new US biodiesel refineries and investors.

5.2 Results of Policy Analysis:

The Environmental Protection Agency (EPA) is responsible for establishing and implementing regulations to ensure that the nation's transportation fuel supply contains the mandated biofuels volumes. Government policy such as the Renewable Fuel Standards (RFS), the biodiesel blenders' tax credit and import tariffs can be drivers to domestic growth through volume of bio-mass based diesel. The Energy Policy Act and biofuel programs within the Energy Title IX can provide a path to achieve certain minimum thresholds of lifecycle greenhouse gas (GHG) emission

reductions, jobs, displacing petroleum, and providing soy meal for livestock producers at a reduced cost. It also provides a market for soy oil other than the food market for soybeans due to "trans fat issues" (ASA, 2013, p. 1) .

Over the long term, the RFS are likely to play a dominant role in the development of the U.S. biofuels sector. The American Soybean Association (ASA) submitted Docket (EPA-HQ-OAR-2013-0479) to Administrator Gina McCarthy of the Environmental Protection Agency in response to the EPA's proposal to maintain 2014 and 2015 RFS volumes for biodiesel at 1.28 billion gallons as the ASA felt they could meet the initial targets to increase the volumes to 1.7 billion gallons (ASA, 2013, p. 1). The ASA felt there was *no need not to increase* the RFS and that biodiesel was the most "prevalent advanced biofuels currently produced in the United States".

The BTC applied to all biodiesel blended with conventional diesel with no specifics on where the biodiesel was produced or where the final blended diesel is consumed (EIA, 2009).

Although the Renewable Fuel Standard (RFS2), which included the first diesel volume requirement, was passed in 2007, this RFS was not implemented until mid-year 2010 (Kotrba, The swinging pendulum of US biodiersel policy, 2013). In addition to this delayed investment driver in the biodiesel industry, Congress let the biodiesel blenders' credit (BTC) expire at the end of 2009, as well. The result left many biodiesel plants idling and some went out of business. In 2010, the biodiesel industry nearly collapsed with no BTC in place until later in the year (see Table 5.1). Also, in 2009 Europe place biodiesel import tariffs on American producers of biodiesel, both anti-dumping and anti-subsidy duties due to the U.S. $1 BTC per gallon of biodiesel produced causing European producers to lose market share (European Commission

Proposes Duties on Imports of US Biofuels, 2013). Currently, the U.S. exports to Canada, Spain, Malaysia, Australia, and Taiwan (Davis, John, 2013).

Table 5.1 U.S. Biodiesel Statistics (millions of gallons)

Year	Production	Imports	Exports	Consumption	RFS	BTC
2008	678	315	677	316	No	Yes
2009	516	77	266	326	No	Yes expires
2010	343	23	105	263	Yes Mid-year	Yes-renews Mid year
2011	967	36	73	887	Yes	Yes expires
2012	969	33	122	870	Yes	No
2013	1,800	341	95.4 thru Aug	1,368	Yes	Yes Retroactive expires

Source: (U.S. Biodiesel Summary, 2013) (2013 Biofuels Consumption, 2014) (Biofuel Exports and RFS Mandates, 2013) (U.S. Biodiesel Exports Surge in August, 2013)

It is assumed exports were about the same for 2013 as 2012 (122M gal) by observing the rate of exports thru August, 2013 as compared to the prior year's total. This estimated export amount for 2013 is probably a low estimate as BTC were in place in 2013 but not in 2012, and producers/blenders were trying to take advantage of BTC before it expired Dec 31, 2013.

In 2011, the biodiesel industry grew in production and consumption with RFS and BTC in place. The BTC expired again December 31, 2011 and biodiesel growth came to a standstill throughout 2012. In 2013 the BTC was reinstated and made retroactive through 2012. Europe imposed a biodiesel import duty on Indonesia and

Argentina, and these countries have become the two biggest biodiesel importers to the U.S. in 2013. Biodiesel imports increased by ten-fold in 2013 with the BTC in place in 2013, as well as both U.S. production and consumption increasing with RFS in place.

5.2.1 U.S. Soy Oil Production: Biodiesel, Food and Exports

In Figure 5.1, it is noted that from 2011/2012 to 2012/2013 soy oil exports increased, soy oil used for domestic food uses increased, biodiesel slightly decreased while the total production increased from 19,775 to 20, 860 measured in million pounds. The BTC expired at the end of 2011, and hence there was no BTC during 2012. From 2012/13 to 2013/14 exports decreased. The increase of biodiesel for 2013/14 shown in Figure 5.1 from 4,870 million pounds in 2011/12 to 5,600 million pounds in 2013/14 is also affected by the RFS mandates and the ability of the biofuel industry to meet the quota with the BTC in affect during 2013, which was renewed and made retroactive for 2012. Therefore, according to the sustainable requirements of Natural Capitalism, U.S. soybean production industry is working to meet the needs of the increasing population demand for food and fuel as needed by both of these sectors. Figure 5.2 showed imports of soy oil increasing from 149 million pounds in 2011/12 to 205 million pounds in 2012/13 to 250 million pounds in 2013/14.

As soy oil imports increase and are added to the total, this quantity adds to the reduction of domestic soy bean oil production. But more importantly, US exports of soy bean oil are competing with Argentina and Brazil who have surpassed the United Sates in soy meal and soy oil exports (Soybeans and Oil Crops, 2013). These two countries now share more than half of the soybean export market, up from less than 15

percent before 1980. Argentina and Brazil have increased soybean oil production and rapid growth in crushing capacity (USDA, Soybean oil: U.S. Supply and Disappearance, 2013). According to the graph, soy oil used for biodiesel is less than 30% in the United States. As a learning organization, the biodiesel industry seems to be growing through successful national energy policy incentives such as the renewable fuel standards, CAFÉ standards, and the BTC.

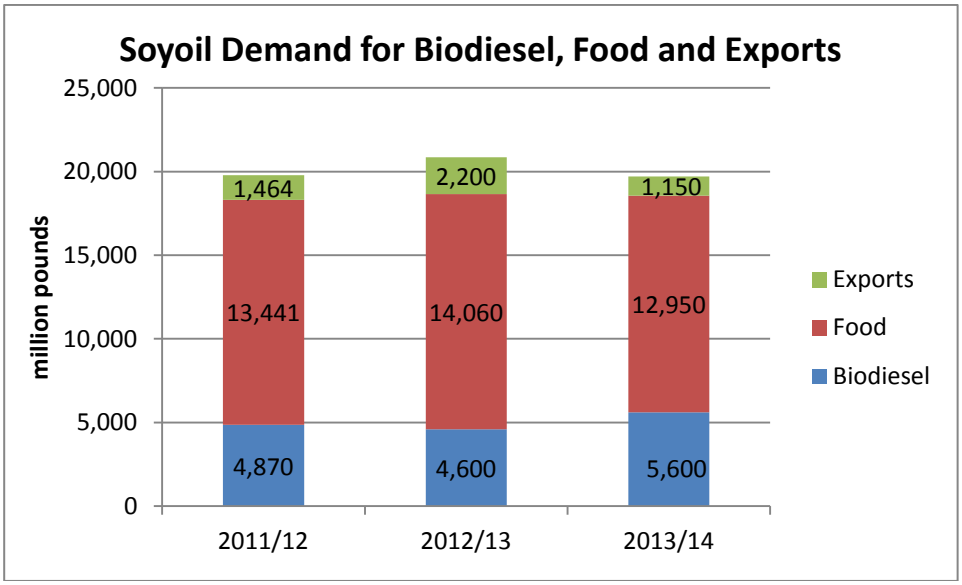

Figure 5.1 Biodiesel – Food – Exports (USDA, Soybean oil: U.S. Supply and Disappearance, 2013)

From Table 1.1 of Chapter 1 Background, Sales of Distillate (Diesel) by End Use, transportation uses have been separated from other uses by total gallons to determine percentage of biodiesel /transportation diesel currently being consumed.

