Sugar Ethanol in Florida: Economic, Agricultural, and Environmental Aspects

by

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A thesis proposal submitted in partial fulfillment
of the requirements for the degree of
Master of Science
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College of Arts and Sciences
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Date of Approval:
October 22, 2009

Keywords: biofuels, sugar ethanol, oil, agriculture, environmental impacts.

ACKNOWLEDGEMENTS

I would first like to thank all interview subjects who participated in this graduate thesis research. Their trust and encouragement has proved essential for advancing the field research aspect of the thesis. Also, I would like to thank my fellow graduate student, Geoffrey Fouad, for assisting with the GIS map diagram, which expertly displayed the South Florida sugarcane agricultural area, and was the geographic centerpiece of this work. I would like to thank Dr. Fenda Akiwumi and Dr. Daniel Yeh, my two graduate thesis committee professors, who provided a great deal of support and criticism during this research process. Moreover, I would to specially acknowledge my thesis advisor, Dr. Pratyusha Basu for guiding me through the entire process. Lastly, I would like to thank my father Roger Berger, mother Mary Geary, and sister Julie Berger who have provided support throughout my academic career.

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ABSTRACT

Ethanol production has been widely perceived as a solution to the global energy crisis, with the added benefit of reinvigorating declining agricultural economies. Moves towards dedicating crop production to ethanol however have raised a number of concerns related to its economic and environmental consequences. Missing from this debate is a consideration of the ways in which sugar can be used as a feedstock for ethanol, an issue that is especially pertinent within the state of Florida. The national commitment and scale of corn ethanol production in the U.S. has largely meant a lack of focus on other feedstocks which could be more effective means of ethanol production.

This thesis demonstrates perspectives on sugar ethanol among key stakeholders within the state of Florida. Through semi-structured key informant interviews, it examines the forces that are promoting or thwarting ethanol production within the Florida landscape. In doing so, this research makes four contributions to energy and environmental studies.. First, it addresses the extent to which overdependence on oil in developed and emerging nations can be mitigated by integrating renewable fuel into supply systems. Second, it provides a wider outlook on biofuels, by investigating whether sugar ethanol can become a viable renewable fuel model within the U.S. Third, it adds a place-based study to national and international debates over biofuels, showing both how the issue of biofuels has unique dimensions in Florida and how it connects to broader

debates over corn ethanol in the U.S. and sugar ethanol in Brazil. Finally, the turn towards sugar ethanol becomes an especially important issue to study within Florida given the current controversies over offshore drilling as well as the negative environmental impacts on the Everglades ecosystem associated with sugar cultivation in south Florida.

CHAPTER 1

INTRODUCTION

While ethanol has been approved as a critical renewable energy component through the federally mandated Renewable Fuels Standard (RFS) in the United States, the actual production and utilization of ethanol remains a subject of much contestation. These debates have usually centered on corn-based ethanol and its potential to reduce foreign oil dependence, increase balance of payments, and revitalize the farming industry in the rural U.S. (Alton and Beach 1996). Yet, the focus on corn ignores the presence of other biofuel feedstocks within the country. This neglect is especially glaring in the context of Florida, where corn-based ethanol use is not prevalent both due to its distance from Midwestern corn ethanol production and distribution markets, as well as the unsuitability of the climate to corn production. Instead, sugar emerges as the more viable ethanol option in the state. Yet to what extent has Florida moved towards considering the production and use of sugar-based ethanol?

This study seeks to highlight discussions of sugar biofuels within Florida, and hence speculate on the possibility of a turn towards sugar-based ethanol within the state. Given that Florida's consumption of gasoline is the third highest within the U.S. (Krohn 2008), renewable forms of energy become an especially pressing matter in the state. Sugar ethanol has been a proven feedstock for over thirty years and its regional implementation has not occurred due to the foreign ethanol tariff and limited sugarcane cropland suitable for national production (Krohn 2008). However, technology is

improving through innovation, which could enable sugar ethanol to become viable for the Florida fuel market. Sugar ethanol also has to be situated in terms of local agricultural and environmental interests in the state, which means that the economic landscape in Florida is also pertinent to explaining and predicting how an ethanol production market can be initiated in Florida over the next few years.

Extensive research has been conducted on U.S. corn ethanol production (Alton and Beach 1996, Rask 1998, Kim and Dale 2002, Shapouri et al. 2002, Patzek and Pimentel 2005, Farrell et al. 2006) and Brazilian sugar ethanol (Goldemberg et al. 1985, Rask 1995, Macedo 1996, Calle and Cortez 1998, Borrero et al. 2003, Schaeffer et al. 2005). In contrast, few studies have been conducted on emergence of sugar ethanol in the U.S. (Salassi and Fairbanks 2006) and the prospect of cellulosic biomass derived from sugar (Wang et al. 1983, Ingram and Doran 1993, Service 1993). Empirical research which addresses the economic and environmental viability of sugar biofuel production in Florida is thus a timely and significant intervention in the larger debate over biofuels that is currently raging at the national and international economic scales.

U.S. energy policy in recent years has begun to contemplate the wide-scale implementation of renewable energy sources. This shift towards new types of clean energy, such as biofuels, is partly being undertaken in order to alleviate U.S. reliance on foreign oil imports, often times from less dependable source nations such as Saudi Arabia or Venezuela. Factors such as the sporadic fluctuation of gas prices and diminishing oil reserves have forced policymakers to foster solutions that have the potential to supplement and potentially supplant the current emphasis on petroleum-based forms of energy and transportation.

Ethanol was perceived to be the answer partly because it has been a proven alternative fuel technology over the last half century, and corn was deemed a viable feedstock for ethanol production in the U.S. because it was an abundant domestic crop which could revitalize farming communities. However, as time went on, the utilization of corn for ethanol drew many criticisms, due to environmental risks and its supposed effects on food price hikes, so that policymakers and other concerned stakeholders are faced with the challenge of fostering and implementing different forms of ethanol which could increase energy efficiency and decrease impacts on the environment. The role of sugar as an alternative to corn, especially in the southern U.S., thus becomes an important issue to consider.

Given the firm support for biomass fuel integration in U.S. energy policy, the chances of ethanol usage becoming obsolete is unlikely in the near future. Thus, the Renewable Fuel Standard (RFS) mandates annual requirements of varying biofuel types to be incorporated into the national petroleum supply. Accompanying the RFS are a number of subsidies and tax incentives which are intended to stimulate the growth of the ethanol industry through the promotion of innovative technologies. The issue of biofuels is likely to continue to increase in significance within the realm of energy policy in the U.S. and a focus on Florida would diversify our understanding of this issue.

1.1. Research Questions

This proposal is organized around four sets of questions related to sugar-based ethanol within Florida and seeks to address these questions through incorporating the viewpoints of a diversity of stakeholders in the state. The stakeholders sought to be

incorporated in this research include ethanol and oil business interests, agricultural interests, state officials, and environmental interests, and university research units within the state of Florida. The broader research question is: **What are the perspectives of stakeholders regarding the feasibility and potential impacts of sugar ethanol production in Florida?**

Specific themes will be examined through four sub-questions related to the broader question. These sub-questions are:

a) How do government policies shape ethanol production and, more specifically, sugar-based ethanol production in Florida?

An examination of government policies provides insights into the wider regime of energy regulation within which sugar ethanol in Florida either flourishes or fails to take-off. By enabling investment and making laws related to mandatory use of biofuels, governments can play a big role in supporting this new source of renewable energy. But the Florida government is also involved with sugar interests more directly, especially through regulation of environmental pollution in the Everglades. The extent to which government interactions with the sugar industry impinge on the promotion of sugar as biofuel will thus also be considered through this study.

b) How do biofuel discussions connect to the larger issue of dependence on oil?

Historically, ethanol interest has increased as the price of oil increased. Recently, interest has developed in offshore drilling, with the Gulf of Mexico bordering Florida having become the most sought after area for drilling (Kane 2008). It remains to be seen how significant an impact corn ethanol is having on the U.S. reduction of petroleum consumption. Also, little evidence exists for how future ethanol innovations, such as

cellulosic technology, can supplement oil reliance. Possibly, lack of significant supplementing of energy sources by ethanol is driving more oil exploitation. This research will uncover the implications of ethanol utilization for oil extraction. It will also investigate the extent to which the commercial viability of sugar ethanol could dampen interest in offshore drilling.

c) How are the economics surrounding sugar-based ethanol affecting agricultural interests in Florida?

Sugar agricultural interests in Florida consist of smaller family-owned farms, most of which are represented within one cooperative, and agribusiness sugar refiner corporations. Introducing sugar biofuel in Florida could increase interest in sugar production for both farmers and corporations alike. Further, sugar biofuel could deter price reduction of the commodity, which in recent years has faced scrutiny in terms of removing the sugar tariff which has kept U.S. sugar price high, compared to the low prices offered by developing countries. This research will examine Florida sugar farming interests in ethanol.

d) How do concerns over environmental impacts, more specifically water, soil, and air quality impacts, emerge within the discussion on biofuels?

Traditional forms of fossil fuel energy, such as oil and coal, entail immense resource extraction operations which often require large amounts of energy during the production process. Integrating renewable fuels into the national energy supply was intended to improve the environment. However, ethanol production in the U.S. has been overshadowed by immense environmental issues, such as excessive water consumption, soil degradation, and global warming emissions. This research will examine whether

ethanol derived from sugarcane is better for the environment than corn ethanol and petroleum.

1.2. Contributions to Environmental Studies

This study draws on and contributes to two specific endeavors within the wider field of interdisciplinary environmental studies: environmental economics and environmental discourse analysis. Environmental economics is a branch of economics which seeks to prevent or decrease environmental problems through the use of economic incentives. The discipline emerged with the environmental movement of the 1960s to shed light on the rapid industrial growth and resource consumption which has occurred in Western societies. While a society cannot progress without impacting the environment in some ways, and hence degrading environmental quality, environmental economists have argued that entities within the economy have the power and resources to enhance environmental protection by implementing strategies which consider environmental values as part of measures when conducting economic pursuits.

Environmental economics takes two main forms: the property rights approach and the pricing approach. The property rights approach states that environmental problems arise from the absence of well-defined property rights in environmental assets. This implies that actors cannot be trusted to act responsibly, which results in unlimited damage to the environment. Therefore, regulation needs to block actors from unsustainable practices. The pricing approach argues that the environment must have a monetary value attached to it so that actors understand the true costs of exploiting environmental resources. Overall, environmental economics seeks to make markets more

environmentally-sustainable. However, skeptics have argued that the combination of environmentalism and economies does not halt environmental degradation, despite the implementation of more sustainable strategies, because measurements are still undertaken in keeping with the wider logic of capitalism.

More recently, scholars have begun to be attentive to the ways in which words and images constitute an important means through which collective ideas are formed and strengthened. One significant way in which the power of language has been understood is through the notion of 'discourse' – a specific series of representations, practices, and performances through which meanings are produced, connected into networks and legitimized. A focus on discourses enables us to understand 'how what is said fits into a network that has its own history and conditions of existence' (Barratt 1992). For example, the discussion of alternative energy sources and biofuels can be said to constitute a set of discursive practices that have created the conditions for particular kinds of investments by the government, and public acceptance of such investments. This study thus seeks to understand the ways in which biofuels are discussed within and outside the biofuels industry to understand the ways in which discourses around biofuels are currently being constructed.

1.3. Significance of the Study

This study is significant for four main reasons. First, the focus on alternative energy sources within this study has the potential to be linked to wider discussions over climate change and the overdependence on oil within First World countries as well as the wider global economy. Even as the extent to which biofuels are more beneficial to the

environment has yet to be firmly established, it is clear that an examination of energy alternatives is key to ensuring the reduction of large-scale environmental impacts of energy use. Second, by taking a wider view of alternative energy, through incorporating economic and environmental impacts, this study can provide a more comprehensive outlook on biofuels, one that is attentive to the wider context within which specific biofuel polices are put in place. Third, this study enables insights into the ways in which the biofuels debate varies by location within the U.S. By concentrating on Florida, this study forms the basis for future studies on how the meanings and implications of biofuels are not uniform across the country. Finally, the turn towards renewable energies becomes an especially important issue to study within Florida given the current controversy over offshore drilling within the U.S. Moreover, the cultivation of sugar around Lake Okeechobee has been linked to pollution and water loss in the Everglades, so that the promotion of sugar ethanol has the potential to directly impact the environmental quality of southern Florida's ecosystems.

The next chapter outlines the various studies from which this particular proposal draws its questions. Chapters 3 and 4 outline the findings of the interviews conducted with stakeholders: Chapter 3 focuses on governmental and market-related factors while Chapter 4 considers the role of agricultural and environmental interests in the biofuels debate. Overall, this study seeks to delve further into the potential of sugar ethanol in Florida in order to extend existing discussions of new sources of renewable energy.

CHAPTER 2

LITERATURE REVIEW

Ethanol is commonly promoted by policy makers as a means to increase fuel supply while at the same time boosting the national economy. Without current large-scale government subsidies, incentives, and tax credits, production of ethanol would unlikely not occur domestically (Pimentel 2003). This chapter will first examine these governmental policies as well as U.S. sugar policy to identify how existing regulations could affect the development of sugar ethanol. Second, it will delve into the social and environmental factors that surround the issue of biofuels. Existing growth and research into sugar ethanol in Florida will then be reviewed to provide a preliminary understanding. Finally, this chapter will examine the Brazilian experience of sugarcane ethanol to understand how it could inform current initiatives within Florida.

2.1. Government Policies and Biofuels

2.1.1 Ethanol Policy

Subsidies provided for ethanol production are among the most discussed policy implications in the U.S. today. According to Rosenberger et al. (2002) the feasibility of ethanol production in the U.S. emerges through the assistance of tax incentives and government subsidies. Present law provides for tax credits for every gallon of ethanol blended into gasoline. For instance, fuel blended with 10 percent ethanol receives a tax credit of 5.1 cents per gallon while E-85, which is 85 percent ethanol by volume, receives

42 cents per gallon tax credit. Petroleum blenders, not farmers, receive this tax incentive (NCGA 2005). This tax exemption approximately equalizes the price of ethanol and conventional gasoline, and thus encourages its use as a gasoline extender (Shapouri et al. 2002). Pimentel and Patzek (2007) argue that large farming corporations are receiving $7 per 25 kg (1 bushel), whereas smaller corn farmers are receiving a maximum of only about 70 cents per 25 kg (1 bushel) for their corn (or about $100 per acre) in the subsidized corn ethanol production system due to economies of scale. This reasoning is attributed to the fact that large corporations usually possess more acreage and can produce crops for ethanol production more efficiently than smaller farms.

The Energy Policy Act of 2005 implemented the Renewable Fuels Standard (RFS) which mandates that biofuels be integrated into the national fuel supply every year (ACE 2008). In fact, RFS directs that each year, a greater amount of fuel ethanol be implemented through 2022. Extending the RFS through 2022, should allow advanced biofuels research to become commercially viable. But policymakers have also mandated caps on conventional corn based ethanol RFS requirements and this could alleviate pressure on world corn prices. The updated RFS will require fuel ethanol to be derived from various types of feedstock sources. As a result, the likelihood of new types of biofuel blends could increase in the near term. Sissine (2007) has stated that 21 billion gallons of cellulosic and other advanced biofuels are required by RFS through 2022. Thus, policy makers at all levels are rushing to stimulate rapid expansion of biofuels (Groom et al. 2008).

My study seeks to examine what factors are driving ethanol allocations in the Florida marketplace. As of 2006, Florida only has one biodiesel facility and, absent a

manufacturing plant, imports its ethanol from refineries outside of the state (FDEP 2006). However, the 2006 Florida Energy Act provided funding under the Florida Renewable Energy Technologies Grants Program for several ethanol projects including refinery construction, a project proposing the use of biomass to co-produce ethanol and electricity, and a project intended to determine the technical feasibility of using Florida sugarcane waste as a feedstock for ethanol production (ACOE 2007). Since Florida can produce sugar effectively, oil distributers could be more inclined to buy from nearby sugar ethanol producers. The Florida Legislature in 2008 mandated that all gas sold in Florida have at least 10% ethanol by the end of 2010 (Vogel 2008).The link between state ethanol policies through the utilization of a sugarcane feedstock needs to be further explored to discover unforeseen implications.

2.1.2 Sugar Policy

In his study on sugarcane refining in the U.S., Nathan (1971) discussed the operation of the U.S. Sugar Act (USSA). The Secretary of Agriculture first determines annual U.S. sugar requirements domestically, and then assigns quotas to U.S. sugar producers and also foreign entities who export sugar to the U.S. The effective levels of these quotas are varied from time to time to ensure that the total supply to the U.S. market achieves the price objectives of the USSA (Blackburn 1984). Further, Blackburn (1984) points out that each time the USSA foreign sugar quotas are re-negotiated, there is intense competition between foreign producers who want to be included and those foreign producers who traditionally hold a quota but want to further expand their quota allotment.

The expiration of the Sugar Act has caused immediate repercussions among both U.S. domestic and foreign sugar producers (Alvarez and Polopolus 2002). These changes include the lifting of import restrictions on refined sugar, direct payments to producers being lifted after 1974, the Secretary of Agriculture losing the authority to allocate sugar quotas domestically, and sugar production becoming unrestricted (Corley, 1975). Under current U.S. sugar policy, which operates through the Farm Bill of 2002, American farmers do not receive government funding, and instead derive all of their income from market demand (ASA 2005). The USDA regulates quotas so that profitability is maintained amongst American producers. It is likely that the profitability and hence interest of Florida farmers could heighten if ethanol derived from sugar becomes a factor within the state.

2.2. Debates over Energy Crops

2.2.1 Oil

Based on the Hubbert peak oil model, several scientific experts have recently predicted that peak world oil production will occur near 2010 (Kerr 1998). Even counting Alaska's prolific North Slope oil fields, domestic reserves are falling. The U.S. now imports more than half of its oil, placing the economy at the added risk from future disruptions of foreign oil supplies (CQ 1998). The reliance on foreign oil has been aggravated by unstable regimes, such as Saudi Arabia, Nigeria, and Venezuela, who often or have the potential to be in conflict with the U.S. Excessive consumption of oil in the U.S. has caused the federal government to invest heavily in renewable energy technologies which can alleviate demand on foreign oil. However, because renewable

energies have not been fully commercialized, some policy makers remain staunch in their support for continued U.S. oil exploitation.

More recently, domestic zones, such as the Gulf of Mexico are being viewed as attractive areas for furthering oil extraction. The offshore exploration and production of oil in the Gulf of Mexico has been taking place at a high rate over the past half century (Freudenburg and Gramling 1993). Petroleum experts estimate that geologic formations underneath the Gulf of Mexico will yield more than 25 billion barrels of oil, more than any other untapped US deposit, including the controversial Arctic National Wildlife Refuge (Appenzeller 2004). In their study on oil seepage and hydrocarbon gases, Anderson et al. (1983) indicated that along the northern Gulf of Mexico shelf, large deposits of oil exist untapped. Controversial legislations are currently being proposed within Congress which could allow offshore drilling in several areas, including the most sought after area of drilling off Florida's western coast in the Gulf of Mexico (Kane 2008). The recent popularity of offshore drilling in the Gulf of Mexico however could be impacted by the availability of ethanol within Florida.

Floridians consumed approximately 208.7 million barrels of motor gasoline in 2007, which equated to a 6.2% share of national demand (EIA 2009). In fiscal year 2006, total petroleum accounted for 373,348 thousand barrels per day which was roughly 4.9% of total US consumption (EIA 2008). Florida has no oil refineries and relies on petroleum products delivered by tanker and barge to port authority terminals near the state's major urban areas (EIA 2008). Florida's reliance on imported petroleum, in addition to its rising population and annual influx of migrating tourists, underscores its susceptibility to fluctuations in the market and interruptions in fuel production, supply and delivery

(FDEP 2006). As a result, intense offshore drilling pressure could arise in Florida from petroleum stakeholders who have a vested interest in untapped reserves in the Gulf of Mexico.

2.2.2 Food versus Fuel Issue

No other issue derived from the ethanol boom is more controversial than its impact on food prices. Factors affecting this global food struggle include higher costs of energy used to transport food, changes in climate and rainfall patterns, and the increased use of corn as a feed product (Katz 2008). Most commentators agree that large scale biofuel generation from corn cannot replace petroleum supply without drastically affecting food supplies (Morrow 2008). However, Urbanchek (2007) found that rising oil prices have impacted food prices more significantly than ethanol and that most of the recent food price increases have occurred in food not affected by corn, such as fish, fruits, and vegetables. According to Cordain (1999), it is wheat that is the world's most popular food crop. Further, Severinghaus (2008) has stated that U.S. corn exports are mostly for livestock feed and that there is no correlation between U.S. corn exports and the alleviation of world poverty because corn is not a global staple; those would be rice and wheat. Nevertheless, the price of U.S. corn over the last 5 years has risen to $7.60 per bushel (Trade Markets 2008) from $2.18 (Urbanchuk 2007), a three and half fold increase**,** before falling again in 2009.

Food prices also increase because ethanol has an effect on substitution crops. Ethanol input demand represents a large and rising share of corn use and co-products of ethanol production are displacing traditional feeds such as coarse grains and oilseed

meals (Westhoff et al. 2007). If fewer crops are being produced as a result of more ethanol production, prices tend to increase because the supplies of substitute crops are diminished. While consumers do not like to pay higher prices for food, some food industries can potentially make larger profits. According to Hurt and Doering (2005), corn growers, beef producers, and the dairy industry should gain more profit from the ethanol boom. On the other hand, hog and poultry producers, grain elevator operators and grain shippers might be negatively affected. Soybean and wheat growers might go either way (Hurt and Doering 2005). Furthermore, U.S. corn production may have an effect on Brazilian soybean production. Because more U.S. corn is produced, less U.S. soybeans are produced. As a result, more land is cleared in Brazil to make way for soy cultivation (MB 2007).

2.2.3 Environmental Impacts of Corn Ethanol

U.S. corn production causes more total soil erosion than any other U.S. crop (Pimentel et al. 1995). Further, Pimentel (2003) stated that corn uses more insecticides, herbicides, and nitrogen fertilizers than any other crop in the U.S. Converting more cropland for ethanol use seems to also exacerbate agricultural runoff. Potera (2008) reports that excessive nitrogen runoff causes severe algae blooms which consume oxygen in waters resulting in ‘dead zones,’ which inhibit the growth of marine life. However, the fate of pesticides and other chemicals used in crop growth for ethanol purposes tends to be difficult to quantify because different fertilizer products and amounts are used in various growing locations (Landis et al. 2007). If fertilizer best practices are employed

appropriately, yield increases could help curtail deforestation, water usage, and runoff (Johnston and Holloway 2007).

Another contentious environmental issue involved in the ethanol debate is that of air emissions. It has been found that different ethanol blends display a varying release of emissions. For example, E10 (90% gasoline, 10% ethanol) causes lower tailpipe CO_2 and particulate emissions, but higher acetaldehyde, ethanol and NOx emissions (Niven 2004). Jacobson (2007) concluded with confidence that E85 (85% ethanol, 10% gasoline) is unlikely to improve air quality over traditional gasoline and that its emissions could have an effect on public health. Furthermore, as more timberland and forests are converted to croplands, emissions are released which contribute to global warming. In his controversial study on land use conversion for ethanol production, Searchinger (2008) found that emissions from corn ethanol nearly double those from gasoline for each km of land converted; and that even if corn ethanol caused no emissions except those from land-use, overall emissions would still increase as land is converted to ethanol production.

The introduction of numerous ethanol production plants in the U.S. is having dire consequences for the sustainability of freshwater bodies. Some 80% of global water supply is used for agricultural cultivation and ethanol production is aggravating this problem (Shiklomanov and Rodda 2003). The production of 1 gallon of corn ethanol for instance, requires 1,700 gallons of freshwater for both corn growth and for the fermentation/distillation process (Pimentel and Patzek 2005). In fact, a 50 million gallon ethanol plant is estimated to consume 150 to 200 million gallons of water per year, or over 400,000 gallons per day (Aden 2007). The acquisition of water resources are of utmost importance to ethanol producing stakeholders, even in sensitive regions (Santa

Barbara 2007, Economist 2008). However, the effects of ethanol production on groundwater withdrawals will vary locally and be affected by a number of factors including amount used and aquifer recharge capability (Keeney and Muller 2006).

2.3. Brazilian Experiences with Sugarcane Ethanol

In Brazil, ethanol for fuel is derived from sugarcane and is used pure or blended with gasoline. Similar to ethanol implementation in the U.S., Brazil's ethanol emergence can be attributed to the rise of gas prices during the 1970s, and subsequently paralleled U.S. research and development in ethanol (Papageorgiou 2005). Ethanol production was stimulated through a combination of policies, including low-interest loans for the construction of ethanol distilleries and guaranteed purchase of ethanol by the state-owned oil company at a favorable price for producers (Schaeffer et al. 2005). Brazil can fuel most of its automobiles and other vehicles with ethanol because they consume only 9% of the U.S. consumption in petroleum (BP 2005). Ethanol from sugarcane in Brazil has remained below the equivalent Rotterdam gasoline price since 1999 (Goldemberg et al. 2004, Sims et al. 2006). In 2007, Brazil became the second largest producer of ethanol behind the US, and now produces 15.1 billion liters per year, whereas the U.S. is producing 18.9 billion liters a year (Calibre 2006). Further, unlike the U.S. which uses most of its produced ethanol, Brazil is a world leader in ethanol exports (Moraes 2008). Petrobras is Brazil's leading producer of ethanol and is aggressively seeking to deploy their biomass ventures throughout the international arena (Ewing 2008).

Despite how prolific Brazil is in manufacturing efficient, low cost ethanol, immense social and environmental issues surround its production. Sugarcane ethanol

production by laborers in Brazil is hard and dangerous work (Pimentel and Patzek 2007). The burning of fields associated with manual sugar labor contributes to air pollution, such as greenhouse gases, ash, and other particles (Filho et al. 2006). However, as the economy modernizes, more mechanical harvesting tractors are being integrated into the production chain (Moraes 2008). Further, production machinery is now being utilized to cut unburned cane and separate leaves mechanically, which in turn is reducing air pollution and the amount of people needed for the dangerous job of hacking sugarcane (Morgan 2005). As for deforestation concerns, biofuel production seems to be centered in the southern regions of Brazil, and not in Amazonia (Coelho 2005). Yet, sugarcane production is most likely affecting the Amazon indirectly as substitute crops consume more land. Searchinger (2008) concluded that tropical grazing land converted to Brazilian sugarcane would pay back the upfront carbon emissions in 4 years, compared to 45 years for rain forest lands which are converted to ethanol land use. Nevertheless, as more scrublands are converted to further ethanol production and global demand increases, more lands in the precious Amazonia ecosystem are likely to be converted to crop land.

Overall, an understanding of the biofuel debates within Florida requires attentiveness to energy and agricultural policies, the wider national debate over corn ethanol, its impacts on oil consumption and food production, as well as comparisons with the well-known case of Brazil. This chapter has sought to outline some initial considerations in terms of the discussion on biofuels, and these themes will be further followed in the remainder of this thesis.

CHAPTER 3

RESEARCH METHODS

This chapter introduces the case study for this research and the methods utilized in order to gather varying perspectives on sugar ethanol development in Florida. It begins by describing the procedure through which interview participants were chosen and contacted and introduces the various categories into which stakeholders have been classified. The second section focuses more closely on sugar-growing areas in Florida and the policy dimensions of sugar ethanol development in the state.

3.1. Description of Interviews

This study is based on data collected through interviews with individuals possessing direct knowledge and experience of sugar ethanol in Florida. Interviews with stakeholders provide more immediate, potentially less commonly covered, and deliberately diverse insights into the political, economic, agricultural, and environmental factors shaping the biofuels debate. Interview participants were mainly solicited from the 2008 Florida Farm to Fuel Summit attendee list (total of 416 attendees), which is freely available on the internet through the Florida Department of Agriculture and Consumer Services website, and care was taken to ensure that the participants represented as wide a range of stakeholder perspectives as was feasible. Participants were initially contacted by email, and 24 agreed to a longer phone interview based on that initial contact. Remaining

research participants were contacted on the basis of suggestions made by the initial participants which enabled both a more in-depth pursuing of particular stakeholder perspectives as well as a broadening of interview subjects beyond the Summit.

The interviews were conducted over the phone from the premises of the Department of Geography and a semi-structured, open-ended questionnaire was administered to the participants. The questionnaire (Appendix 1) consisted of 20 questions beginning with general inquiries into sugar ethanol in Florida, and progressing to more specific questions related to government support, economics of ethanol and oil, conflicts between sugar as food and sugar as fuel, and the role of environmental regulations in the sugar and ethanol industry in Florida. The objective of a semi-structured interview is to understand the respondent's point of view rather than make generalizations about behavior (Socio Org 2008).

Semi-structured interviews are intended to be somewhat open-ended so that the respondent can voice an opinion based on experiences and knowledge. It is not as rigid a research method as surveys, which forces the participant to pick an option, without elaborating on why an answer was chosen. This method allows for the emergence of previously undiscovered themes which can shed light on the investigation at hand (ESDS 2007). The interviewer would usually use a standardized interview schedule with set questions for all respondents. Further, the questions are asked in numerical format to identify similarities and differences amongst respondents when asked the same questions.

Thus, this interview process was specifically geared towards providing new insights into sugar ethanol debates. Participants were assured that strict confidentiality would be maintained throughout the research process. They were also given the option of

skipping a question or providing a "best-guess" response in case of lack of familiarity with the issue being addressed. In some cases, participants did chose to skip questions for lacking general knowledge regarding the given question at hand or for the sensitivity of the question being asked. It seemed that a few respondents were unwilling to answer all questions in a straightforward manner for fear of asserting a viewpoint which was sensitive to the organization or reputation of the participant at hand. However, most participants answered all questions, resulting in a sound comparative analysis.

In all, 49 stakeholders were interviewed as part of this study, including 16 ethanol representatives, 7 oil company representatives, 9 government officials, 9 agricultural stakeholders, 5 environmentalists, and 3 university/research stakeholders. Interviews were conducted between January 9th and February 20th 2009, and the average length of an interview was around 40 minutes. More specifically, interview times ranged from around ten minutes to seventy minutes, depending on the convenience of the interview subject and the amount of detail that he/she was willing to provide. The discussion of results draws for the most part from the longer interviews, but the range of views on a particular issue are also incorporated in the process.

A portion of the interviews conducted with five agricultural stakeholders was obtained through a visit to the Lake Okeechobee area, the principal sugar-growing region in Florida. This visit was undertaken over May 3rd and 4th, 2009 and included a visit to the towns of Clewiston and Belle Glade, which are the headquarters of the U.S. Sugar Corporation and Sugar Cane Growers Cooperative of Florida respectively. As part of this visit, each organization led me on a tour of their compounds or work areas which added a

more direct understanding of sugar production processes and possible ethanol production plans in the southern Florida.