With biodiesel production at 1.8 B gallons in 2013 being blended with 41.4 B gallons of transportation diesel, this yields 4.4% biodiesel to transportation diesel ratio, currently. The EIA 2020 projections of quadrillion BTUs of U.S. transportation diesel in 2020 converted to gallons yields 57.4 B gallons of transportation diesel (Transportation from Executive Summary, 2014). U.S. biodiesel production in 2020 is projected to be 5 B gallons (Gruenspecht, 2013). Therefore, the calculated projected biodiesel/transportation diesel ratio for 2020 is 8.7%.

5.2.2 Soy Oil Supply

By referring to Figures 5.2, it can be noted soy oil production is fairly stable. This represents that the growing biodiesel industry is not hurting the food industry. Furthermore, the purpose of Chapter 3 US Green Incentives for local industry, such as a higher import tariffs on biodiesel and renewing the blenders tax credit on biodiesel should be for the benefit of local industry and workers in order to grow the local economy. Tax credits like this are environmentally sound but biodiesel producers need consistent support so that entrepreneurs of start-up plants can become established in the local and growing clean energy industry.

As described in Chapter 3, Building Blocks model gives a sense of strong support allowing a company to be socially responsible to employees and communities. By allowing US national policy to benefit local industry gives this sense of community to US businesses and workers and shows national support for the US biodiesel industry. Europe has imposed a five-year biodiesel import tariff increase to $332.05 per metric ton on countries such as Argentina and Indonesia, over the $ 25 per

metric ton due to dumping to protect local industry (Steams, 2013) . Local biodiesel producers in Europe suffered injury due to these countries dumping biodiesel into their ports and anti-dumping duties have been established for fair competition.

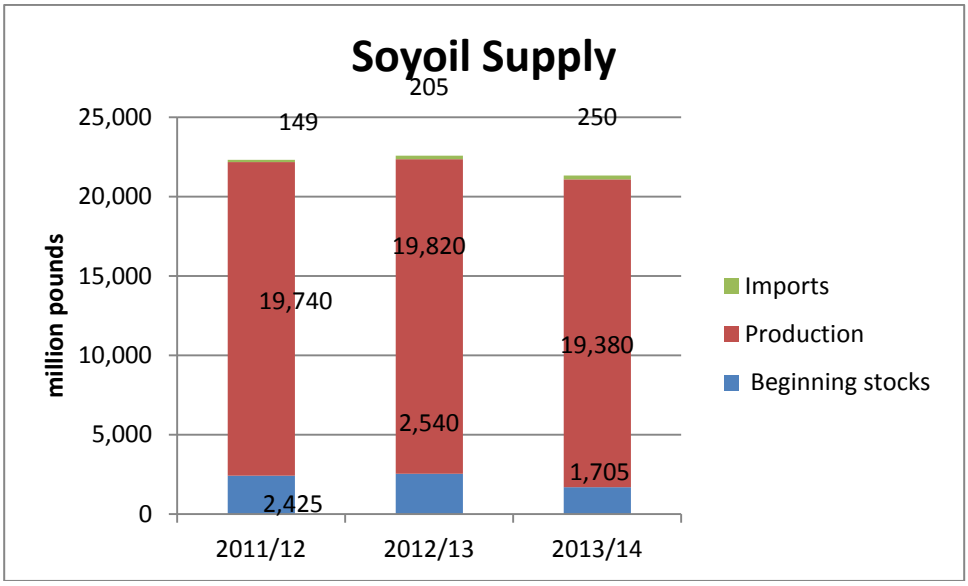

Figure 5.2 Production vs. Imports (USDA, Soybean oil: U.S. Supply and Disappearance, 2013)

5.2.3 Soybean Supply

Figure 5.3 confirms that the United States soybeans are plentiful in supply for many uses. The graphs show crush soybeans soybean oil as increasing, as well as exports for soy bean oil which is used for the food industry. As the framework discusses, the free market shows there is ample supply of soybean oil for the biodiesel

and food industry as populations increase. The added costs for purifying and the fuel taxes keep the market competitive.

Innovation has allowed harmony in the soybean industry where domestic crushing for soybean oil production for food uses and biodiesel refining and the supply of soybeans for exports are all actually increasing (Figure 5.3). The US has invested in Natural Capital and as a result there is a balance in the markets of uses of soybeans: soybeans used for oil, whether for food or biodiesel refining and soybeans exported to other countries for food. Innovative policy such as RFS and CAFÉ standards has lead the U.S. on a more sustainable energy path. Soybeans used for animal feed are a small percentage as the soy oil industry has been innovative in the processing of soy oil, and animal feed is a major byproduct of the oil processing method which lowers the amount of raw soy beans needed for animal feed.

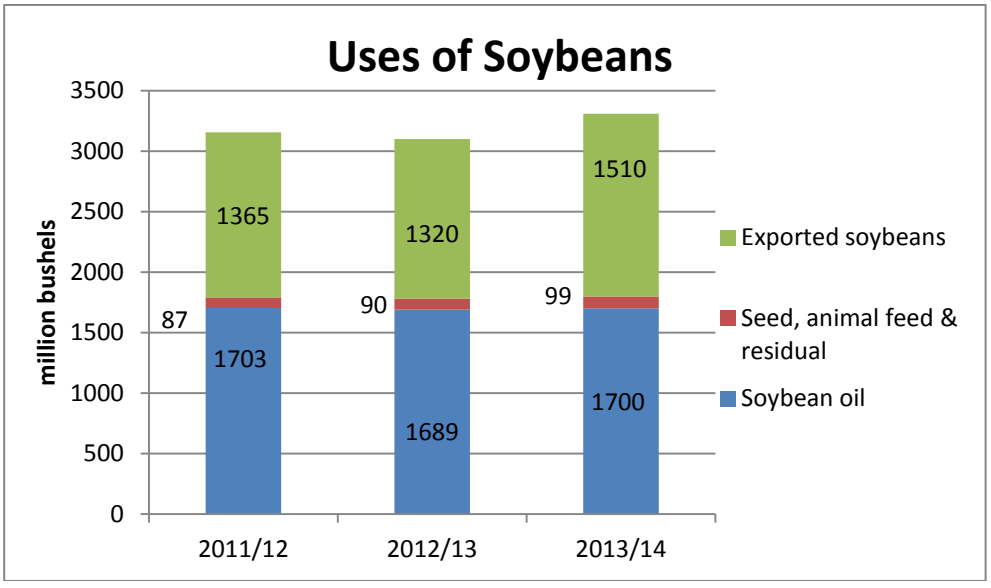

Figure 5.3 Uses of Soybeans (USDA, Soybeans: Annual U.S. Supply and Disappearance, 2013)

5.3 **Investment in Natural Capital through Energy Title Programs**

On February 7th, 2014 President Obama signed the 2014 Farm Bill, the Agriculture Reform, Food, and Jobs Act of 2014. Legislation has allocated $881 million in mandatory funding in the new five year Farm Bill Energy Title programs (Business Wire, 2014). This funding helps programs such as the REAP program, Biodiesel Education Program and Biobased Market Program help rural America create new jobs and with economic growth in more efficient and clean renewable industry.