3.2. Case Study: Sugar Ethanol in Florida

Florida is an ideal location for the cultivation of sugarcane in the U.S. (Figure 1). It is one of four U.S. states (the others are Hawaii, Louisiana, and Texas) which presently participate in the cultivation of sugar. Sugarcane can be grown anywhere in Florida, but the commercial sugarcane industry is isolated around the southern shores of Lake Okeechobee (Baucum et al. 2006). Most of the current sugar industry in Florida is vertically integrated, but independent growers and grower-owned cooperatives produce some of the commodity output (Alvarez and Polopolus 2002). During the harvest year of 2005-2006, Florida harvested 376,000 acres of sugarcane from a total of 401,000 acres in cultivation (Shapouri et al. 2006). This harvested acreage accounted for 44 percent of the total sugarcane acreage harvested in the U.S. Overall, the Florida sugar cane annual harvest has remained stable over the past few years, with abrupt reductions in output occurring from hurricane and lesser tropical climatic storm system activity (Shapouri et al. 2006).

The sugar landscape in Florida is dominated by a farmers' cooperative and two large sugar refiners. The Sugar Cane Growers Cooperative of Florida is a consortium comprised of 54 grower-members ranging from large to small sugar farmers (Co-op 2008). The Florida Sugar Cooperative engages in long-term contractual agreements with one of the State's two large sugar producers – Florida Crystals, which is planning to supply sugar bagasse for cellulosic ethanol production purposes (Vogel 2008). U.S. Sugar

Corporation, headquartered in Clewiston, Hendry County, is the country's largest producer of sugar cane (US Sugar 2008), and it does have a vested interest in diverting sugar cane byproducts to ethanol production in Florida. In this vein, the Florida Molasses Exchange has seen a surplus in its sugar byproducts and has subsequently entered other industries, such as alcohol and yeast production (FME 2003).

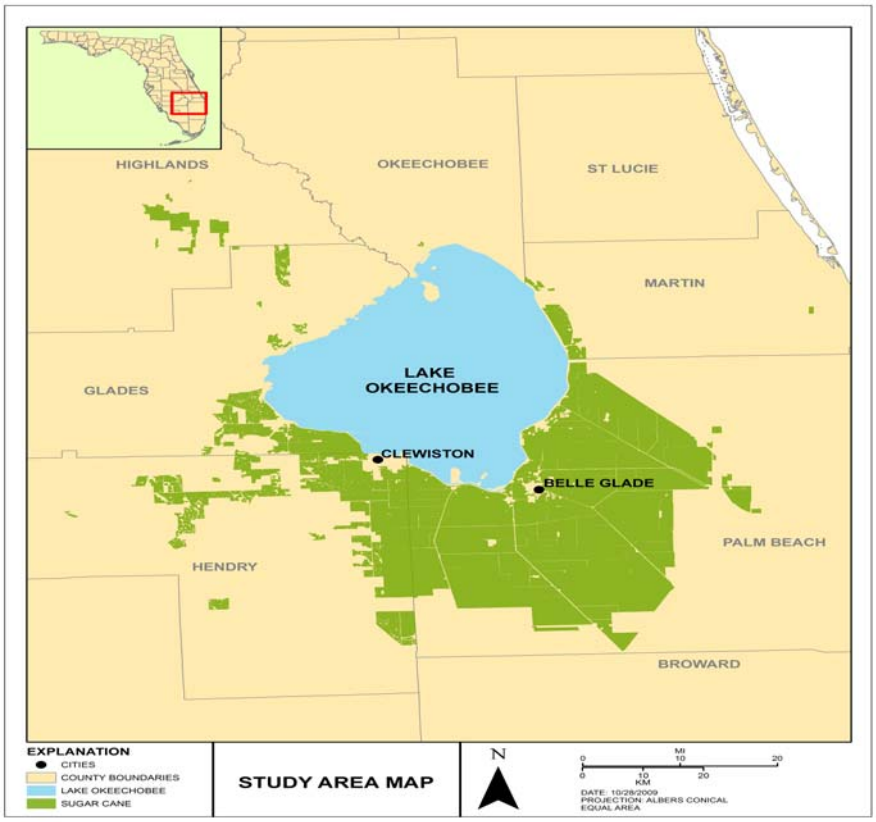

Figure 1: South Florida Sugar Cane Agricultural Area.

Universities in Florida are facilitating the advancement of biofuels technology through research and development. Lonnie Ingram, professor of microbiology and cell science at the University of Florida, has patented a method of producing ethanol from sugar cane waste and is researching this potential at a state-funded pilot plant in Palm Beach (Vogel 2008). State sugar producer Florida Crystals will supply Ingram with the

sugar bagasse necessary for the research, which is already collected and used for refinery electricity generation (FL CRY 2008). Also, Florida Crystals and Florida International University (FIU) have received a $1 million grant to develop cellulosic ethanol technology under the Florida Renewable Energy Technologies Grant Program (FIU 2007).

There are many biofuel companies pursuing transportation fuel production in Florida and throughout the country. Highlands Envirofuels, an ethanol venture operating out of Tampa, is seeking to develop a $40 million plant in Highlands County which utilizes sugar cane and sweet sorghum for fuel production (Konkoly 2008, Krohn 2008). In 2008, Panama City-based Applied Research Associates was awarded $203,130 in state grant funds for research and development in cellulosic materials, including sugarcane bagasse (FDACS 2008). In 2007, the U.S .Department of Energy (DOE) announced that it would award a $33 million grant to Alico for developing a cellulosic ethanol plant. Alico subsequently declined funding and decided not to pursue ethanol production because this type of venture deviated from their core business model (FCM 2008). A steady supply of sugarcane and bagasse is being supplied by Cajun Sugar Co-op to Verenium for a $60 million demonstration cellulosic ethanol plant (Bevill 2008). Local farmers have benefited from this project by receiving extra revenue whose value is amplified by the fact that sugar prices have fallen recently (Bevill 2008).

The byproduct of sugarcane is a fibrous material known as bagasse (Turn et al. 2006). In modern sugarcane ethanol plants, bagasse is used for production of steam and electricity, even though its use pollutes the air (Salassi and Fairbanks 2006). Over a million tons of sugarcane bagasse are produced every year by the Florida sugar industry

(Philippidis 2008). Sugarcane bagasse could be a good solution for Florida because large amounts are readily available within the state. Ho (2006) estimated that the 2005 U.S. sugar harvest yielded 25.8 million tons of sugarcane, and of that 35% or 9 million tons of bagasse would be generated. The commercialization of sugarcane bagasse is significant because it could provide a further incentive for Florida sugar producers to sell their byproducts to ethanol manufacturers if demand were to increase for advanced biofuel cellulosic products.

In 2005, the DOE and the USDA estimated that the US could potentially convert 1.3 billion dry tons a year of biomass to 227 billion liters (60 billion gallons) a year of ethanol (Service 2007). The U.S. would offset at least 30% of its annual petroleum supply if 1 billion tons of biomass were processed for cellulosic ethanol (RFA 2005). Cellulosic ethanol can be derived from a variety of the non-food parts (waste) of crops, such as sugarcane bagasse. Processing cellulosic biomass seeks to extract fermentable sugars from complex carbohydrates called polysaccharides which are engrained in the plant biomass material (Greer 2005). Once these complex cellulosic structures are exposed using strong acids or enzymes, soluble sugar solutions can be produced into ethanol (Ingram and Doran 1993). Researchers have made significant progress in the commercialization of cellulosic technology in recent years. However, production costs remain high at the present time and that is why cellulosic is not considered commercially viable (DOE 2008).

According to Oliveira et al. (2005) in terms of energy balance, ethanol production from sugar is a more efficient feedstock than corn in the U.S.While corn requires new planting and harvesting every year, sugarcane is planted every 6 years (Hofstrand 2007).

Further, the sucrose in sugar can be converted into ethanol directly, whereas the starch in corn is first converted to sugar, and then to ethanol (Hofstrand 2007). Sugarcane uses less fertilizer than corn which would reduce contaminant and wastewater runoff (Yacobucci and Seelke 2007). In fact, Magdoff (2008) also reports that, unlike corn, sugar cane is actually a net producer of energy when used during ethanol production because its waste products can be used for electricity generation at the production plant. When compared to gasoline emissions, sugar released up to 86% less greenhouse gas emissions, with corn only providing a 30% reduction (OED 2008).

Ostensibly, the most attractive benefit from ethanol derived from sugar is the fact that it can produce more gallons of ethanol per bushel of crop when compared to corn. Sugarcane yields 600 to 800 gallons of ethanol an acre which is more than twice as much as corn (Bourne 2007). Since sugar is not a main food staple like corn or wheat, less controversy is attached to it in terms of relationship affect on food prices. Thus, growing a crop that is more efficient can possibly offset impacts on rising food prices. On the other hand, Pimentel and Patzek (2007) argue that using sugarcane for fuel purposes raises sensitive issues regarding food production and food exports, which could otherwise be used for food preparation and consumption. Further research will have to take place to understand whether sugar will have less of an impact on food prices than corn.

The next two chapters detail the various perspectives out forward by interview participants. Chapter 4 focuses on perspectives related to governmental regulations and the economies of oil production and pricing.

CHAPTER 4

GOVERNMENT POLICIES AND OIL ECONOMIES

This chapter focuses on how the interplay between state-level regulatory frameworks and the working of energy markets supports or hinders the growth of sugar ethanol production in Florida. It is divided into five sections. The first section provides a general overview of factors shaping ethanol development in Florida, and shows the extent to which government policies and oil economies were viewed by interview subjects as the main factors driving sugar ethanol growth. The second section delves further into how government policies shape sugar ethanol development, and the third section provides insights into one major policy instrument – the ethanol tariff – and its role in enabling sugar ethanol growth. The fourth and fifth section focus on the relationship between ethanol and oil – on how market prices for oil shape ethanol development and whether the growth of sugar ethanol in Florida has the potential to reduce the demand for offshore oil drilling in the Gulf of Mexico.

4.1. Sugar Ethanol Development in Florida

What are the main factors shaping ethanol development in Florida?

Each individual interview began with a general question that sought to gauge respondents' perspectives on whether governmental policies, agricultural interests, oil prices, environmental concerns, or economic issues were shaping the discussion of sugar

ethanol in Florida. Each respondent could choose more than one factor as part of their answer and could also mention a factor outside the list provided to them. Figure 2 below summarizes this factor:

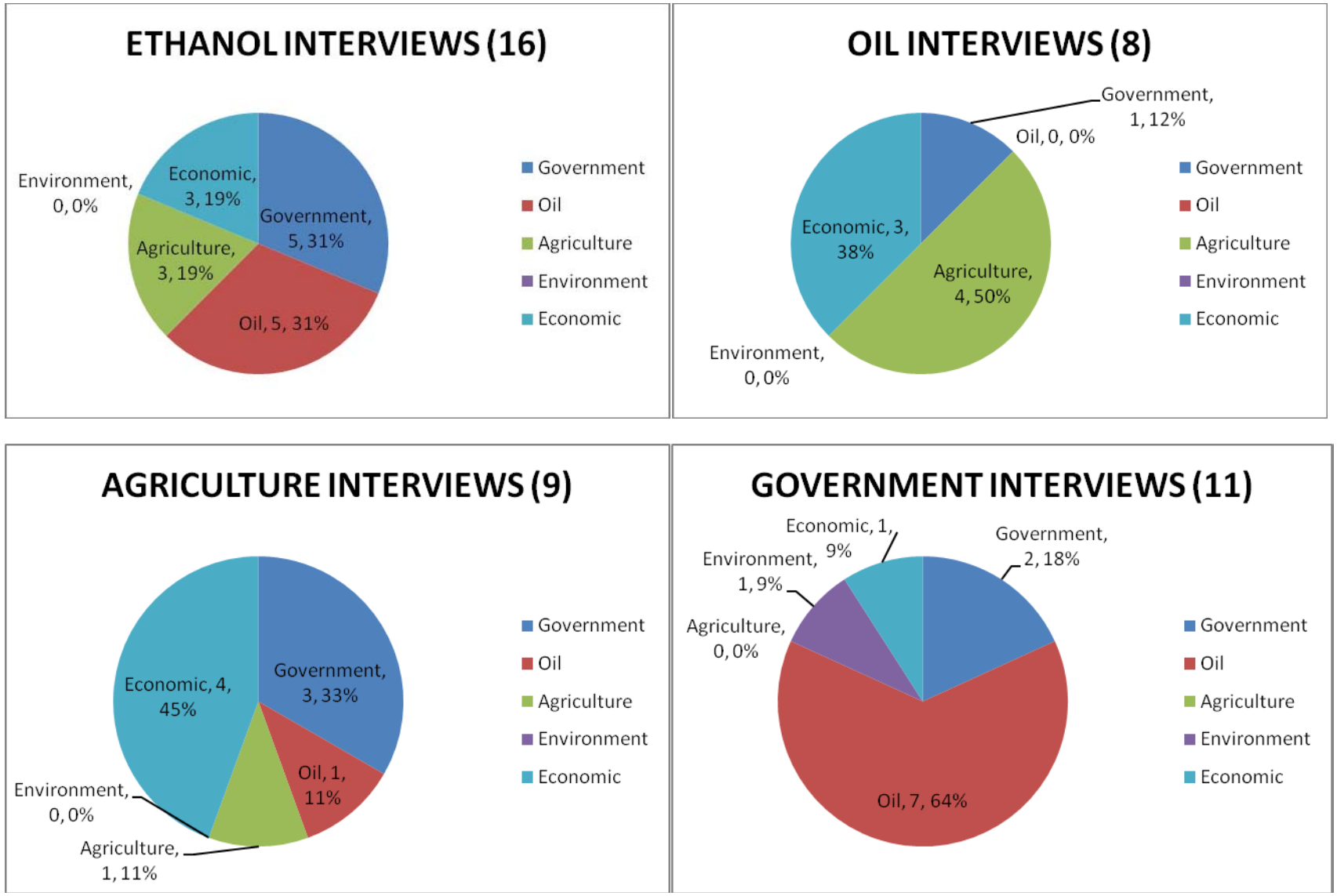

Figure 2: Stakeholder Perspectives on Main Factors Shaping Ethanol Development in Florida

designated as most important by the respondents in terms of the broad stakeholder categories of this research.

As can be seen from Figure 2 , for the sixteen ethanol stakeholders interviewed, government policies and oil prices were deemed as the most significant factors shaping ethanol development. For oil industry respondents, however, agriculture is deemed the most significant factor, and for governmental actors, it is oil prices that hold the key to ethanol development. Wider economic issues emerge as important for both oil and agricultural stakeholders. Other factors mentioned included energy independence, feedstock availability, land availability, infrastructural issues, economic development, and availability of capital.

Two issues arise from this preliminary analysis. First, there is no consistency across stakeholders in terms of the factor deemed most significant in shaping ethanol development in Florida. This seems to suggest that there is no coherent discourse related to sugar ethanol development in the state, so that sugar ethanol remains a site of potentially conflicting perspectives. The second issue however is that each set of stakeholders seems to consistently define the matter of sugar ethanol as being shaped by factors outside its control, so that government stakeholders point to oil prices and oil industry representative's point to agricultural interests. This again points to potential conflicts related to sugar ethanol in the current Florida landscape. Overall, this preliminary classification builds the case for more in-depth understanding of debates over sugar ethanol in Florida and the next two chapters are devoted to providing this detailed analysis.

4.2. Government Policies

Do you feel that the Florida state government has been supportive of ethanol production and more specifically, sugar-based ethanol production?

Seven respondents gave a positive appraisal of the role played by the Florida state government in promoting ethanol, and sugar ethanol, development specifically mentioning the Farm to Fuel Summit, state grant programs, ethanol mandates, and the establishment of E85 retail gas stations. The role played by the current Charlie Crist Administration and the activities of the Florida Department of Agriculture and Consumer Services (FDACS) were especially singled out as notable in this regard. According to Neil M., an agricultural stakeholder, FDACS has played a crucial role in building ethanol industry momentum, stating that ethanol development 'has been really well managed, well reported, and well presented from the State's perspective.' Alan W., also an agricultural stakeholder, mentioned that Governor Charlie Crist was a chief architect of the Florida State Energy Bill which will mandate a 10% E10 gasoline blend at all Florida gas stations in 2010. Adam L., an environmentalist, praised Governor Crist for his steadfast support of renewable energies supplying at least 20% of all energy demands by the year 2020.

The most cited instance of government support for ethanol development was the Renewable Fuel Standard (RFS) which mandates by law that 36 billion gallons of various biofuel types be developed commercially and integrated into the annual national petroleum fuel supply. The RFS thus seeks to stimulate the fledging ethanol industry by encouraging new capital, new technologies, and eventually new feedstocks which will allow for greater growth in the future (Dineen 2005). As mentioned earlier, in Florida, an

E10 blend will be a statutory fuel mandate for vehicles by the end of 2010, as a result of Governor Charlie Crist's 'Green Energy' initiative (DOE A 2008).

The annual Florida Farm to Fuel Summit was also mentioned as a key event in the promotion of biofuels (which is not surprising since most of the participants were drawn from the list of attendees for this Summit). Begun in 2006, this Summit aims to 'promote the production and distribution of renewable energy from Florida-grown crops, agricultural wastes and residues, and other biomass and to enhance the value of agricultural products or expand agribusiness in the state' (FDACS 2009). FDACS also offers a $5 million grants program annually, which the agency secured from the Florida Legislature for funding of new renewable bio-energy technologies within the state. Respondents also noted that the Florida Department of Environmental Protection (FDEP) offers grant assistance financing which has been valuable to bio-energy ventures. In 2008, the Florida Legislature provided $15 million in grant funding through the FDEP (FDEP 2009).

Oil industry respondents provided especially interesting perspectives on the role of governmental support for ethanol production in Florida. According to Teresa S., there has been more senior leadership on fostering ethanol production in Florida than in any other state in the nation. This statement is significant because it suggests that the actions of Florida are also being noted by the broader U.S. context. Alexander W., owner of an E85 gasoline retail chain, stated that the government has funded three E85 gas stations in Florida to foster flex fuel potential in the state. E85 is a gasoline blend of 85% ethanol and 15% gasoline. But is should also be noted that E85 can only be inserted into vehicles specifically fabricated for combustion with a fuel that is mostly ethanol. As of 2007,

approximately 307,093 flex-fuel vehicles exist in Florida, second only to Texas (CAP 2007).

Grants provided to universities were also mentioned in the interviews. Anthony O., a university representative indicated that the recent installation of the Florida Energy System Consortium has been critical to promote renewable fuel research within the State. The Florida Energy Systems Consortium is a sub-component of the Florida State Energy Bill signed into law in 2008 by Governor Charlie Crist. It is expected that the consortium will bring together research efforts in the major Florida universities, providing frameworks for market-driven renewable energy technologies and fostering a new workforce of graduates with renewable energy expertise (Hoover 2008). The University of Florida (UF) is the flagship institution in this consortium, and Mike G., an ethanol representative, mentioned Dr. Lonnie Ingram as one of the principal ethanol researchers in the nation at large. Dr. Lonnie Ingram was awarded $4.5 million for an ethanol training facility on the campus of UF, with another $20 million allocated for a joint bagasse-to-ethanol plant venture between UF and Florida Crystals on agricultural lands near Lake Okeechobee (Crabbe 2008).

A positive view of the role of government has to however be moderated by the views of respondents who argued that the government has been selective in promoting biofuel development, with some arguing that the government in fact has not done enough. Six participants were of the opinion that sugar (or sucrose) ethanol was not being promoted by the state government in Florida, and that the government instead was promoting cellulosic ethanol feedstocks. Alan W., an agricultural stakeholder, stated that sugar is still a very taboo subject in Florida, and if anything, the state government's role

has been counter-productive for ethanol development with the pending acquisition of US Sugar Corporation lands in order to restore the natural water flow to the Everglades. Edward D., a Florida farmer, echoed this view, stating that with the looming US Sugar Corporation acquisition, the state has not been supportive for sugar based ethanol production.

Mike E., who belonged to a rising cellulosic ethanol company, made note of the government's distinction between sugar and cellulosic ethanol:

> Yes, I think they (state government) have been very supportive of ethanol development. Over the past few years, the Florida government has given out a lot of money in grants to help cellulosic ethanol companies or next-generation ethanol get up and started. Specifically sugar, I would say, I don't think so. And I would classify sugar as the older or last generation of ethanol. The government is very supportive of the new generation. When you look at sugar, it is a food-based feed stock. There seems to be a big drive to get away from things that would impact food supply and sugar is definitely one of those things.

Cellulosic ethanol is thus perceived by some policy makers as a more favorable renewable fuel source which will not impact food sources the way that corn has in the past, or that sucrose ethanol could have on domestic food in the future. Nick C., a sugar industry representative (classified as an agricultural stakeholder) was of the view that the state government was moving in a supportive direction with cellulosic, but that there has not been enough research money available to support fledgling ethanol ventures within the state, especially during tough economic times.

Seven participants emphasized that the government has not done enough to

support the growth of ethanol production in Florida. Nicolas S., aspiring ethanol developer, said that there have been some grants which support alternative fuel development, including sugar-based ethanol, but there should be a lot more support to further the potential of the industry. Moreover, state congressional representative Todd M. admitted that these are tough economic times and, as a result, the state budget has really dampened the state's ability to improve the ethanol grants program.

Similarly, four participants noted that more government grant funding is needed to launch bio-energy production projects within the state, since these projects demand large capital investment over time. Unfortunately, government grant funding is only awarded to a few select entities, leaving others energy ventures at a disadvantage. Drew K., an ethanol production plant entrepreneur in Florida, stated that access to capital for bio-energy ventures to expand commercially is an issue, especially during an economic downswing.

> Currently, in this economic environment and the credit crunch, getting access to equity investment, is very challenging. And getting access to credit financing, the credit markets have not loosened up yet, especially with American lenders. Even with the US government bailout, the lenders are not loosening up and providing financing, which is hard to believe. Access to capital is hampering the development of ethanol production in Florida.

This viewpoint is crucial for understanding the complexity involved with government influence in the financing of renewable energy projects. Even though the state government has provided grant money for venture financing, these funds appear meager for successful plant operations to scale-up commercially over time. In this regard,

respondents mentioned the role of lobbying groups in ensuring that the state government's attention did not waver from ethanol. One such advocacy program mentioned during interviews was the 25 x 25 initiative which seeks to have 25% of national energy demand derived from renewable energy sources by 2025.

4.3. Ethanol Tariff

Should the ethanol tariff be removed and how does the ethanol tariff affect sugar-based ethanol specifically?

The aim of the ethanol tariff is to stimulate the establishment and growth of domestic production by levying a tax on foreign, notably Brazilian, ethanol sought to be imported unrestricted into the U.S. market. All ethanol imports are subjected to a 2.5% ad valorem tax and a 54 cent per gallon tariff is additionally assessed on all US ethanol imports from non-Caribbean Basin countries. The tariff is intended to offset the blender's credit, which provides 51 cents a gallon to petroleum companies for integrating ethanol into their gasoline supplies. In theory, it is hoped that this will lead oil companies to mixing more U.S. ethanol and hence supporting the domestic production market.

A number of interview participants however were not supportive of the ethanol tariff since it went against their support of free trade. Thirteen participants stated that the ethanol tariff should be eliminated. One of the most common responses dealt with the notion that subsidies/tariffs increase protectionism and thereby hinder the free market economy. Matt R., a trade specialist, while accepting that tariffs on foreign goods promote domestic production was of the opinion that:

Generally, they [ethanol tariffs] should be minimized or eliminated. My reasoning

> has little to do with ethanol – general feelings are that free trade has a tremendous beneficial impact on the US and world. For example, in the 1930s the entire world went to a highly protective tariff system which minimized world trade. It had a significant impact on the deterioration of foreign relations throughout the world, with the culmination being World War II. Since then, the entire world has been pushing hard for free trade. I support removing tariffs. Thus, I would generally be in favor of removing the ethanol tariff.

It is worth noting in this context that trade-related conflicts are brewing between the U.S. and Brazil, Thus, President Lula of Brazil has recently criticized the U.S. corn ethanol production industry and the ethanol tariff, arguing that Brazilian sugar ethanol is a more efficient fuel resource for America than corn ethanol.

According to Eric P., cellulosic researcher, Brazil should have the right to export its fuel unhindered to U.S. markets. In his words,

> Yes, the tariff should be eliminated. It is the only way to for biofuel or ethanol to become global commodities. Protectionist measures will not suffice in this realm. The tariff harms the consumers because of the limits on Brazilian ethanol importations. It behooves the U.S. to open up its markets freely until we are in a position to develop large amounts of ethanol from sources other than corn.

Eric P. believes that the ethanol tariff actually hurts the average U.S. consumer because it hinders low cost sugar ethanol originating in Brazil from entering the U.S. market. As stated earlier, the threat to the U.S. consumer comes in the form of the government disregard for cost-effective allocation of taxpayer's monies. By appropriating taxes which are currently providing grants and incentives to the U.S.'s fledging ethanol

industry, the cost of living for the domestic population is unnecessarily increased. Sam S., an agricultural stakeholder, adopted the same position, stating that:

> I am not a proponent of subsidies - except if you have a need to push development of a new technology and a need to get the market started, as long as not permanent. Cash-based market controls are not sustainable. Yes, it should be eliminated. [There is] not enough production worldwide to impact. Without the subsidy to blenders, there would be no ethanol market in the U.S.

In fact, if the tariff is removed, the U.S. domestic ethanol industry presumably would not be affected because ethanol producing countries, led by Brazil, do not have large additional amounts of market-ready ethanol for importation to U.S. markets presently. Thus, the export of large additional amounts of ethanol from Brazil would take time to implement. In this vein, Bill C., an oil industry respondent, felt that sugar-based ethanol potential is impacted not by ethanol tariffs, but by U.S. price supports for sugar, which make it more profitable to maintain sugar as food rather than as a source of fuel. Another oil respondent, Teresa S. was also of the opinion that domestic sugar policy affects U.S. sugar production and therefore impacts sugar ethanol more than the ethanol tariff.

In contrast to the above views, a number of respondents were in favor of the ethanol tariff, with twelve participants arguing that the ethanol tariff should not be eliminated, and another nine participants supportive of the tariff in the short term, but in favor of phasing out or elimination in the long term. It should be pointed out that of these supporters of ethanol, four were agricultural stakeholders with direct ties to ethanol production, and seven were representatives of ethanol interests.

Alan W., an agricultural stakeholder in favor of the tariff, contended that the tariff does restrict Brazilian ethanol, and if removed, the U.S. would switch its energy dependence from the Middle East to Latin America. Moreover, this could result in upheavals in domestic ethanol production since demand would grow rapidly for foreign ethanol. Kevin N., a government official, added that buying foreign products causes domestic vulnerability, so protecting ethanol producers by way of tariffs is necessary. Thus, removing the tariff would crush any hope of domestic sugar ethanol production to occur, notably due to lower costs of sugar-to-ethanol production in Brazil.

Rick B., ethanol lobbyist, acknowledged that the tariff is a protectionist measure, but justified it on the basis of unequal market protection guidelines between Brazil and the U.S. –lack of environmental regulation constraints, cheap labor, lower worker safety guidelines, and subsides that allow for cheaper ethanol production in Brazil. But Rick B. also argued that large amounts of Brazilian ethanol are being imported despite the tariffs. This was further explicated by ethanol producer Mike E. in terms of a loophole in ethanol import regulations which allow Brazil to export dehydrated ethanol to Caribbean nations such as Jamaica and El Salvador, which is then subsequently shipped duty free to the U.S.. Under the previous Caribbean Basin Initiative (CBI), and now the Central American Free Trade Agreement (CAFTA), specified amounts of ethanol can be imported to the U.S. without tariff sanctions. The intention of CBI/CAFTA, are to promote the economies of developing nations in Latin America by encouraging free trade with the U.S. While Brazil does not qualify for free trade under CBI/CAFTA, it provides incentives to CBI/CAFTA countries, and hence gains access to U.S. ethanol markets through them.

4.4. Ethanol and Oil in National Energy Markets

To what extent will ethanol substitute for oil/gas demand over time?

Eight participants were of the view that over time ethanol can potentially substitute for more than 25% of oil demand within the U.S. According to Richard C., a renewable fuels producer:

> [Ethanol] will substitute as much as 1/3 of our liquid use because we currently use 150 billion gallons of gasoline a year, plus or minus, and another 60 billion gallons of diesel. We are currently producing 11 billion gallons, but are approaching 14 billion gallons of ethanol, and maybe 18 billion gallons will be the ceiling for sugar/corn feed stocks. Then you look at cellulosic ethanol and that will get us up to about 50 billion gallons … 50 billion gallons is pretty aggressive and will only be 1/3 of our oil demand. But our fuel consumption should come down with the introduction of more efficient vehicles.

Drew K., an ethanol proponent, was of the opinion that the 'blending wall' could be increased through government policy over time, and as a result ethanol would substantially replace gasoline demand. In his words,

> It's going to take several decades. But if you believe what Vinod Khosla says, by 2050, we can potentially replace all of our gasoline with biofuels, which is predominantly ethanol. Currently, the 36 billion gallons RFS mandate will replace about 25% of our gasoline supply. If you assume that the country uses 140 billion gallons of gasoline a year, and there's not a lot of growth in gasoline demand in the next ten years, then 36 billion gallons of fuel will be about 25% of our motor

fuel supply. However, part of President Obama's energy policy is to expand to 60 billion gallons by 2030. 60 billion gallons of fuel represents 46% of our gasoline supply.

Vinod Khosla is a renowned Silicon Valley based venture capitalist, who has a reputation for investing aggressively in clean energy technologies. Reaching the target of 60 billion gallons will also depend greatly on the efficiency surrounding the production and commercialization of technology. But Drew K. also emphasized that if the right types of funding and loan guarantees become available, such as a $150 billion renewable energy fund currently supported by the Obama administration, then the U.S. can turn away from substantial dependence on gasoline.

Several comparisons to Brazil were made by participants in answer to this interview question. Eric S., an agricultural stakeholder, contended that in time 80% of U.S. demand for gasoline could be substituted by ethanol, especially if various feed stocks were combined. The creation of comprehensive ethanol programs in Brazil were impelled in part by similar energy security threats as being currently faced by the U.S. Friedman in a discussion of energy security in the U.S. quotes Gal Luft, Director of the Institute for the Analysis of Global Security, as saying that, "Bringing hydrocarbons and carbohydrates to live happily together in the same fuel tank has not only made Brazil closer to energy independence, but has also insulated the Brazilian economy from the harming impact of the current spike in oil prices." (Friedman 2005). However, it should also be kept in mind that the population and automobile sector in Brazil is a fraction of the U.S.

As opposed to support for the substitution of gasoline by ethanol, fifteen

participants indicated that ethanol will play a limited role or only supplement less that 25% of the national gasoline demands over time. Sean D., a renewable energy producer, was of the opinion that ethanol will decrease demand for oil, but will do so only marginally because it will also compete with other sources of renewable energy. Similarly, Neil M., an agricultural stakeholder, was of the opinion that ethanol usage was likely to function as a transitional fuel, with a market window of about 25 years and a market capture of 30% of gasoline consumption. According to him, other renewable technologies, such as hydrogen, are more efficient, and will thus be more available to the consumer through the automobile industry in the long term. But, the RFS would have to be reconfigured to support new auto fuel technologies. Presently, the target is to integrate 36 billion gallons of biofuel into the national fuel supply by 2022.