Lloyd Ritter, co-director of the Agriculture Energy Coalition (AgEC) which represents a broad group of renewable energy, energy efficiency and agriculture groups, said, "By making modest investments in renewable energy, energy efficiency, and renewable chemical technology, the five year Farm Bill adopted today will have major benefits for energy security, economic growth, and environmental gains across the entire United States" (Business Wire, 2014). These benefits of investing in the top -funded program REAP, is discussed below as related to renewable energy and efficiency. Also, the Biodiesel Education Program will be discussed as related to this thesis, as well as the current results of the Biobased Market Program.

5.3.1 REAP Program

The REAP program provides grants and loan guarantees to farmers, ranchers and rural small businesses and rural electric cooperatives to install energy efficiency and also a wide range of renewable energy technologies such as biodiesel refineries. REAP receives $250 million in mandatory funding over 5 years, $50 each fiscal year in addition to up to $20 million in discretionary funding each fiscal year from 2014 through 2018 (Soybeans & Oil Crops, 2014). "REAP funding was reduced by $50 million in mandatory and by $20 million in discretionary funding per fiscal year from 2014 through 2018 from the 2008 Farm Bill (Energy: Title IX, 2014).”The program continues to provide assistance to agriculture producers and small businesses in rural America for adopting renewable energy and improving energy efficiency” (Energy: Title IX, 2014).

REAP serves every state and every agriculture sector. Late last year, in the latest rounds of grants and loans, farmers, ranchers and small businesses in rural areas of 22 states were awarded grants and loans to benefit from projects designed to use renewable energy, as well as to conserve power for this year (Rural Area to REAP Benefits of Energy Projects, 2013). The grants are a cost share from the federal government which the government may pay for maybe 25% of the cost of a project. The loans guarantee say a banker will provide a loan to start a project and the government will cover a certain percentage of that loan in the event of a default (2014 Farm Bill Includes Important Energy Title, 2014).This is now a three-tiered loan and grant program according to project size and cost: projects less than $80,000, between $80,000 and $200,000 and 0ver $200,00 in order to allow the program to more effectively administer funding (2014 Farm Bill - EnergyTitle Funding, 2014).

Nearly $50,000 has been approved for two biodiesel blending and pumping stations in Georgia through REAP funds in 2013 (Rural Area to REAP Benefits of Energy Projects, 2013).More than $31,000 was allocated for E85 and biodiesel blender dispensers in Iowa through this same program. Also, in Indiana $60,000 was awarded for the purchase of equipment for refining biodiesel. The REAP program has been part of the success of the biodiesel industry. In addition, "REAP can no longer provide funding for feasibility study grants, nor for blender pumps “due to a modified definition of "renewable energy system (Energy: Title IX, 2014).

5.3.2 Biodiesel Fuel Education Program

The 2014 Farm Bill has allocated the Biodiesel Fuel Education program to include $1million for each fiscal year 2014 through 2018 and an additional million in discretional funding for FY 2014 through 2018 (Energy Resources Group, 2014). The Biodiesel Fuels Education Program provides funding to educate fleet operators and the public on the benefits of biodiesel such as reducing carbon emissions and imports of foreign oil. The biodiesel industry can also provide growth to the economy by providing local jobs. The funding is awarded on a competitive basis to non-profit organizations or institutions of higher education (Biodiesel Fuel Education Program, 2014).

5.3.3 Biobased Market Program

The USDA has designated a total of 33 biobased product categories in the Biobased Market Program which can include cleaners, lubricants, building materials, insulation, roof coatings, fuels additives, and a long list of other sustainable industrial materials made from agricultural commodities (Biobased Markets Program (BioPreferred Program), 2014). The CCC provided $3 million for FY 2014-2018, an increase on $1 million per year from the 2008 Farm Bill. Discretionary funding was authorized for $2 million per year (Energy: Title IX, 2014).

The Biorefinery, Renewable Chemical, and Biobased Product Manufacturing Assistance Program was specifically included to increase demand for renewable commodities. Mandatory funding $100 million for FY 2014 and $50 million for FY 2015 and 2016 have been allocated. Discretionary funds provide $75 million for FY 2014through 2018.

This program is also known as BioPreferred, is expanded to "require bio-based-only procurement targets for supplies and services in Federal agencies, reporting of biobased products by procuring agencies, audits to ensure compliance, and a study of the economic impacts of the program" (Energy: Title IX, 2014). Mandatory funding of $3 million was provided for 2014- 2018, which was an increase of $2million from the 2008 Farm Bill. In addition, discretionary funding of $2 million per year was also authorized for the BioPreferred program. (Energy: Title IX, 2014).

5.4 **Case Study**

The Illinois case study showed that the average costs of "gallon-miles" to transport biodiesel from processing plant to biodiesel refinery was about 105 gallon-miles per gallon. That is, according to the Excel Solver Spreadsheet Figure 4.1, minimized costs were approximately 105,000,000 "gallon miles", which is calculated by total miles needed to deliver processed soy oil from processing plants to refineries multiplied by the demand of refineries in gallons per day.

As this optimization number is the minimized cost based on a location analysis of the refinery demand, the shadow prices in the sensitivity analysis (Table 4.1) displays the shadow prices (Lagrange Multiplier), of particular interest, some processing plants, which have negative shadow prices and zero shadow prices. For example, if Bloomberg had the capacity to process another gallon of soy oil, it would reduce the total minimized costs measured in gallon miles by 89 as shown in the sensitivity analysis by the negative shadow price (-89). Similarly, Gibson City would reduce the costs by 109 gallon miles based on the negative shadow price -109. Based on this location analysis and the sensitivity analysis, it is observed the Illinois soy oil processors with the negative shadow prices are closer to the Illinois biodiesel refineries.

For the processors, the negative Lagrange multiplier, or shadow prices represent the marginal cost reduction in the system (in transportation miles) that an additional gallon of processing capacity would yield. The processors that have excess capacity (Cairo and Quincy) in the sensitivity report have zero capacity shadow prices. These processing plants are located along the state border of Illinois and are furthest from the biodiesel refineries. The analysis of the model suggests that the soy oil is

being exported across state lines based on location, and the demand for soy oil within the state of Illinois is being met. (See Figure 4.3) Note that the model shows Quincy delivering to two refineries within the state, but that this processing plant has excess soy oil capacity and is able to export based on location. The model also shows that Cairo exports all soy oil due to its location to Illinois refineries and showing excess capacity with a zero shadow price, that is, it processes soy oil and but none of the processed soy oil is delivered to the biodiesel plants within the state of Illinois based on the location of the Cairo soy oil processing plant (see Figure 4.2 GIS Map).

A follow-up call was made to the two processing plants located in Cairo and Quincy to determine if soy oil is actually being exported, as the location analysis model indicated. Cairo exports soy oil across state lines for further refining solely for the purpose of food uses. Quincy has an on-site food refinery plant which utilizes the bulk of the soy oil processed but this plant does export the balance of its product to its own private biodiesel plant in Missouri.

This may possibly mean that all food and biodiesel refinery demands are being met in the state of Illinois such that it is cost effective and allow exportation across state lines rather than expand within the state of Illinois at this time. For the refineries, the positive shadow prices represent the marginal acquisition costs of obtaining an additional gallon of soy oil from the nearest processor with available capacity. A positive shadow price represents additional cost for one more gallon of biodiesel to be brought to the refinery from a processing plant to be refined at that refinery. This is a representative of the biofuel industry as a learning organization by improving through innovation, monitoring and measurement:

As a learning organization, the soybean oil industry continually changes as new information becomes available which enables the food and biodiesel markets to remain competitive." A business that ignores measurement will inevitably fall behind in making useful and cost-saving discoveries" (Hawken, Lovins, & Lovins, 2000, p. 68).

After researching quantity, current RFS standards of 2014- 2015 biomass-based diesel policy calls to maintain the biodiesel standard at the 2013 level, 1.28 billion gallons. Higher volumes of biomass-based diesel can be used to help meet the volume requirement of advanced biofuel, 2.20 billion gallons. This is an example of Building Blocks with the successful biodiesel industry supporting green development, as needed.

Example of "Building Blocks" as discussed in the Framework by creating a strong community bonding can be demonstrated by companies who have chosen their headquarters within close proximity to employees' homes; these companies might have indoor and outdoor gardens fed by rainwater captured from the rooftops for workers' aesthetic pleasure; and/or the building mandated to be an 'organic' building to integrate natural and local materials and energy conservation (Hawken, Lovins, & Lovins, 2000, p. 82). In this analysis, any shortages in the 2014 - 2015 volumes requirement which have been set for advanced biofuel are allowed to be made up by the biodiesel industry. Allowing the biomass-based biodiesel industry to support the advanced biofuel stocks creates a strong sense of community throughout the biofuel industry.

Chapter 6

CONCLUSIONS

One of the main objectives was to look at the soy oil industry to review the balance of the biodiesel and food industry as related to soy oil supply in the United States. There is a demand for soy oil in both the food and biodiesel markets locally and nationally, and the data shows that these markets are fairly stable. In the Methodology chapter, it was shown there was an adequate supply of soy oil to meet the biodiesel demand in Illinois and still allow for exports across state lines for food and biodiesel refining. On a national level, the data showed that U.S. biodiesel production is increasing but soy oil exports were decreasing due to foreign competition with Argentina and Brazil in the soy oil export market. The numbers showed soy oil imports increased slightly which resulted in less U.S. soy oil production for food uses in 2012-2013. Finally, the data showed that the soybean demand used for exports, animal feed and used to make soy oil (Figure 5.3) in the U.S. were expected to increase in the U.S. for 2013/2014. Overall, U.S. domestic biodiesel (Figure 5.1), soybean exports (Figure 5.3), and soybeans used for domestic soy oil (Figure 5.3) are all increasing at a steady rate, and there does not seem to be a shortage of soy beans in the U.S. to meet this demand as shown in the graphs in the Analysis chapter.

As mentioned in Chapter 2, and Chapter 5, Literature Review and Analysis, the Renewable Fuel Standards and the Blenders' Tax credit are included as part of the

Energy Policy Act. These Act states three goals, one of which to reaffirm a commitment to competition in wholesale power markets as national policy and assures fair competition recognizing effective regulation is necessary. As also discussed in the Literature Review, the Energy Title IX within the 2014 Farm Bill does contains mandatory funding for many energy programs, but the biodiesel blenders' tax credit was allowed to expire at the end of 2013. Yet, there is a consistent stream of billions of dollars in fossil fuel subsidies given annually by the United States to lower the cost of fossil fuel energy production (Fossil Fuel Subsidies in the U.S., n.d.). Global warming is caused by carbon dioxide emissions from fossil fuels. Congress and the world are primarily investing in the industry that is leading to global warming.

Choosing the state of Illinois for the case study provides a very good example for local support such the Illinois Soybean Association and the State of Illinois, to encourage environmental stewardship, best management practices and environmental controls. Among the local policies Illinois offers are tax exemptions on B11 biodiesel blending and a blending mandate for state and local owned diesel powered vehicles.

As discussed in Chapter 5, Results/Analysis, the price of diesel fuel in the transportation sector is projected to decline to $3.50 per gallon in 2017, then increase to $4.73 per gallon by 2040. The share of diesel in the total domestic petroleum is also expected to rise, but the share of gasoline will fall as a result of light duty vehicle models switching to diesel in 2017.

Building Blocks: As mentioned in Chapters 2, 3 and 5, Literature Review, Framework and Results/Analysis, when biodiesel is produced here in the United States by American industry, it gives a sense of community to this developing industry. The attention to the protection of the local surroundings by “green development” then

becomes a priority (Hawken, Lovins, & Lovins, 2000, p. 85) . A main objective of a green local industry is that it is"environmentally sensitive to the external environment which is sound business and is socially responsible to employees and communities with attention to well-being" (Hawken, Lovins, & Lovins, Natural Capitalism, 2000, p. 85). For example, the "Sustainable Biodiesel Alliance" that was mentioned in 2.1.7 which brought together stakeholders such as consumers, farmers, environmental organizations, renewable energy experts, and NGOs to promote sustainable energy practices such as harvesting soybeans, processing, distribution and end-use. That is "green development". This is a good path to reducing petroleum use and imports. The renewable industry is a growing industry which is strengthening our energy security, creating jobs and improving our local economy.

Investment in Natural Capital: In Chapter 2, Literature Review, Chapter 3, and Chapter 5, Literature Review, Framework, and Analysis, Biodiesel was acknowledged that it can be used to help meet the advanced biofuel quota according the federal policy, reduce exports and reducing the use of natural resources. As stated previously, B100 biodiesel reduces hydrocarbons over regular diesel by more than 50%, and B20 which is more commonly used in the United States reduces carbon emissions by 11% (How Much Does Biodiesel Reduce Air Pollutants, 2007).

Many innovation stems from the Energy Title Programs described in Chapter 1, Chapter 2, and Chapter 5, Background and Literature Review, and Analysis which prove as a means and ways for local green energy development. This research Issue took notice of programs such as REAP which supports every type of renewable energy across the United States and has assisted with 6600 projects with 15,000 employees.

The Biodiesel Fuel Education Program funds annually to nonprofit organizations to educate fleet operators and the public on the benefits of biodiesel.

As discussed in Chapter 1 and Chapter 5, Background and Analysis, the U.S. RFS for biomass-based diesel is 1.28 billion gallons for 2014 and 2015. Many foreign imports have cost advantage through cheaper inputs and subsidies and can sell the biodiesel at a lower price. The second problem stated U.S. Biodiesel import tariffs are low: U.S. biodiesel import tariffs are 5% compared to Europe at 25%, which are hurting the local industry with subsidized foreign imports (Steams, 2013). Europe imposes the duty on all biodiesel imports, including biodiesel imports from the United States, to protect their local producers from outside interests that have a cost advantage from tax breaks and government subsidies and having an unfair advantage over local businesses in their market economy.