According to Joseph M., a large petroleum corporation manager, production of ethanol will be hindered by feed stock availability.

> Globally, ethanol can make a contribution to the supply/demand balance. However, it will not make a big dent against fossil fuels. The second generation could make a small number bigger, but still not big enough. The only real alternatives to oil are coal and nuclear – they are the only technologies that have the scale to compete effectively with oil. Other technologies are limited by supply.

A different argument was made by three participants who argued that ethanol does not compete with gasoline. In fact, Greg C., an ethanol stakeholder, viewed ethanol as a complement to gasoline because it provides a high octane component which improves the efficiency of gasoline. Mike G., a cellulosic ethanol company

representative, contended that the primary benefit of ethanol is an octane boost for gasoline, so ethanol will only supplement 10-20% gasoline demand.

A number of participants sought to make a link between gas prices and the attractiveness of ethanol. Kirk R., a farmer, noted the complexity associated with fluctuating commodity prices:

> The factors are obviously the price of oil and cost to produce ethanol. One of the concerns with corn ethanol is that the price of oil goes up creating a demand for ethanol and also increasing the price of inputs, such as fertilizer. It is also more expensive to produce ethanol as the price of oil goes up. It's a hard question. It's the reason why a lot of ethanol is not produced in this country, is because the price of oil is so low recently. So the price of oil fluctuates greatly … thus, some of the ethanol producers are quickly going out of business, because they can't stand $40 oil prices. If the price of oil stays over $100 a barrel, then I think you will see substitution.

It seems therefore that one viable price solution for ethanol producers could be the introduction of a subsidy which floats according to the price of oil (Barrionuevo 2006). However it is also too simplistic to assume that a rise in gasoline prices will automatically stimulate ethanol production. Given that ethanol is now a publicly traded commodity which is subjected to the uncertainties of speculation and supply/demand, the production and price of ethanol may fluctuate without regard to oil prices.

What implications could sugar-based ethanol in Florida have for the national energy market?

To begin with, it is useful to consider the substantial annual gasoline consumption that currently characterizes the U.S. In 2008, the US consumed nearly 137.80 billion gallons of gasoline and ethanol replaced an estimated 7.2 billion gallons of gasoline (DOE 2008). The value of potential sugar ethanol production becomes magnified given such consumption levels. The Department of Energy has estimated that gasoline prices would be 20 to 35 cents higher if ethanol were not blended into the nation's gasoline (Anton 2008), which suggests that ethanol is currently beneficial in its blended form with gasoline.

Twelve participants were of the opinion that sugar-based ethanol production in Florida could have a substantial affect on the national fuel market. According to Juan C., a representative of cellulosic ethanol, Florida has the potential to become the largest ethanol producer in the nation for two reasons – its weather and the potential availability of land for growing biofuels. Mike E., also a cellulosic ethanol representative, added that Florida's ethanol advantage lies in the availability of large tracts of land, and farmers who own that land. Large tracts of land provide security for long term business investments because they are easier to parlay, while fewer parties allow for simpler negotiations and financial transactions between parties.

Herman K., another ethanol stakeholder, suggested that all renewable energy produced in the state will have major effects on energy independence and environmental protection. Rick K., an environmentalist, took this one step further by asserting that Florida could provide more than just fuel to the national energy supply.

> Anytime we can diversify a state energy use, you can impact the rest of the country. You relieve some of the pressure for fossil fuels elsewhere. In Florida,

> we have the opportunity to grow our own fuel. Florida is a bellwether state, a politically powerful state, and when we show progress in Florida, we can do it in the rest of the nation.

Rick K.'s assumption makes sense when considering that Florida is the third largest state in terms of gasoline consumption in the U.S., and thus can provide inspiration for other stakeholders and policymakers in the country who seek innovations within their statutory frameworks. It seems that if Florida makes a transition within its renewable fuel framework, others will notice and attempt the same within their own states, because the industry is still immature. An immature industry, one that is not competitive, provides room for the bold to be noticed. While Florida will not become the Brazil of North America in terms of production of sugar ethanol, when combined with other fuels, sugar-based ethanol could potentially provide for the Southeast region or at least the Florida consumer market.

Drew K, an ethanol producer, supported the view that sugar-based ethanol in Florida will have tremendous implications for the national market because of the underlying statutory framework. In his words,

> The implications are huge. Sugar-based ethanol would contribute to the Renewable Fuels Standard (RFS) by qualifying as an Advanced Biofuel, which is different than the corn starch process. Ethanol made from sugar qualifies as undifferentiated advanced biofuel. The RFS requires 21 billion gallons from non-corn feed stocks by 2022. If you break down the RFS requirements further, sugar could be applied to the 15 billion gallon cellulosic and/or 6 billion gallons of undifferentiated advanced biofuel requirements.

The RFS is unique because it provides a statutory mandate that ethanol must be integrated into the national gasoline supply annually. Thus, the mandate provides an incentive for producers to initiate ethanol production because it ensures that a market will be in place, unless enough foreign competitors enter the marketplace or RFS requirements are not met. Considering that most advanced biofuels and cellulosic products are not commercially viable yet, there is much room to grow for new entrants.

In contrast, some participants felt that sugar-based ethanol in Florida would not have much of an impact on the national energy market. Edward D., an agriculturalist, was of the opinion that sugar-based ethanol in Florida would have minimal impacts because other renewable fuel products, such as biodiesel, are more attractive since they will not corrode existing vehicular combustion engines (as ethanol would in higher blends). Neil M., another agricultural stakeholder provided a response similar to Edward D. His position was that sugar-based ethanol will most likely be a transitional fuel to other innovative technologies, such as hydrogen fueled cars, mainly because it will take a very long time to establish a large ethanol infrastructure in the U.S.

A more detailed perspective on the link between Florida's sugar ethanol and the national energy market was provided by Sam S., an aspiring agronomist. In his words,

> I did an analysis essentially for [a university research group] on the amount of land that would be suitable climate-wise for sugar production. [In Florida,] we basically have 6 million acres that is in some crop, including citrus, improved/unimproved pastures, etc. At a production rate of 400 gallons of ethanol per acre, that amount would be less than 10% of the Florida demand. At a E10 level, Florida would not even put a dent at the national market, if we planted

> every square inch that was available in the state … Overall, the Florida ethanol market will grow over time. It may play a larger role in electricity production by doing cogeneration from wood waste and things like that. But distance becomes a big issue. What wild lands are still out there are going to play an important role in what you can harvest and how often. It [ethanol] is going to be a component of the overall energy spectrum. [But] I don't see ethanol becoming 50% of our energy use.

4.5. Relationship between Ethanol Production and Oil Exploration

Is lack of an adequate fuel supplementation for gasoline driving more oil exploration in the U.S.?

At the beginning of the rise in attentiveness to ethanol in 2003, it seemed that in due time the amount of ethanol produced would fulfill a significant amount of the annual petroleum demand for transportation fuel. More recently, however, a shift has occurred partly driven by research, lobbying groups, and the media, which has led to a criticism of ethanol's potential, based partly on the fact that the ethanol to gasoline fuel supplementation has been reported to only provide a 1-2% fulfillment ratio. This interview question addresses whether a failed ethanol supplementation for gasoline is driving more oil exploration to fill the void that ethanol could have otherwise met.

Thirty two participants felt that any real or perceived lack of ethanol for gasoline would not interact with processes of further oil exploration led by U.S. petroleum corporations. Bobby H., an oil industry representative, was also of the view that there was no relationship between lack of ethanol fuel supplementation and oil exploration because

the large petroleum companies have little or no investment in ethanol production. Terrance F., another stakeholder connected with oil interests, argued that the low levels of ethanol use within the U.S. makes it difficult to compare ethanol with gasoline. Matt R., an official from Tampa, stated that:

> No, I do not think lack of ethanol is driving more oil exploration. The oil industry is doing what they are supposed to do, which is to find, refine, and bring the product to the marketplace. Just as the sugar and corn industries do what is appropriate for their interests. I don't believe oil people see ethanol as a true competitor. In general, I think they view it as an irritant which is hard to solve.

This mention of ethanol as an 'irritant' for oil companies is worth noting. Petroleum corporations are now mandated through the RFS to integrate ethanol into gas supplies leading to higher infrastructural and distribution costs. For instance, to prevent corrosiveness, storage tanks must be upgraded with expensive epoxy coatings to contain ethanol properly.

Supply-chain logistics for transporting corn to destination plants or to coastal markets have been stifled due to lack of an adequate transportation infrastructure. The primary challenges associated with transporting ethanol through a pipeline are twofold; challenges resulting from the corrosive nature of ethanol, and challenges resulting because of how ethanol reacts with other products and substances within the existing pipelines (Voegele 2009). Therefore, ethanol must be sent by highway or rail tanker, instead of through petroleum pipelines, where the potential of contamination is high (Wald 2005). Ethanol's solvent characteristics attract dirt, water, and other residues that are a byproduct of petroleum products. Water is also an issue, especially with denatured

ethanol. For instance, if ethanol-gasoline blends and water comingle, the water actually causes ethanol to be released from the blend (Voegele 2009). As a result, it makes sense for Florida to develop feed stocks for ethanol production locally to reduce the impact of transportation costs from Midwestern production facilities.

Forces outside of the domestic market were also mentioned as providing an overbearing driver for more oil exploration. Globally, the need for oil is more critical than ethanol, and oil companies have a larger market to service. The rising economic strength of emerging economies and depleting oil reserves globally is putting further pressure on oil companies to extract resources faster. Adam L., an environmentalist, argued that oil exploration has always been a global demand issue, which indicates that domestic demand in the US cannot be limited to ethanol supplementation. Drew K. elaborated this viewpoint further:

> I don't believe that is a fair statement [the relationship between lack of ethanol supplementation and oil exploration]. So far, there has not been a shortage of ethanol, but a surplus of ethanol. I do not believe that oil companies should be using lack of adequate ethanol supply for more exploitation. The real reason they are doing more is that global oil supply is peaking and in decline – that's the real reason. Plus, you have the global demand for oil, through such developing countries as China and India. Oil companies know that the supplies are peaking and drive the exploitation to capture remaining reserves.

The surplus of ethanol mentioned above can be partly traced to flaws in the continental pipeline transportation infrastructure which has thwarted effective distribution to coastal markets. However, there also is an overabundance of ethanol due to an overestimation of

how much product the oil companies would be willing to purchase. As for global oil demand, the economic decline has hindered demand for oil across the world.

Eight participants however were of the view that a lack of ethanol fuel supplementation for oil is a factor which is driving further oil exploration. Nicolas S., aspiring ethanol producer, felt that if more ethanol were available, it will definitely drive down the need for oil exploration to an extent. Another ethanol producer, Herman K., added:

> I think lack of an adequate ethanol supplementation does have an effect on further oil exploration. So far, we have only replaced 2-3% of automobile fuel demand in the form of ethanol or biodiesel. It is one of the driving forces behind further oil exploration.

It should also be noted that the amount of ethanol integrated into fuel supplies differs and will continue to differ by state. In time, and as cellulosic fuels become efficient, the ethanol fuel supplementation for oil consumption demand is expected to increase dramatically, but the extent will most likely remain uncertain in the near future. A state official, Anthony O., agreed that limited ethanol supplies do affect more oil exploration, but only when combined with other factors:

> Certainly, it is a driver for more oil exploration in the US. But, there are other drivers as well. The price of oil was used last summer to promote oil exploration. Energy independence is another significant driver, to the extent that we can rely on our own reserves down the road. Also, greenhouse gas emissions are another driver, maybe in the reverse sense. The question, as stated, most likely yes, it is a driver. But, I don't think it is a significant driver. Public perception is a tough

thing though. Any critic to ethanol could also bring up other technologies, such as plug-in hybrids or electric vehicles to fulfill our petroleum needs.

This brings up another significant element in the link between oil exploration and ethanol: public perception. While the interviewed stakeholders took two diametrically opposed positions, with a large number arguing that oil and ethanol are two separate entities and some arguing that lack of ethanol is driving oil exploration, the extent to which public opinion can be swayed towards one position or another will be a significant determinant of the extent of support provided to increasing ethanol production. In Florida, drilling for oil in the Gulf has become a public concern, so that arguments in favor of sugar ethanol are also structured by public perceptions of the fragility of the Gulf's environment as well as the viability of ethanol supplementation. This issue is addressed more directly in the next question.

Can ethanol production substitute for offshore drilling in the Florida market place and/or do you see a correlation between the two?

Eleven participants stated that ethanol production can substitute for offshore drilling or that increased ethanol production could reduce the need for offshore drilling. Nicolas S., aspiring ethanol producer, agreed that there was an inverse relationship between ethanol production and a need for offshore drilling in Florida. Presumably, even a small amount of ethanol integration into the national fuel supply will alleviate further demand for gasoline. Rita B., a state official, was also of the same opinion. The need to develop cellulosic ethanol feedstocks was emphasized by Nick C., an agricultural stakeholder. In his words,

> Yes, cellulosic ethanol has the potential to substitute. According to a USDA study, Florida can produce between five and eight billion gallons of transportation fuel a year. We can be self-sufficient with cellulosic ethanol but the technology is not ready yet. We in Florida consume 8 billion gallons of gasoline annually. All biomass products, when combined, can equate to five and eight billion gallons of fuel. Depends on the ability to commercialize the technology.

Alexander W., an E85 gasoline station owner, pointed to the ethanol mandate in the U.S. and argued that this reduces the need for drilling in the Gulf. However, Richard B., an ethanol representative, pointed out that the oil reserves in the Gulf of Mexico would serve the national fuel market, especially since no gasoline refineries exist currently in Florida. It seems that the ethanol industry in Florida can potentially offset the need for offshore fuel demand solely in State.

In contrast to the above viewpoints, fifteen participants were of the opinion that no substitution can be derived between ethanol production in Florida and offshore oil drilling. Victor M., an oil industry representative, stated this most clearly:

> No; offshore drilling in Florida is very broad and there is no way it can substitute. Everything offshore is the ocean and 30% of our oil is domestically produced in the Gulf of Mexico. Now moving eastwards, it's difficult to say how much oil we could produce in the eastern Gulf of Mexico as we get closer to Florida. The reality is, and the likelihood is, we are going to need all types of fuel that we can produce domestically to create a positive mix. Offshore energy is a proven technology and it's very friendly from an environmental standpoint using the best technologies that are out there now. I obviously see that as a very important part

> of the mix. But I do think the production of biofuels, particularly biofuels in Florida, are part of the mix too. So, I don't think it is one or the other. No, you cannot pick one energy type and especially not in the near term.

Diversification was also mentioned by Teresa S., an oil company representative,

> We do not see a direct replacement for oil. A diversification is needed that will further the growth of the transportation fuel industry through new growth which will be led by biofuels. The demand for energy is going up, but if we can use advanced biofuel technologies to capture growth, that will provide lower carbon solutions to meeting that demand.

According to Joseph S., petroleum company representative, while a correlation is unlikely, biofuels could potentially compete commercially somehow with offshore drilling, if a carbon tax regulation evolves over time. He thus places the oil-ethanol debate in terms of its evolution within a larger time frame.

Of the remaining respondents, some argued that ethanol production and offshore drilling are completely separate issues, consisting of their own realities. Rick B., ethanol advocate, stated his viewpoint as follows:

> No, because the number of people in Florida, the growth associated, the energy demand, the growth of energy without substantial energy efficiency measures. So no, I don't think ethanol will ever supplement – with the exception of partially in E10 framework which can potentially capture up to 10% of the market. So, we are going to need diversity. Politically, I don't know if offshore drilling will ever occur off of Florida. They are two separate issues in my mind.