As imports were mentioned in Chapter 2 and Chapter 5, Literature Review and Analysis, the U.S. imported more than 46 million gallons of bio-massed diesel October, 2012, which was an increase of 28.7 million gallons from September (Kotrba, 2013). As Europe has enforced anti-dumping duties on Indonesia and Argentina, imports to the U.S. have been steadily increasing. As also stated in Chapter 2, Literature Review, predictions for biodiesel production in Indonesia for 2012 and 2013 are steadily increasing with 90% of Indonesia's subsidized production going to overseas exports (USDA GAIN: Biofuels, 2012). The Indonesian subsidy is approximately $1 per gallon of biodiesel and Indonesia's biggest refineries are state owned. U.S. biodiesel refineries which produced between 5 and 10 million gallons of biodiesel at their plants last year, have filed Chapter 11 bankruptcy this year due to the competitive biodiesel marketplace in the United States (Veronikis, 2014). Foreign

imports seemed to play a key role in the developing biodiesel marketplace especially when the blenders' credit as stated as mentioned in Chapter 5, Analysis, was in effect as the importers were selling at a lower price due to their subsidies and the blenders' credit gave them increased profits. Now, U.S. biodiesel producers may be at a disadvantage competing in the U.S. marketplace with subsidized importers, and with a low U.S. import tariff (U.S. 5% compared to Europe 25%).

As discussed in Chapter 3, Framework, the free market and consumers may sometimes not know that prices have built in taxes and incentives and processing costs such as with the soybean industries for food and biodiesel. But innovation seems to have resulted in a balance of soy oil for food and fuel represented by U.S. soy oil markets showing there is currently a healthy market for both the food industry and the biodiesel industry in the United States. The demand is being met locally and the surplus is being shipped across state lines for both food and biodiesel refining based on location advantage. For the United States soy oil market, biodiesel, food and exports, there is a market for soy oil in both the food and biofuel industry, and these industries appear to be in balance. Soybeans are in demand for soy bean oil and for biodiesel, as well as for exports for food in other nations, and here too the market seems to be stabilized with no shortages in either sector with prices and supply stable.

As discussed in the Introduction and the Problem Statement, this research has attempted to examine the benefits of U.S. national energy policy for the local soy oil industry for food and biodiesel, some policy measures have been inefficient in the process of implementation of national energy policy. This research brought to light the low priority of national energy policy such as allowing renewable energy policy to expire is a regular occurrence with Congress. By doing so, investments in the

renewable energy industry could slow down or sometimes stop altogether. This research did not locate any lapses in any energy programs due to the expiration of the Farm Bill or Energy Title programs but this thesis was on a time constraint.

In conclusion, this thesis has brought to light many opportunities for growth in the U.S. biodiesel industry which are being monitored and certified as sustainable practices through non-profit organizations, Though a combined effort of farmers, industry, NGOs and consumers, renewable energy such as biodiesel development can further succeed to provide jobs and cleaner fuel to reduce greenhouse gas emission, reduce petroleum imports and secure national energy security.

RECOMMENDATIONS

The first problem stated that United States Congress could provide a consistent blenders' tax credit to the local biodiesel industry, because local biodiesel producers, such as those in Illinois, depend on this subsidy. The biodiesel industry needs the same support as the fossil fuel industry, if not more, considering the goal is to reduce greenhouse gas emissions and to reduce imports or energy security. Subsidies are suppose to help local industries overcome cost, pricing or market disadvantage (Hawken, Lovins, & Lovins, 2000, p. 60).

As discussed in Chapter 3, Framework, U.S. Green Incentives such as the biodeisel blending credit should help local industry. An increased import tariff could help protect local biodiesel companies from the increased biofuel in the marketplace due to subsidized foreign imports as previously described. Also discussed in the

Framework, this further establishes a sense of community and those involved have a personal interest in the local environment and the local economy.

Furthermore, Congress has at times had difficulties keeping up with many decisions as was the case in 2012-2013 by letting the farm bill expire, as well as shutting down in October, 2013. Jobs, projects and industry can be jeopardized by such delays. Renewable energy programs need permanent funding in a growing industry in order for planners and investors not to be stalled in their project efforts. This research brought to light the urgency of the necessity of carbon reducing energy and program funding as a top priority as climate change becomes more apparent.

Based on the Illinois case study results, Illinois should not expand biodiesel refineries until soy oil processing plants are expanded or new soy oil processing plants are built based on location of biodiesel refineries. According to the sensitivity analysis, there is no room for growth in biodiesel refineries without expansion of soy oil processing capacities based on location.

The 2014 Farm Bill is providing sound support for the Energy Title IX from 2014 through 2018, but will these programs be allowed to expire again as the Biodiesel Blenders' Tax has been allowed to expire! Without permanent funding, energy programs, renewable jobs and renewable programs could be at risk. As policy approaches expiration, investors tend to shy away from that industry and the incentives are not guaranteed to be renewed. The renewable energy industry needs permanent support from U.S. energy policy to pave the way for a cleaner and more sustainable America.

BIBLIOGRAPHY

2013 Biofuels Consumption. (2014, March 27). Retrieved March 27, 2014, from American Fuels: http://www.americanfuels.net/2014/03/2013-biodiesel-consumption.html

2014 Farm Bill - EnergyTitle Funding. (2014, February 21). Retrieved from energysolutionforum: http://www.energysolutionsforum.com/2014-farm-bill-energy-title-funding/

2014 Farm Bill Includes Important Energy Title. (2014, February 14). Retrieved February 14, 2014, from Windpoweringamerica.gov: http://www.windpowingamerica.gov/filter_detail.asp?itemid=4130

Agriculture Energy Coalition. (2012, November 13). Retrieved November 13, 2014, from Business Wire: http://www.businesswire.com/news/home/20121113006644/en/Ag-Energy-Coalition-Joins-Groups-Urging-House#.U2AsQ2co_IU

Alternative Fuel Data Center. (2013). Retrieved from U.S. Department of Energy: http://www.afdc.energy.gov/laws/key_legislation#epact92

Alternative Fuels Data Center. (2013). Retrieved March 12, 2014, from US Department of Energy: http://www.fdc.energy.gov/fuels/biodiesel_blends.html

Alternative Fuels Data Center: Biodiesel Mixture Excise Tax Credit. (2014, January 25). Retrieved January 25, 2014, from U.S. Department of Energy - Energy Effiecincy and Reneqable Energy Alternatives Fuels Data Center: http://www.afdc.energy.gov/laws/law/US/395

Alternative Fuels News and Commentary. (2013, January 31). Retrieved February 8, 2-14, from American Fuels: http://www.americanfuels.net/2014/01/november-2013-biodiesel-production-dips.html

American Soybean Association. (n.d.). *Soygrowers.com*. Retrieved November 21, 2013, from http://soygrowers.com/issues-pages/farm-bill/

ASA. (2013). 2014 Standards for the Renewable Fuel Standard (RFS) Program. (p. 3). American Soybean Association.