This statement is interesting because it draws on the political complexities associated

with comparing ethanol production and offshore drilling. Behind each position are many interests groups: companies, farmers, citizens, and political actors, and it is difficult for a medium to be reached which can satisfy all.

Another interesting viewpoint which contradicts the substitution/correlation argument is that the waters off the coast of Florida contain natural gas reserves, and not petroleum deposits. According to Paul D., a government agency-related stakeholder:

> No correlation/substitution can be assumed. The Florida offshore market possesses natural gas. Actually, natural gas is the main fossil fuel resource off of Florida. It does not hold very good potential in Florida and the Southeast [region] within the fuel and power supply industries.

Natural gas brings its own environmental and energy security implications because, like oil, it is a fossil fuel and non renewable.

The more controversial aspect concerns environmental threats associated with offshore drilling in the Gulf of Mexico near the Florida coast and stakeholder perspectives wavered on this issue. Eric S., an agricultural stakeholder and avid fisherman, believed that offshore drilling can cause problems with the aquatic ecosystem in Florida. Rick K. of the Environmental Defense Fund argued that the environmental concern was also an economic concern because of Florida's tourism industry which draws millions of visitors every year. Thus, Rick K. believes that the discussion in Florida must be on renewable energy technologies which do not threaten Florida's tourism industry. The question that arises therefore is about the effectiveness of current oil drilling technology in enabling environment-friendly extraction.

Some participants pointed out that ethanol production and offshore drilling are

linked to very different market demands, bringing the discussion back to the economics of oil and ethanol. For instance, the ethanol market is primarily coupled with the transportation fuel market. However, oil has demands related to the commodity in various buyer industry groups. Neil M., an agricultural stakeholder, contended that there will always be a market for oil separate from fuel because 60% of oil is used for plastics and other products. This point is echoed by Maurice L., who is associated with a prominent ethanol publication:

> There is not too much connection between the two industries. Offshore drilling produces a crude oil which is refined into a lot of different products. Oil is fractioned into polymers and other fuel products. Ethanol only drops into passenger vehicles for a 10% supplement.

However, diversifying away from mainstream petroleum products will not arise easily. Shifting to the global stage**,** another crucial factor in the demand for petroleum products is the economic rise of previously developing economies, such as China, India, and Brazil. These economies require greater amounts of petroleum to fuel their economy, as more people gain a higher standard of living, and are therefore able to purchase high end goods, such as automobiles. As a result, a diversification of energy products, on the global scale is needed.

The conflicting opinions expressed on the economic viability of Florida's sugar ethanol provide an insight into the complexity associated with Florida ethanol fuel predictions at the national level. Since the sugar ethanol industry is still young in terms of cellulosic technology and the economics for sucrose ethanol are not attractive at present, projections cannot be made with any degree of certainty. The argument here is that like

any other technology, such as the personal computer or automobile, ethanol fuel is a technology that will improve over time. The technology will continue to improve resulting in enhancement of production potential and minimization of environmental impacts. To quote Bob Dineen, President of the Renewable Fuels Association, “While developing new oil reserves is proving more difficult and expensive, the American ethanol industry is rapidly developing new cost-effective technologies that will greatly reduce our nation’s reliance on imported oil” (Dineen 2008). Governmental support for the fledging infrastructure and promising technology is likely to be an important part of the processes through which it becomes competitive both in national and international terms.

CHAPTER 5

SUGAR ECONOMIES AND ENVIRONMENTAL ISSUES

This chapter focuses on the economic and environmental impacts of sugarcane cultivation in order to delve further into the specific consequences of using sugarcane as a fuel crop. The chapter begins by outlining stakeholder perspectives on whether sugar ethanol is likely to add to the profits of Florida's farmers and the role of sugar subsidies in the competition between utilizing sugar as food versus fuel. It also provides a comparison between corn and sugarcane as biofuel feedstocks. The chapter concludes by considering the impacts of sugarcane cultivation on the Everglades. More broadly, this chapter addresses whether economic or environmental factors are driving the use of sugarcane as a biofuel feedstock.

5.1. Approaching the Florida Sugar Farmer

What is the current economic condition of Florida's sugar farmers?

Eight participants were of the opinion that the current economic condition of Florida's sugar farmers is either good or stable. An important issue in this regard, however, is to make the distinction between sugar growers and sugar mill processors. Alexander W., an oil-related stakeholder, asserted that farmers are highly dependent on the few large sugar mills that are able to process sugarcane stalks into refined sugar. According to Mike G., who is associated with cellulosic ethanol production, sugar

farmers are doing relatively well currently because they have a market for their product at one of the large sugar mills, and with the looming state acquisition of U.S. Sugar Corporation, demand could increase even further.

In contrast, thirteen participants felt that the current economic condition of Florida's sugar farmers is in decline or unstable. The biggest issue, according to Florida farmer Kirk R., is that sugar is a wholesale product, and only escalating demand will produce a continued growth in profits. Also, to offset the impact of rising cost of farming inputs, the farmer is pressured to produce higher yields through better agricultural techniques. Drew K. pointed out that the price of sugarcane has been driven down by the large sugar mills making it difficult for small farmers to maximize profitability for the sugar crop. Sam S., an agricultural stakeholder, also affirmed the profit limitations associated with sugar production:

> The economic condition of Florida sugar farmers is the same as farmers elsewhere in the US. The margins have always been slim. Generally, prices have remained largely flat over the last 30 years with the exception of a few crops. What I paid for fertilizer three years ago was about $150/ton and now the same type of fertilizer costs $1000/ton. The fuel situation last year literally put us in a panic.

Ethanol lobbyist, Sean D., was of the opinion that the U.S. sugar economy is struggling, which is evident in the decision to sell the U.S. Sugar Corporation. Maurice L., who is associated with an ethanol trade magazine, explained the difficulty facing sugar farmers in Florida:

> The price of sugar is not very good. Labor and land prices have been rising faster in Florida. The US has more expensive land than Mexico for example and more

expensive labor. This creates a problem for the economic sustainability of the sugar market.

Fourteen participants were unsure about the current economic condition of Florida's sugar farmers. Matt R., a specialist on international trade issues, assumed that sugar farmers were doing well and based his assumption on sugar quota price supports. Neil M., an agricultural stakeholder added a geographic element to the discussion of the current economic condition of Florida's sugar farmers, contending that the economic condition depended on where sugar farming occurs. In his words,

> The farmer gets the dollar figure per ton of cane grown on his land. On muck land, he's getting $42 per ton per acre; on sand, he is getting $36 per ton per acre - which equates to a price range between $360-460 per acre for sugarcane. The question becomes how do we then get a greater return on the same land? We look at the biogasification process or the enzymatic process. You would leave the cane trash and harvest it resulting in 4-6 acres of dried cane trash per acre and you would get about $100 for that lot. So, you are increasing that value of what the farmer gets back. The farmers are hip on this because if you only do vegetables, the land is useless for 6 months of the year, and could take as long as 15 years to be productive, as is the case with citrus.

Alan W., an official with an agricultural agency, estimated that if smaller farmers were receiving $50/acre for sugar, their economic condition would be favorable.

Profitability thus emerges as the biggest concern for Florida's sugar farmers, so that sugar ethanol is crucially shaped by the economics of sugar cultivation. Most respondents, irrespective of the content of their response regarding the condition of

Florida's farmers, were certain that profitable alternatives would be welcomed, especially if farmers could gain dual value from sugar crops as both food and fuel. A more direct question regarding possible support for sugar ethanol by farmers will be addressed next.

5.2. Competition between Sugar as Food and Sugar as Fuel

To what extent are farmers supportive of sugar-based ethanol?

Twenty four participants stated that farmers would embrace sugar-based ethanol, but a number of them also argued that this support would be conditional on the economics of sugar ethanol versus sugar. Congressional representative Rita S. asserted that every farmer is a business person and will try to maximize return through ethanol or vegetable crops, whichever is financially attractive. Another Congressional representative, Todd M., said that while Florida's farmers are interested in ethanol production, they are also concerned about whether ethanol production could effectively compete with the price of gasoline. Ethanol producer, Nicolas S., added another element to this discussion, stating that farmers would be supportive of sugar-based ethanol as long as they can get a price that is profitable and one that does not conflict with the current sugar-for-food price supports. Thus, for sugar farmers to embrace sugar-based ethanol, market potential was viewed as being the main drivers.

Another point brought up was that sugar farmers would embrace ethanol production if long-term contractual agreements could be built. As Teresa S., an oil industry representative, explained,

> The prospect of having a long-term contract is maybe something that is quite appealing to farmers. They can use this as collateral for justification for their

> agricultural production in a constrained credit market - could be valuable to a farmer.

Ethanol producer, Juan C., felt that the only way to ensure farmer support for ethanol production would be through long-term contracts which would guarantee that farmers have a market for their sugar product year after year. Thus, market fluctuations in the price of sugarcane, ethanol, and especially oil become important for Florida farmers who have an interest in ethanol production, and farmers would require guaranteed profitability if their crops were to be allocated for sugar-based ethanol production instead of sugar food production.

The shift from sucrose ethanol to sugar bagasse ethanol is likely to be another important factor in building farmer support for a shift to biofuels. Richard C. and Eric P., who are involved in cellulosic ethanol production and research respectively, were of the opinion that the agricultural sector is very interested in bagasse/biomass ethanol because it will provide income, increase the value of agriculture in Florida, and minimize ethanol's impact on food prices. Since bagasse, which is the fibrous by-product of sugar food production, will be processed for fuel, and because cane juice can continue to be utilized for food production, the farmers would have two markets for their sugar crop. Juan C., a cellulosic company representative affirmed that

> Sugarcane growers in Florida would be very supportive of ethanol production. Currently, farmers can only sell their product to two or three sugar mill producers. The only way to make ethanol will be with the efforts of the current industry players; Florida Crystals, U.S. Sugar Corporation, and the Florida Sugar Growers Cooperative. As a result, the current producer of sucrose sugarcane will now be

exposed to two commodities, instead of one.

Another issue that needs to be kept in mind however is that profits from sugar ethanol may not percolate down to farmers, as has been alleged in the case of corn. In 2005, NCGA (National Corn Growers Association) president, Leon Corzine, was of the opinion that, “Those (farmers) who sell corn to an ethanol plant gain an additional dime or more per bushel, while those that own the ethanol plant gain a much greater opportunity for return” (DiGiuseppe 2005). The extent to which sugar farmers move into actual control of ethanol processing plants could thus also determine the extent to which all farmers benefit from sugar ethanol.

Not surprisingly, seven out of eight agricultural participants expressed a keen interest in ethanol production, stating that farmers are always looking for alternative markets to increase profitability. Similarly, eight out of ten ethanol participants agreed that there is interest in ethanol production amongst farmers. The extent to which farmer and ethanol interests come together

will depend on whether land can be devoted to sugarcane cultivation, and the next section delves further into this issue.

What factors have to be in place for more sugarcane acreage to be used for ethanol production in Florida?

The recurring theme in discussions of devoting more sugarcane acreage towards ethanol production was that sugar-based ethanol was unattractive in terms of economic returns compared to sugar as food. As Ann. M., an agricultural stakeholder put it, if the price of sugar per pound were pennies, the cost of production for sugar-based ethanol

would be lower, and sugar ethanol would become attractive for farmers. In a similar vein, Bill C., an oil-related stakeholder argued that what was required was the removal of price supports for sugar, which would then make allocating sugar to ethanol more economically feasible.

Land availability was another important factor that was widely mentioned. Devon E., specialist in trade issues, was of the opinion that the most significant challenge facing ethanol production was competition from urban sprawl, which could make land values too high to justify continued sugarcane cultivation. Researcher Lance Y. also mentioned this issue: as some farmers are finding it attractive to sell off existing farm land to development for quick profits, devoting land to sugarcane cultivation becomes a less favored option. Farmer Edward D. explained a possible solution to this threat from escalating land values,

> New tax incentives for folks to preserve their land for agricultural production should be created. You have to make it easier for folks. If farmland is being utilized, it has to be assessed as farmland, and not assessed as development land, because that increases taxes. For example, some type of government incentive for converting citrus farms into sugar farms should be invented because otherwise, land conversion from citrus to sugar would be expensive. However, government involvement is never a good thing.

Eric P. added to the land use discussion emphasizing that marginalized or under-utilized land could be pursued before any acre of food land is touched for ethanol production, even as existing sugarcane acreage could also be more intensively cultivated. However, Eric S., an agricultural stakeholder, took a different position arguing that more

land, beyond current sugar acreage, would have to become converted from citrus or cattle production into sugar production for ethanol to become a feasible option. However, it should also be noted that for farmers to devote more acreage to ethanol production, market demand would have to increase substantially and continuously, thereby increasing profits associated with such commitments.

The role of governmental policies in encouraging sugarcane acreage was also emphasized. According to Dave M., an oil-related stakeholder, a crucial factor for ethanol production on current sugar acreage would be the political will associated with such utilization of sugar. Sugar growers in Florida and associated advocacy groups would most likely have to undertake extensive lobbying efforts to persuade lawmakers to support sugar ethanol, as has been the case with Midwestern corn growers. Archer Daniels Midland spent nearly three decades pushing relentlessly for the use of ethanol in gasoline, lobbying Congress and the White House, while arousing farmer interest (Barrionevo 2006). Evidently, the government has to similarly support sugar ethanol initiatives for them to succeed.

Ethanol producer, Cameron S. was of the opinion that ethanol must be subsidized to the point where it is financially feasible to plant additional sugarcane. However, as Ted M. pointed out, planting additional sugar cane would probably be more expensive because this would take place on sandy soil which requires more inputs. Nicolas S., ethanol producer, also supported government incentives for sugar ethanol production, especially for farmers to take the risk in the initial years. Florida farmer, Kirk R., also supported the need for government support:

I think the main [factor for increasing sugar cane acreage] is government policy.

> The Brazil government is the model for any type of ethanol production from agricultural products. The public should be aware that it is better to grow crops for fuel domestically than importing it. The Farm Bill is the ideal place to encourage more ethanol from farm products.

To elaborate, every few years the Farm Bill is amended with new provisions for permanent law which could authorize the promotion and further requirement of ethanol in the U.S. Thus the 2008 proposed Farm Bill extension encouraged the government to buy surplus sugar and sell it to ethanol producers for use in a mixture with corn, and also cut a per-gallon ethanol tax credit for refiners from $0.51 to $0.45 (Bevill 2008). However, with the potential introduction of imported sugar for ethanol production through the Farm Bill, sugar farmers in Florida might be more inclined to continue sugar food operations.

A final factor that was mentioned as important by a number of respondents was the environmental implications of increasing sugarcane acreage. Environmentalist Rick B. argued for a serious discussion regarding land use planning, because it impacts wildlife habitat, water use, and restoration. Many species are endangered in Florida, such as the gopher tortoise, which could stymie ethanol development. Farmers will have to navigate and comply with the Endangered Species Act (ESA) if more acreage in Florida is allocated for ethanol production, or risk heavy fines (Chin 2008). For example, some corn ethanol producers in the Midwest have faced resistance in the extension of their agricultural lands due to the presence of the sensitive Seneca White Tail Deer.

Moreover, ethanol production in the Everglades Agricultural Area (EAA) could be counter-productive to the state's current goals, especially given the proposed acquisition of U.S. Sugar Corporation mentioned earlier. Richard C., a biofuels producer,

was of the opinion that environmentalists will most likely become involved and make things more difficult for ethanol production on sugarcane acreage. Supporting this previous position, state energy official Anthony O., pointed out that potential ethanol production on current sugarcane acreage must demonstrate sustainability without impacting other natural resources. Overall, economic factors such as price supports for sugar and competing land uses require a regulatory environment within which sugar ethanol is supported by state policymakers and not opposed by environmentalists.