Aubrey, S. B. (2012, April 25). USDA Repowering Assistance Program: Underutilized Pot of Gold? *Biomass Magazine*. Retrieved November 11, 2013, from http://biomassmagazine.com/articles/6300/usda-repowering-assistance-program-underutilized-pot-of-gold

Behrens, C. E., & Carol, G. (2012). *U.S. Energy: Overview and Key Statististics.* Congressional Research Service. Retrieved January 15, 2014

Bergstrom, K. (2012). U.S. locomotive order activity has slowed, but demand for GenSets is up for some motive power manufacturers. *Progressive Railroading*. Retrieved February 11, 2014, from http://www.progressiverailroading.com/mechanical/article/US-locomotive-order-activity-has-slowed-but-demand-for-GenSets-is-up-for-some-motive-power-manufacturers--33578

Biobased Markets Program (BioPreferred Program). (2014). Retrieved from USDA.gov: http://attra.ncat.org/gide/a_m/biopreferrrred.html

Biodiesel Fuel Education Program. (2014). Retrieved from www.law.cornell.edu: www.law.cornell.edu

Biodiesel Production, Imports Records for October. (2013, December 31). Retrieved from Domestic Fuel: http://domesticfuel.com/2013/12/31/biodiesel-production-imports-records-fo-october/

Biofuel Exports and RFS Mandates. (2013). Retrieved March 27, 2014, from farmdoc DAILY: http://farmdocdaily.illinois.edu/2013/08/biofuel-exports-rfs-mandates.html

Business Wire. (2014, February 4). Retrieved February 4, 2014, from Funding for Farm Bill Energy Title Programs Will Help Rural Amrica Create Economic Opportunity: http://www.business/com/news/home/20140204006719/en/Funding-Farm-Energy-Title-Programs-Rural*.UyMpIWco_IU

Caparella, T. (2013, December). EPA Holds Firm o 2014 Biodieselmandate. *RENDER*. Retrieved from http://www.rendermagazine.com/article/2013-issues/ecember-2013/epa-holds-firm/

Cazzola, P., Morrison, G., Kaneko, H., Cuenot, F., Ghandi, A., & Fulton, L. (2013). *Production Costs of Alternative Transtportation Fuels.* Internation Energy Agency. Retrieved from http://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=4&cad=rja&ved=0CDgQFjAD&url=http%3A%2F%2Fwww.iea.org%2Fpublications%2Ffreepublications%2Fpublication%2FFeaturedInsights_AlternativeFuel_FINAL.pdf&ei=HgP9UqSRJKnT0wHMqYGoAw&usg=AFQjCNEWLRjn9awNLv

Center for Agriculture and Rural Development. (2014, February 7). Retrieved February 7, 2014, from Historical Biodiesel Operating Margins: http://www.card.iastate.edu/research/bio/tools/hist_bio_gm.aspx

Cornell. (2013). *7 USC § 8102 - Biobased markets program.* Cornell University. Retrieved September 2013, from http://www.law.cornell.edu/uscode/text/7/8102

Curran, G., Olsen, A., & Putz, K. (2014). *Farm Energy Success Stories.* Environmental Law and Policy Center. Retrieved from farmenergysuccessstories2014-finalweb.pdf

Davis, J. (2009, September 2). Illinois Ups Biodiesel Mandate to 5 percent. *Domestic Fuel*. Retrieved March 1, 2014, from http://domesticfuel.com/2009/09/02/illinois-ups-biodiesel-mandate-to-5-percent/

Davis, John. (2013, September 5). Retrieved January 11, 2014, from Domestric Fuel: http://domesticfuel.com/2013/09/05/us-biodiesel-imports-up-but-so-are-exports/

Difference Between Diesel and Gasoline Engines. (2010). Retrieved February 10, 2014, from Fourthgen: http://www.fourthgen.ne/difference-between-diesel-gasoline-engines-shtml

EIA. (2009). *Biodiesel Supply and Consumption.* Energy Information Administration. Retrieved from http://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&cad=rja&uact=8&ved=0CCkQFjAA&url=http%3A%2F%2Fwww.eia.gov%2Fforecasts%2Fsteo%2Fspecial%2Fpdf%2F2009_sp_01.pdf&ei=1TJhU7b6B9PIsA

SA5oDgBA&usg=AFQjCNHU3S0Qe1g7220oXvPmlwVc8vzZ8Q&sig2=8Rd_PFAOqT25

Energy Resources Group. (2014, January 29). Retrieved from Farm Bill Passes House - Energy Title Explained: http://pa-erg.com/2014/01/29/farm-bill-passes-house-energy-title-explained/

Energy: Title IX. (2014, March 11). Retrieved from ers.USDA.gov: http://www.ers.usda/agricultureal-act-of-2014-hgihlights-and-implications/energy.aspx

Environmnetal and Social Impacts of Palm Plantations and their Implications for biofuel Production in Indonesia. (2012). *Ecology and Society*.

EPA. (2013). *EPA Proposes 2014 RFS, 2015 Biomass-Based Diesel Volume.* EPA.

European Commission Proposes Duties on Imports of US Biofuels. (2013, January 28). Retrieved March 11, 2014, from International Centre for Trade and Development: http://ictsd.org/i/environment/152942/

Farm Bill Advances Toward Passage. (2014, January 28). Retrieved from Biofueldigest.com: http://www.biofuelsdigest.com/bdigest/2014/01/28/farm-bill-advances-towards-passage/

FERC. (2006). *Energy Policy Act 2005.* Fact Sheet, Federal Energy Regulatory Commission, Washington DC. Retrieved from http://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&cad=rja&ved=0CCQQFjAA&url=http%3A%2F%2Fwww.ferc.gov%2Flegal%2Ffed-sta%2Fepact-fact-sheet.pdf&ei=6Bb5UqTeBefq0AGO7oH4Bw&usg=AFQjCNFWlfMCOr1otkGbzwhdEKA0QaHKag&bvm=bv.60983673,d.dmQ

Fossil Fuel Subsidies in the U.S. (n.d.). Retrieved March 9, 2014, from Oil Change International: http://priceofoil.org/fossil-fuel-subsidies/

Frame, E., Bessee, E., & H.W., M. J. (1997). *Biofuel Technology for Military Application.* San Antonio: U.S. Army. Retrieved January 15, 2014, from http://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&cad=rja&uact=8&ved=0CCkQFjAA&url=http%3A%2F%2Fwww.chevronwithtechron.com%2Fproducts%2Fdocuments%2FDiesel_Fuel_Tech_Review.pdf&ei=

VxFgU8HpKIrKsQSe6YHACw&usg=AFQjCNGEJT2B4JsvmnUlFh1jPyjw31obpg&s

Gas Taxes. (2014, February 14). Retrieved February 14, 2014, from www.gaspricewatch.com: http://www.gaspricewatch.com/web_gas_taxes.php

Gefvert, A. (2013, December 20). *2014 Will Be A Tough Year For Renewable Energy Group And Other Biodiesel Producers.* Retrieved December 20, 2013, from Seeking Alpha: http://seekingalpha.com/article/1909331-2014-will-be-a-tough-year-for-renewable-energy-group-and-other-biodiesel-producers

Good, K. (2010). Farm Bill; Biofuels; Aniaml Agriculture; and Taxes. 8. Retrieved 2013 27, November, from http://farmpolicy.com/2010/07/15/farm-bill-biofuels-animal-agriculture-and-taxes/

Gruenspecht, H. (2013, January 24). Biofuels in the United States: Conflict and Outlook. Washington DC: U.S. Energy Information Administration. Retrieved from http://www.eia.gov/pressroom/presentations/howard_01242013.pdf

Hawken, P., Lovins, A., & Lovins, L. H. (2000). *Natural Capitalism.* New York: Little , Brown and Company.