How would sugar-based ethanol affect the commodity price of sugar potentially?

To begin with, twenty-seven participants expressed uncertainty regarding whether sugar-based ethanol would affect the commodity price of sugar. While researcher Lance Y. and ethanol producer Cameron S. argued that a turn towards sugar ethanol would decrease sugar prices since sugar supply is likely to increase in those circumstances, it is difficult to verify if this is the actual relationship that would unfold between ethanol and sugar. Moreover, sugar commodity prices will also be shaped by whether sugarcane is subjected to sucrose or cellulosic processes. Daniel B., agricultural economist, depicted the confusion associated with estimating how ethanol production might affect the commodity price of sugar:

> It depends if it is marginal production or bites into existing sugar economy - I don’t track sugar markets. If it encroaches on other uses, the price will go up. With corn, we saw the price go up by increasing speculative activity. Prices went up for beef, etc, when ethanol took off. Any time a reduction of an available resource occurs by creating an alternative market, you are going to drive up the

> price. How much of that is sugar - or is there a surplus of sugar? Surplus kept corn prices relatively flat. The markets were supply driven and sugar will probably entail the same outcome.

The determining factor here might also be whether sucrose or the bagasse waste by-product is utilized for sugar ethanol production. Thus, if sucrose is utilized for ethanol, the price of sugar would increase. After admitting that domestic price estimation is difficult, bio-energy researcher, Bob G., stated that when Brazil started mass-producing ethanol from sucrose, the world price of sugar increased. Initially, Brazil provided subsidies to its sugar growers for ethanol, but currently does not because the production pipeline has become extremely effective. According to ethanol producer, Nicholas S., comparing the current market parameters between the U.S. and Brazil is often misleading because:

> As long as we have subsidies for sugar, it would be very difficult for ethanol from sugarcane to take off. I think it wouldn't even move. Now, everyone likes to talk about Brazil, that they don't have any subsidies and it's a market driven process. And so, all their mills are set up to grow sugarcane … if the ethanol market is better, they make more ethanol and if the sugar market is better they make more sugar. I think right now with the subsidies in place, that is a big detriment for sugar ethanol production.

However, while Brazilian sugar growers were heavily subsidized by the government initially, over time the incentives were removed, especially when oil prices plummeted in the late 1980s. Currently, no government subsidies are extended to sugar growers from the Brazilian government. To increase sugar ethanol production, the U.S. could therefore

borrow from procedures for coordinating supply and demand as practiced in Brazil. However, the number of people and vehicles in Brazil are significantly less than in the U.S., making replication difficult.

If sucrose ethanol production can occur in the U.S., importations of sugar might be the only feasible solution to activate this industry. At the very least, the USDA would likely have to adjust current prices and the amount allocations of sugar used for food versus fuel. Since the USDA controls the price of U.S. sugar, it would be difficult to predict what could happen if more ethanol production from sugarcane were to occur. According to Nick C., an agricultural stakeholder,

> Sugar is the only commodity that hasn't spiked amongst commodities over the past two years. It has been relatively stable at $0.18/lb. If you use sugar for ethanol, [the price] probably will increase. There should not be an effect for bagasse/cellulosic biomass.

Cellulosic non-food parts of sugarcane, such as bagasse, do not affect the price of sugar because sugar waste materials are not publically traded commodities, and some of the by-product is currently used for plant electricity generation. Congressional representative Todd M. also pointed out that the state of Florida has a lot of sugarcane byproduct, which is currently not being used for ethanol. Furthermore, environmentalist Rick K. was of the opinion that the price of sugar should not be affected because only the waste products of sugar will be processed. Thus, to avoid price and food-related controversy, bagasse waste by-products should be utilized to the fullest extent possible for ethanol production before sucrose is widely promoted.

Eight participants stated unequivocally that sugar-based ethanol production would

affect the price of the sugar commodity.

> If sucrose ethanol production ensued in Florida, the price of U.S. sugar would most likely increase. Over time, more sugar producers would potentially switch to ethanol production from sugar food production because of the high profitability of ethanol compared to food. As more ethanol producers enter the marketplace, the price of ethanol should gradually drop. The price of sugar would be dictated by how much sugar is available for ethanol production relative to the amount of ethanol utilized in the production process. If the overall amount of sugar did not increase in the U.S., then the price of the commodity would increase, and vice versa.

There is also the threat of speculation, mainly conducted by major Wall Street banks, hedge funds, and private individuals who buy and sell futures contracts on commodities for no other reason than to make substantial financial gain (Rogers 2004). Also, the media could have an effect on commodity prices through the highlighting of particular issues. For instance, farmer Edward D. said that if the media denoted citrus as a cancer-fighting agent, then citrus would become more valuable.

Biofuel prices can also be impacted by natural disasters, such as hurricanes or floods. In 2008, excessive precipitation brought about record flooding in the Midwestern Corn Belt. As a result, the price of ethanol spiked 19% in one month (Mouawad 2008). Partial crop failures reduce supply, thereby also increasing prices, at least temporarily. For agricultural products, supplies might stabilize until the next harvest cycle, which could take up to a year, depending on crop affected. Hurricanes in 2004 disrupted oil production in the Gulf of Mexico. In comparison, biofuel production could be suspended

not only at the production facilities, but also on agricultural fields. But distributed fuel production from ethanol facilities dispersed across the U.S. could mitigate economic price impacts (Bryan 2008).

Three participants stated that no price effect will occur on sugar due to ethanol production. Teresa S., an oil representative, stated that sucrose ethanol will not be produced on a large level, since any sugar-based ethanol development will be devoted to cellulosic processes which are more advantageous. Further, Neil M., an agricultural stakeholder, asserted that sugar beets and imports would fill the void before the commodity price of sugar fluctuates. Specifically, the sugar beet industry in the Northern U.S. would increase production or Mexico would provide imports to fill the gap (Neil M.). Finally, cellulosic ethanol representative Mike G. explained why the commodity price of sugar would not be affected from sucrose ethanol production:

> I don't see sugar-based (sucrose) ethanol production in this country occurring. The sugarcane we make in this country is not economical for sugar producers to pursue [ethanol production]. Brazil is a huge player in the sugar ethanol market. I do not see Florida using our sugar to make ethanol. And I do not see an impact of current sugar farmers taking any of their sugarcane out of food production, to put a dedicated energy crop in. If you took current sugar and made ethanol, that would upset demand by the sugar mills [for food production].

How would the demand for sugar be affected if more ethanol companies are established in Florida?

Eighteen participants stated that, to some extent, the demand of sugar would be

affected if more sugar-based ethanol production companies were activated in Florida. Transportation official, Oliver W., anticipated that the price of sugar would go up through increased demand for sugar-based ethanol and food. Oil-related respondent, Terence F., was also of the opinion that if demand increased for sugar, prices would probably follow the increase in demand, as long as the production dynamics of sugar-based ethanol were economically viable.

The need for ethanol feedstocks however would be affected by the current large sugar refineries which utilize most of the sugar in Florida for food production. According to Sam S., an agricultural stakeholder, aspiring sugar ethanol companies in Florida therefore might have to acquire their feed stock elsewhere. In his words,

> It would depend on access to offshore sugar. Sugar in Florida is feeding refineries. U.S. Sugar Corporation and Florida Crystals are the refineries. It would increase demand, but I don't see where new companies would survive - you just cannot make ethanol with $0.22/lb sugar. The gasoline price has to be steady at the pump. Sugar would have to be a whole lot lower than $0.22/lb.

Establishing a sucrose ethanol production infrastructure in Florida would be challenging given the significance of the food versus fuel debate. When all sugar produced in the U.S. is allocated for food, obtaining sucrose feed stock for ethanol production would be difficult, if not impossible. Drew K. outlined this challenge associated with competition for access to sugarcane:

> The key is if you built sugar-based ethanol in Florida, that feed stock must not be linked to food use. I don't think you will find anyone building sugarcane to ethanol production facilities on a large-scale in Florida. I think companies would

> focus on delinking ethanol products from food use. Any intelligent sugar ethanol producer would have a business not linked to food use and no affect on the price of sugar. That's the objective. If you are linked to food use, the commodity price fluctuates, and you're no different than corn ethanol.

Fifteen participants argued that the demand for sugar would not be affected if more sugar-based ethanol companies were established in Florida. USDA official Edward M. stated that it would take a really long time for ethanol production to affect the demand for sugar, because the industry remains immature. Ethanol producer Herman K. felt that the price of sugar would not be affected because it is determined by subsidies. Interestingly, biofuels producer Richard C. contended that no impact would occur because ethanol companies in general will not commit to production operations without having a pre-established long-term feed stock supply in place, and this inventory aspect of ethanol production would be planned months in advance.

Devon E., a trade specialist, asserted that if all other factors remain stable, there should not be an effect on the price of sugar because pricing is driven by a number of factors. Further, tariffs could have an effect on price in the future. Maurice L., associated with an ethanol publication, mentioned the complexity associated with sugar commodity price movements; thus, it would be difficult for ethanol companies to have an effect on the sugar price. In Maurice L's words,

> I don't think there would be a change in the price of sugar. However, there would be an opportunity for a price change in ethanol. That would create a spread between the generally historic low price of sugar and perhaps a higher price of fuel. I think there is a profit incentive for sugar growers to make money off of

ethanol production. So, you might see the spread increase, but I do not expect a change in the price of sugar, that's driven by larger international factors, especially since NAFTA quotas have been eliminated.

5.3. Sugar Subsidies

At what level could sugar-based ethanol production reduce the need for sugar subsidies? Do you believe that a sugar subsidy should be in place?

Only five participants were of the opinion that sugar-based ethanol production would reduce the need for sugar subsides. Edward D., a Florida farmer, stated that since sugar ethanol production could increase profitability, this would reduce the need for subsidies or price supports. In his words, "It could potentially eliminate the need for subsidies because the purpose of subsidies is to offset the losses that the farmer incurs every year for growing food."

Only one participant stated that price supports/subsidies would continue to be required despite sugar ethanol production. Eric P., an ethanol researcher, mentioned that any reduction in need for subsidies due to growth of sugar-based ethanol in Florida was highly unlikely.

> First of all, there is no Florida market. The market for sugar is global. You can look at it on a nation-wide basis, but there is no local market in the sense that anything that differs from what's happening in neighboring states or in another state in the country. It is a very complicated issue. There is the Farm Bill that addresses issues related to the production and pricing of a whole range of agricultural products. It is simply an issue that is too complicated to address, to

isolate the sugar component, and be able to address it in this discussion.

Ethanol producer, Drew K. explained what parameters could be necessary for subsidy reductions to occur:

> I think you are going to need to see long-term, high-sustained ethanol prices, in order for sugar-based ethanol and mainly sugarcane to ethanol prices to stimulate development of sugarcane ethanol by the sugar mills. Once that happens, and if that happens, then you could see a phase of sugar milling and sugar production or elimination of the sugar subsidies, because now those sugar mills can be highly profitable making ethanol … Now those sugar companies can be profitable, but low ethanol prices around $1.60/gallon are not good**.** The Florida price of ethanol is now $0.25 over the Chicago Board of Trade price, due to transportation. The market price of ethanol is about $1.85 right now. That's way too low for any sugar mill to convert their sugar process over to ethanol. They will make way more money making sugar. The price of ethanol has to be much higher, I am talking north of $3.00/gallon on a guaranteed sustained level for the sugar mills to get into ethanol, and that could help eliminate the subsides. Alternatively, if the sugar mills could be successful converting their bagasse into ethanol, that creates a new revenue stream which becomes much more profitable. And that profit level, could allow for sugar subsidies to be phased out.

Steven O., ethanol lobbyist, acknowledged that he was not aware at what price point sugar subsidies would be no longer necessary, but added that subsidies can be critical in some cases, such as for minimizing the price of food. Mike G., cellulosic ethanol producer, stated that he does not anticipate that the big sugar companies will become

large sugar ethanol production actors, resulting in no price reduction.

In response to whether a sugar subsidy should be in place, six participants, most of whom hailed from the agricultural sector, stated that no subsidy is currently in place which benefits the grower. Besides price supports set by the USDA, which keep the price per pound of sugar higher relative to international prices, only low-interest loans are offered to sugar mills annually so that farmers can be paid. Once all the sugar is milled, and profits are gathered, the large sugar mills pay back the federal government. Ann M., who is an agricultural corporation stakeholder, noted that,

> There is no subsidy. We borrow money from the community credit organization at $0.18/lb plus interest. We put up sugar as collateral and then use that revenue for sugar production throughout the growing season to repay loans once we make the sugar. Then there is a balancing mechanism in the market where you have a projected consumption of 10 million tons per year of sugar. Also, 2.5 million tons are imported. That keeps prices flat. Prices have not really been raised since 1980. There is no need for the subsidy and we don't want one.

Evidently, the sugar industry is vital to the interests of U.S. food production, because all domestic sugar supply is utilized for food production. Nick C., an agricultural stakeholder, mentioned that the U.S. is the only sugar producing country in the world which imports sugar. Removing the price supports, would thus open U.S. sugar to competition from lower world prices, and effectively put U.S. sugar farmers out of business. In a similar vein, Neil M., also an agricultural stakeholder stated that if price supports are eliminated and U.S. sugar prices are allowed to float on the world market, then the U.S. sugar farmer will be driven out.

However, when asked about their opinions on subsidies, whether in general, or specifically in terms of sugar, ten participants indicated that subsidies should be removed. For instance, biodiesel producer Gina M. stated that sugar subsidies are nothing more than a boondoggle for the sugar industry. Oil respondent Bill C. contended that all price protections and tariffs surrounding sugar in the U.S. should be removed which would result in more competition globally. It should be noted though that if sugar were to lose U.S. price protections, the result would not only destroy the sugar industry in the US, but also decrease the global supply of sugar.

5.4. Comparing Sugar and Corn

According to you, what are the most striking differences between sugar-based ethanol and corn-based ethanol? Do you feel that one is more advantageous than the other? Is sugar the more worthy feed stock in terms of water, soil, and air quality impacts than other general feed stocks available?

Thirty-eight participants stated that sugar was more advantageous than corn as a biofuel feedstock. State energy official Anthony O. preferred sugar because it is more energy efficient due to being able to be converted directly into ethanol; whereas corn must first convert starch into sugar before fermentation can occur, which is an extra processing step. As a result, the cost of production for corn ethanol is higher than for sucrose ethanol. Further, corn requires natural gas to be made available for electricity production. In contrast, Neil M., an agricultural stakeholder, pointed out that sugar ethanol uses its own bagasse for boiler electricity generation, which saves on additional fuel inputs for production. According to cellulosic ethanol representative, Juan C., sugar

ethanol is eight times more efficient than corn, so that for every BTU inputted through the sugar ethanol process, 8 BTUs of energy are produced, while Sam S., another agricultural stakeholder, noted that corn only provides 1.3 BTUs of energy output for every BTU that is inputted.

Differences in water use between corn and sugar ethanol were also pointed out. Drew C. compared the water usage of the two crops in his response:

> Corn requires a lot of water; very intensive. Each gallon of corn ethanol produced uses about 3 gallons of water. However, new corn ethanol plants are becoming more efficient where only 1.5 gallons of water are required. Sugar-based ethanol is a net water producer. Those plants do not require drilling wells and water. Water is in the form of juice in stalks, and can be extracted and purified and then sent back to the fields for irrigation.