HOR. (2000). *Biomass Research and Development Act of 2000.* U.S. House of Representatives. U.S. House of Representatives. Retrieved November 9, 2013

HOR. (2008). *The Food, Conservation, and Energy Act of 2008.* House of Representatives. U.S. House of Representatives. Retrieved September 30, 2013, from https://www.govtrack.us/congress/bills/110/hr2419

HOR. (2013). *H.R. 3102: Nutrition Reform and Work Opportunity Act of 2013.* House of Representatives, Congress. U.S. House of Representatives. Retrieved September 2013, from https://www.govtrack.us/congress/bills/113/hr3102

How Much Does Biodiesel Reduce Air Pollutants. (2007). Retrieved 9 2014, March, from Allegro Biodiesel: http://allegrobiodiesel.com/howmuchdoesbiodieselreduce pollutants.html

IEPA. (2008). *Building a Biofuel Plant in Illinois.* Illinois Environmental Protection Agency. Retrieved December 30, 2014, from http://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&cad=rja&uact=8&ved=0CCkQFjAA&url=http%3A%2F%2Fwww.epa.state.il.us%

2Fagriculture%2Fbuilding-an-ethanol-plant.pdf&ei=fjRhU8bSF6HksAS3zILoBg&usg=AFQjCNGdPRhB83-vMxB6gzSYhNyshXzN7A&sig2=E-N2-UFdKR

Illinois Farm Report. (2013). Retrieved February 1, 2014, from http://www.nass.usda.gov/Statistics_by_State/Illinois/Publications/Farm_Reports/

Illinois Laws and Incenives for Biodiesel. (2013, November 12). Retrieved January 13, 2014, from U.S. Department of Energy: http://www.afdc.energy.gov/laws/laws/IL/tech/3251

Illinois Soy. (2012). Retrieved March 15, 2014, from Illinois Soybean Association: http://www.ilsoy.org/

Illinois Soybean Association. (n.d.). Retrieved from Insights: http://syinsiht.com/embracing-the-past-envirsionng-the-future

ISA. (2012). *Our Soy Checkoff.* Illinois Soybean Association.

Jalonick, M. C. (2013, December 12). Reid says Senate will not extend farm law. *Morning Ag Clips*. Retrieved Decemeber 12, 2013, from http://morningagclips.com

Kotrba, R. (2011, December 14). Illinois supports state B11 tax incentive through 2018. *Biodiesel Magazine*. Retrieved March 1, 2014, from http://www.biodieselmagazine.com/blog/article/2011/12/illinois-supports-state-b11-tax-incentive-through-2018

Kotrba, R. (2012, September 5). Palm Oil Biodiesel and the Renewable Fuel Standard. *Biodiesel Magazine*.

Kotrba, R. (2013, Novemember 20). The swinging pendulum of US biodiersel policy. *Biodiesel Magazine*. Retrieved March 5, 2014, from http://www.biodieselmagazine.com/blog/article/2013/11/the-swinging-pendulum-of-us-biodiesel-policy

Kotrba, R. (2013, June 5). U.S. biodiesel exports surge in August. *Biodiesel Magazine*, p. 2. Retrieved from http://www.biodieselmagazine.com/blog/article/2013/06/why-us-imports-are-a-concern-but-dont-have-to-be

Kotrba, R. (2013, June 5). Why US imports are a concern, but don't have to be. *Biodiesel Magazine*. Retrieved February 13, 2014, from http://www.biodieselmagazine.com/blog/article/2013/06/why-us-imports-are-a-concern-but-dont-have-to-be

Lane, J. (2013). The Farm Bill: Biofuels Digest's 5-Minute Guide to the Energy Title. *Biofuels Digest.com*. Retrieved from www.biofuelsdigest.com/bdigest/2013/05020/the-farm-bill-biofuels-digests-5-minute-guide-tothe-energy-title/

Lloyd-Miler, J. (2013, November 22). *6 New Diesel Cars Bound for 2014*. Retrieved February 10, 2014, from Wall St Cheat Sheet: http://wallstcheatsheet.com

Mackinnon, L. (2013, July 11). *Despite Evidence, Food Vs. Fuel Fight Continues*. Retrieved April 9, 2014, from Forbes: http://www.forbes.com/sites/pikeresearch/2013/07/11/despite-evidence-food-vs-fuel-fight-continues/

Major Crops Grown in the U.S. (2014, January 2014). Retrieved January 8, 2014, from United States Environmental Protection Agency: http://www.epa.gov/oecaagct/ag101/cropmajor.html

Monke, J. A., & Stubbs, M. (2013). *Expiration and Extenstion of the 2008 Farm Billl.* Congressional Research Service. Retrieved September 30, 2013

Mushrush, G., Willauer, H., Wynne, J., Lloyd, C., & Bauserman, J. (2005, October). Storage Tank Stability of Soybean Derived. *Energy Sources*. Retrieved February 10, 2014, from http://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=4&cad=rja&ved=0CDgQFjAD&url=http%3A%2F%2Fwww.tandfonline.com%2Fdoi%2Fpdf%2F10.1080%2F15567030903530590&ei=nBv5UoSSGanI0QGl3oD4Cg&usg=AFQjCNG3lRAsDLzAyWaGlyosyDpuaqHRAg

Nordisk, N. (2008). A new framework for implementing corporate sustainabiliy. In M. J. Epstein, *Making Susatianilbiity Work* (pp. 33-34). San Fransisco: Berrett-Koehler Publishers.

Olson, A. (2011). The Farm Bill's Energy Title" Producing Clean Energy & Power, Advancing Biofuels and Savings Energy. *Farm Bill Enery Title_ Rural Energy*

for America Progarm, (p. 21). Retrieved October 2, 2013, from http://files.eesi.org/olsen_071911.pdf

Petroleum. (2014, February 13). Retrieved February 13, 2014, from Energy Information Administration: http://www.eia.gov/petroleum/gasdiesel/

Petroleum and Other Liquids. (2013, November 15). Retrieved January 15, 2014, from U.S. Energy Information Administration: http://www.eia.gov./dnav/pet/pet_cons_cons821est_dcu_nus_a.htm

Qata's Comments on Biofuels are Self Serving: GRFA. (2011, September 27). Retrieved March 30, 2014, from Renewable Fuels Association (RFA): http://ethanlolrfa.org

Renewable Fuel Standards. (2013, December 10). Retrieved from EPA: http://epa.gov/OTAQ/fuels/renewablefuels/

Renewable Fuels: Regulations & Standards. (2014, February 8). Retrieved Febuary 8, 2014, from epa.gov/renewable fuels/regulations: http://www.epa.gov/otaq/fuels/renewablefuels/regulations.htm

Reuters Summit-crisis hit Argentina biodiesel sector eyes U.S. market. (2013, May 20). Retrieved March 8, 2014, from Reuters: http://www.reuters.com/article/2013/05/20/latam-summit-argentina-biodiesel-idUSL2N0E11V920130520

Rural Area to REAP Benefits of Energy Projects. (2013, Septemeber 27). Retrieved September 27, 2013, from Domestic Fuel: http://domesticfuel.com/2013/09/27/rurral-area-to-real-benefits-of-energy-projects-/

Rural Development. (2012, March 19). Retrieved February 15, 2014, from U.S. Department of Agriculture: http://www.rurdev.usda.gov/STELPRD4015290.html

Rural Energy for America Program - Renewable Energy System and Energy Efficiency Improvement Guaranteed Loan and Grant Program. (2013, January 14). Retrieved November 9, 2014, from http://www.rurdev.usda.gov/BCP_ReapResEei.html

S.954. (2013-2014). Retrieved October 2013, from http://thomas.loc.gov/cgi-bin/query/z?c113:S.954:

Schnepf, R., & Yacobucci, B. D. (2013). *Renewable Fuel Standard (RFS): Overview and Issues.* Congress. Congressional Research Service. Retrieved December 16, 2013, from http://www.fas.org/sgp/crs/misc/R40155.pdf

Schnept, R. (2013). *Renewable Energy Programs and the Farm Bill: Status and Issues.* Congress. Congressional Research Service. Retrieved November 10, 2014, from http://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&cad=rja&uact=8&ved=0CCwQFjAA&url=http%3A%2F%2Fnationalaglawcenter.org%2Fwp-content%2Fuploads%2Fassets%2Fcrs%2FR41985.pdf&ei=eyBhU4-sEJTLsQTjrYG4DQ&usg=AFQjCNEVMRfI2xrC8OFV1cZJyjNXz8O3AA&sig2=k

Silviati, A. (2008). *Indonesia: Biofuel Development.* U.S. Commercial Service.

Slette, J., & Wiyonp, I. E. (2012). *USDA Foreign Agriulture Service GAIN Report.*

Soybean Oil Meal. (2014). Retrieved February 10, 2014, from Aston food and Food Ingredients: http://www.aton.ru/en/production/22/

Soybeans & Oil Crops. (2014). Retrieved December 10, 2013, from U. S. Department of Agriculture: http://www.ers.usda.gov/topics/crops/soybeans-oil-crops/trade.aspx

Soybeans and Oil Crops. (2013). Retrieved February 2, 2014, from U.S. Department of Agriculture: http://www.ers.usda.gov/topics/crops/soybeans-oil-crops/trade.aspx

Stearns. (2014). *Bloomberg*. Retrieved from Argentina, Indonesia Hit With EU Tariffs on Biodiesel: http://www.bloomberg.com/news/2013-11-19/argentina-indonesia-hit-with-eu-tariffs-on-biodiesel.html

Stubbs, M. (2014). *Biomass Crop Assistance Program (BCAP): Status and Issues.* Congressional Research Sevice. Retrieved March 20, 2014, from http://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&cad=rja&uact=8&ved=0CC4QFjAA&url=http%3A%2F%2Fdigitalcommons.unl.e

du%2Fcrsdocs%2F18%2F&ei=CzVhU9fKJcXesATQ6YLABQ&usg=AFQjCNHEwcdT5DeAwkQ-evko1oCBTEeeFw&sig2=zbh2PwqfjLeLfTEH43GeyQ

Summary of Weekly Petroleum Data for the Week Ending January 31, 2014. (2014). Retrieved February 13, 2014, from SuperPenny Stock Alerts: http://www.talkstop.com

Sustainable Biodiesel Alliiance. (n.d.). Retrieved from The Sustainable Biodiesel Alliance: http://test.sustainablebiodieselalliance.com

The Biofuels Facts. (n.d.). Retrieved March 5, 2014, from Energy Future Coalition: http://www.energyfuturecoalition.org/biofuels/fact_biodiesel.htm

The Farm Bill. (n.d.). Retrieved September 30, 2013, from The American Soybean Association: http://soygrowers.com/

The Importane of Cetane in Diesel Fuels. (2014). Retrieved February 10, 2014, from Fuel Majic: http://www.fuelmajic.net/cetane%2Booster.html

Today in Energy. (2014, February 8). Retrieved February 8, 2014, from epa.gov/Energy Information System: http://www.eia.gov/todayinenergy/detail.cfm?id=11511

Transportation. (2013, August 21). *Business Insider*. Retrieved February 10, 2014, from http://www.businessinsider.com/10-reasons-why-you-should-buy-a-diesel-car-2013-8

Transportation from Executive Summary. (2014, April 7). Retrieved April 7, 2014, from U.S. Energy Information Administration: http://www.eia.gov/forecats/aeo/sector_transportation_all.cfm

U.S. announces tough new 54.5-mpg CAFE standard for vehicle fuel economy. (2012, August 28). Retrieved March 20, 2014, from Detroit Free Press: http://www.freep.com/article/20120828/BUSINESS01/120828029/CAFE-mpg-fuel-economy-standards-ray-lahood

U.S. Biodiesel Exports Surge in August. (2013, November 6). *Biodiesel Magazine*. Retrieved from http://biodieselmagazine.com/blog/article/2013/11/us-biodiesel-exports-surge-in-august

U.S. Biodiesel Summary. (2013, April 30). Retrieved April 30, 2014, from eia.gov: http://www.eia.gov/tools/faqs/faq.cfm?id=927&t=9

USDA. (2013). *Agriculture Reform, Food and Jobs Act of 2013.* Senate, U.S. Department of Agriculture. U.S. Department of Agriculture. Retrieved September 30, 2013, from http://thomas.loc.gov/cgi-bin/cpquery/T?&report=sr088&dbname=113&

USDA. (2013). *Soybean oil: U.S. Supply and Disappearance.* U.S. Department of Agriculture. Retrieved from http://www.ers.usda.gov/publications/ocs-oil-crops-outlook/ocs-13iaspx

USDA. (2013). *Soybeans: Annual U.S. Supply and Disappearance.* U.S. Department of Agriculture. U.S. Department of Agriculture. Retrieved February 10, 2014, from http://www.ers.usda'gov/publications/ocs-oil-crops-outlook/ocs-13i.aspx

USDA. (2013). *USDA Press Release.* Natural Agricultural Statistical Service. U.S. Department of Agriculture. Retrieved March 20, 2014, from www.nass.usda.gov

USDA Economic Research Service. (2012). Retrieved October 2, 2013, from Food, Conservation, and Enery Act of 2008: http://ers.usda.gov

USDA GAIN: Biofuels. (2012). Retrieved February 2, 2012, from The Bioenergysite: http://www.thenioenergysite.com/report/?id=844

USDA, U.S. Navy Unveil Farm to Fleet Program: as Shift to Biofuels Blends Begins. (2013). *Renewable Energy World*, 3. Retrieved February 11, 2014, from http://www.renewableenergyworld.com/rea/news/article/2013/12/usda-us-navy-unveil-farm-to-fleet-program-navy-open-for-business-as-shift-to-biofuels-blends-begins

Veronikis, E. (2014, January 28). Keystone Bifuels looks to sell Camp Hill refinery. *Penn Live*. Retrieved January 28, 2014, from http://www.pennlive.com/midstate/index.ssf/2014/01/keystone_biofuels_looks_to_sel.html

Wagner, R. (2014, January 14). Biodiesel Blenders' Tax Credit Expired - Now What? *Seeking Alpha*. Retrieved January 14, 2014, from http://seekingalpha.com/article/1938131-biodiesel-blenders-tax-credit-expired-now-what

What are the projected diesel fuel prices for 2014 and 2015? (2014, February 17). Retrieved February 17, 2014, from eia.gov: http://www.eia.gov/tools/faqs/faq.cfm?id=31&t=9

Wisner, D. R. (2009, June 23). *Biodiesle Economics - Costs, Tax Credits and Co-Proucts*. Retrieved January 15, 2014, from Agriculture Marketing Resarch: http:www.agmrc.org/renewable_energy/biodiesel/bioddiesel-economics-costs-tax-credits-and co-product

Yoon, J. J. (2011, March 8). What's the Difference between Biodiesel and Renewable (Green) Diesel. *Advanced Fuels*. Retrieved March 13 2014, from http://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&cad=rja&uact=8&ved=0CCkQFjAA&url=http%3A%2F%2Fadvancedbiofuelsusa.info%2Fwp-content%2Fuploads%2F2011%2F03%2F11-0307-Biodiesel-vs-Renewable_Final-_3_-JJY-formatting-FINAL.pdf&ei=1WBhU6ypBsbQsQS