The impact of ethanol production on food prices is also significant and, as portrayed in the media, the most controversial issue associated with corn ethanol production in recent years. Congressional representative Todd M. sees the food versus fuel issue to be of utmost importance and thinks that ethanol from sugar-cellulosic processes is advantageous because it utilizes an existing byproduct of sugar cane production. Farmer Edward D. added that people are starving throughout the world and corn should not be utilized for fuel consumption purposes. Also, Herman K. asserted that corn is not attractive because its use for ethanol affects animal feed prices, which is the largest usage of corn in the U.S. market. Since corn is more of a staple food crop than sugar, conflict has been associated with its usage. In contrast, sugar is perceived less threatening because it is a sweetener and flavoring component for food (Kevin N.;

government official).

Thirteen participants stated reasons why corn is also an advantageous feedstock for ethanol production in the U.S., mostly because corn is suitable for U.S. agricultural cultivation on a broader scale given its adjustment to cooler Northern climates. According to Joseph M., corn is advantageous because it can be grown on more acreage nationwide, which equates to more commercial value. Environmentalist Rick B. stated that he anticipates that the waste material from corn will become a viable feed stock for cellulosic ethanol in the near future, which is another reason why the commercialization of cellulosic technologies will become crucial for national energy security.

While corn ethanol has been chastised for its distribution limitations to coastal markets relating to pipeline distribution obstacles, the product does have advantages because of its scale. According to ethanol producer, Nicholas S., corn is better for trading, shipping, and processing year round, compared to the fact that sugar is only processed for 4-6 months of the year. Ethanol is shipped from the Midwest to coastal markets, via railroads and commercial shipping. In contrast, it does not make sense to produce sugar ethanol in Florida and ship to Midwest markets (Maurice L., associated with an ethanol publication). It was also mentioned that there is simply not enough sugarcane ethanol potential to compete with corn ethanol, outside of the cellulosic variety potentially. Bill C., an oil-related respondent, also pointed out that the US government is protecting corn ethanol constituents.

Eleven participants stated that both corn and sugar are advantageous feed stocks generally. The most interesting explanation was provided by Daniel B., an agricultural economist at a large U.S. fertilizer corporation, who discussed the differences in fertilizer

application rates between corn and sugar:

> Here is the breakdown on Brazilian application rates as provided to me by ANDA [Brazil's government statistics agency]. These rates take into account new hectares of sugarcane. In the first year of planting sugar, they typically load the soil with P, K, and some S as the soils tend to be deficient in these nutrients. Brazilian sugarcane: 74 Kg/Ha nitrogen, 26 Kg/Ha phosphate, and 103 Kg/Ha potash. Brazilian corn: 58 Kg/Ha nitrogen, 46 Kg/Ha phosphate, and 57 Kg/Ha potash. In the U.S., for sugarcane you are looking at 68 Kg/Ha nitrogen, 8-15 Kg/Ha phosphate, and 56-94 Kg/Ha potash. If you compare that to corn in the US, you're looking at 149 Kg/Ha nitrogen, 40 Kg/Ha phosphate, and about 53 Kg/Ha potash. You're looking at roughly equivalent for nitrogen and phosphates, and for potash is significantly lower. So, fertilizer rates between corn and sugar are roughly equivalent, with the exception of potash.

According to Daniel B., therefore, it would seem that sugarcane in the U.S. is the less fertilizer intensive crop compared to corn, but when sugarcane cultivation in the U.S. is compared to its counterpart in Brazil, the difference is in terms of lower applications of fertilizers in the U.S. Viewed from the perspective of variations in soil types and applications of chemicals, corn and sugarcane thus show divergent results when compared to one another and when compared to their counterparts in Brazil, so that a simple analysis of which kind of cultivation is more environment-friendly cannot be quickly made.

Sixteen participants were of the opinion that sugar was not a worthy feedstock. Many respondents in this category felt that other growing feed stocks, such as grasses,

hold more potential for biofuel production. Bob G., an ethanol researcher, pointed out that the original ecosystem in Florida was actually saw grass which held enormous benefits regarding flooding and drought. Thus, producing ethanol from local feed stocks known to an area will not disrupt the natural environment, such as non-native, invasive species would tend to do. Mike E., a cellulosic ethanol company representative, held the same view:

> Feed stocks such as energy cane, grasses, and high biomass forage crops are much better because they are drought resistant and use less fertilizer/inputs. The dedicated energy crops are much better for the environment than corn.

Grasses and sugar cane derivatives, such as energy cane or sweet sorghum, thus possess many benefits: they do not compete with food, are not publicly traded, and require fewer inputs than current ethanol production processes.

Sweet sorghum was praised by four participants as a more attractive ethanol feed stock than sucrose from sugarcane. Sweet sorghum has a sugar content similar to sugarcane, and was traditionally used as a sweetener for food. Steven O., ethanol lobbyist, viewed sweet sorghum as a great alternative over sugarcane because it requires fewer inputs and the yields are generally higher than most ethanol feed stocks. Ethanol producer, Nicolas S., also considered sweet sorghum as the more efficient feed stock than sugar because it uses less water and can grow in poor soils lacking nutrients, so that fertilizer costs drop significantly for the sweet sorghum producer.

Opinions thus ranged from support for sugarcane as feedstock (due to problems with corn-based ethanol), support for both sugarcane and corn, and support for

alternatives to both sugarcane and corn. It thus seems that all forms of ethanol feedstocks potentially have costs and benefits associated with them. In the process, the notion that sugarcane, since it is not a staple food crop, is more advantageous does not emerge from the respondents.

5.5. Environmental Issues

What is the most threatening environment impact for Florida potentially, from sugar-based ethanol production?

Nutrient runoff refers to excess levels of fertilizer components; nitrogen, phosphorus, and carbon dioxide which drain off farms into local waterways. Once there, excess nutrient levels build up, and could cause such environmental threats as algae blooms, which consume large amounts of oxygen in water, and as a result, kill local aquatic life. Paul D., an environmental official, stated that fertilizer runoff stemming from ethanol production and running into canals and aquifers is a key concern. Ethanol producer, Ted H. spoke about nutrient runoff from fertilizers:

> I would say [environmental impact would occur] in the form of more intensive agriculture - to grow crops, to produce the sugar-based feed stocks; particularly sugarcane. Down in the EAA, fertilizers have had an adverse affect on the ecosystem, which are probably the biggest negative impact.

However, environmentalist Adam L. contended that the level of phosphate fertilizer required for sugar ethanol production is less than what is needed for sugar food production. Further, ethanol producer Richard C. added that energy cane, a derivative of sugar cane, would use less fertilizer than traditional sugarcane. Drew K. emphasized that

any ethanol producer operating near the EAA would operate in an environmentally responsible manner:

> If you're going to produce ethanol from sugar in the EAA, then clearly the issues associated with pesticide/fertilizer runoff could worsen, if the producer does not design a zero-waste effluent so that they are not discharging ethanol into the environment. These facilities need not release effluent.

Another environmental threat mentioned by participants was the release of vinasse or silage which is a sugarcane byproduct, consisting of high levels of organic matter, potassium, calcium, and moderate amounts of nitrogen and phosphorus (Rodriguez 2000). As a result nutrient runoff occurs, which again has been proven detrimental to aquatic ecosystems. Sam S., an agricultural stakeholder, noted the risks associated with vinasse:

> The silage is what is left over after fermentation. The Florida water tables are too high and the soil is not deep enough. In Brazil and Australia, vinasse is used as a fertilizer. There is too much material produced and biological oxygen demand is too high to support.

Unlike Brazil, Florida must abide by strict federal water quality standards which prevent the release of vinasse into the environment. According to Ted M., representative of a biofuel plant company, vinasse increases the production price of sucrose ethanol because waste water must be cleaned up by law.

It is worth noting that vinasse is only a threat to the environment in the traditional method of sucrose ethanol production. Neil M., an agricultural company representative, pointed out that through the biogasification method of cellulosic ethanol production, no

additional amounts of vinasse will be discharged into the local environment. Only in the sugar mill process will vinasse become an issue. Also, bio-energy researcher, Bob G., added that promising technologies, such as anaerobic digestion exists, which will drastically reduce the amount of vinasse.

As for land-use effects, participants noted a variety of potential environmental impacts on surrounding areas. Academic Lance Y. noted the conversion of land to more farming zones presents an environmental threat, especially if increasing farm land around the EAA conflicts with the State's Comprehensive Everglades Restoration Project (CERP) objectives of restoring the natural flow of water to the Everglades from Lake Okeechobee. Paul L., an environmental official argued that the displacement of land from one crop to another could cause soil erosion issues. Erosion has been a looming problem in the EAA for years and results from oxidation, which has steadily decreased the levels of soil in the region over time. Also, Herman K. stated that sugar mono-cropping, the process of growing the same crop year after year, could become an environmental burden.

Air quality issues are also often associated with sugarcane cultivation. Oil representative, Joseph M., mentioned that the burning of sugar cane fields during the pre-harvest period to facilitate cutting of stalks by manual laborers produces hazardous air quality issues in Brazil. Intentional burns are moderately undertaken by Florida's sugar mills before harvesting. Manual laborers however are not employed, and stalk separation is conducted automatically by large tractor-like mechanical harvesters. As a result, air contaminants do not affect human laborers directly. Trade specialist Matt R. indicated that possible air quality issues, in the form of greenhouse gas emissions, could arise due

to rising ethanol production in Florida. However, air quality compliance measures are of utmost importance, and strict regulations exist which ethanol producers must abide by. In 2002, the EPA implemented air quality restrictions against ethanol producers in Minnesota which other producers across the country noted. To demonstrate compliance, ethanol producers are usually required to conduct emissions testing, monitor production or emission rates, maintain records and submit reports to the permitting agency at hand (McIntyre 2008).

Invasive species in a foreign ecosystem present an environmental threat if energy plant species outside of Florida are grown within the state. Environmentalist Adam L. said that some non-native species could have dangerous ecosystem implications. For instance, farmer Edward D. stated that there were some concerns by environmentalists that jatropha, used for biodiesel production, is non-native and invasive, and thus may impact the environment detrimentally. There is also the threat of genetically modified crops, which can present an environmental contamination issue if safeguards are not initiated when utilizing foreign genes for crop production. With genetic engineering, scientists can introduce a foreign vector through transfection which would accelerate crop production, leading to higher crop yields per acre. The enhanced yields available from the current generation of genetically modified (GM) crops such as corn can help farmers meet the growing feedstock demand for biofuels while still producing sufficient quantities of food and animal feed (Evans 2008). Proven GM techniques are applied to cellulosic feed stocks to enhance ethanol processes and can be used for furthering sugarcane output in Florida. But such technologies are often opposed by environmentalists due to inadequate knowledge of their consequences.

Four participants stated that sugar ethanol production would not present any type of environmental threat in Florida, because they felt that the technology had progressed to a point where no impacts were created. Eric P., an academic, noted the high levels of environmental consciousness associated with biofuels technology in this way:

> All technologies have to be done in an environmental way. We can learn from Brazil. We are practicing high-rates of recycling of water, we don't let gases into the atmosphere, and we are producing biogas from our waste streams which is preventing methane from impacting the environment by turning it into additional renewable fuel. I believe that ethanol is a great environmentally friendly process.

The previous statement is crucial for understanding the social responsibility which farmers and ethanol producers espouse when conducting daily operations. Abiding by federal and state environmental statutes is required by law, and violation represents a direct blow to the economic well-being of agricultural and ethanol producing entities. Sanctions would come in the form of monetary fees required by courts, or through revenue declines which could be substantial, as the public tends to avoid entities who participate in threatening environmental activities.

Evidently, the environmental efficiency of ethanol production processes have been evolving. According to biofuels specialist, Teresa S., there are a lot of environmental benefits surrounding 2nd generation ethanol crops, such as lower fertilizer inputs. Further, congressional representative Todd M. was under the impression that there are no environmental threats because sugar cellulosic ethanol production will incorporate the waste product of sugar food production. Cellulosic ethanol producer Mike E. provides a unique perspective on the environmental benefits of ethanol production:

> I am not even sure there is even one environmental threat. If I look at where the ethanol industry can go in this state, we could convert a lot of underutilized pasture land to crop production. We have great regulations on the amount of phosphates you can add to the land. As you build out these massive farms, we have put in all kinds of storm water control. In the area of Lake Okeechobee, as these areas get built out, we are adding retention ponds, helping to modify … I think we are actually helping the environment.

How would increasing sugar acreage affect the Everglades ecosystem?

Fifteen participants indicated that if sugar acreage were to increase, the effects on the Everglades ecosystem would be negative. The most commonly cited detrimental effect dealt with water flow threats, such as runoff. Matt R., a trade specialist, contended that overall the Everglades ecosystem would decline because of runoff, unless better water control was initiated, but this would probably make sugar production less efficient. Richard C., a biofuels producer, stated that any kind of cultivation in the Okeechobee area will have some effect on the Everglades, and sugarcane runoff has actually been proven to leach down into the Everglades. Paul D., a government official, noted the environmental difficulties associated with sugar farming:

> Through surface water and fertilizer runoff, because it is a very fragile ecosystem. Diversion of water can cause problems with the ecosystem, additional irrigation water for sugarcane, and land conversion from whatever land use is present near the Everglades can affect recharge rates.

According to Alexander W., an ethanol-gasoline wholesaler, the threat of increasing

sugarcane acreage is the biggest problem, and if it were in fact expanded, the watershed will be compromised. Further, agricultural official, Edward D., emphasized that if farming intensity and spread is increased in South Florida, the Everglades will definitely be affected. Florida farmer, Edward, D., provided a wider perspective on sugar farming and its environmental impacts:

> Sugar has been produced for decades along the Everglades. I am assuming that they [the government] found out that sugar was having a negative effect on the Everglades. The federal government is now shaking their fingers at the farmers, but the government started this issue to begin with. Increasing sugar acreage probably would have a negative impact on the Everglades, but the whole purpose of the drainage initially was to stimulate farming for troops overseas.

This respondent is referring to drainage disruptions along the Kissimmee River leading south to Lake Okeechobee which was initiated by a government request to the Army Corp of Engineers. The impacts from the initial diversion reconfigured the natural flow of water to Lake Okeechobee, leading to substantial runoff issues from farms because the drainage ditches led to and from the Kissimmee River.

Four participants took an opposite position from the above, maintaining that any increase in sugar production would hold positive impacts for the Everglades ecosystem. Sugar acreage does not necessarily have to increase near the Everglades, so it seems that the environmental impact would be unknown until newly developed farmland is established. For instance, Nicolas S. acknowledged that sugarcane production can be installed on sandy soil lands outside the EAA, which might not impact the Everglades ecosystem. Also, as cellulosic ethanol respondent Mike G. noted, strict environmental

regulations exist for farming currently, so the quality of the Everglades might actually be improving.

According to farmer, Kirk R., sugarcane is the only crop in South Florida which has no detrimental effect on the Everglades because it requires almost no fertilizer, releases little runoff, and requires little to no drainage. Further, Kirk R. asserted that vegetable crops in the area contribute 90% or more of harm to the Everglades ecosystem than sugarcane. Neil M., an agricultural stakeholder, most prominently took this position.

> Sugarcane would create a positive impact for the Everglades, because it is the cleanest crop available through less fertilizer requirements. The water is actually cleaned by the sugar fields before entering Everglades. The problem with the Everglades is all the pollution coming out of Central Florida. The measuring stick is phosphorus. In Lake Okeechobee, phosphorus levels are 200 parts per billion and 400-600 parts per billion in the Kissimmee River. The goal is 10 parts per billion for the Everglades. When we get the water for irrigation, it is usually 150-200 parts per billion. The sugarcane is actually absorbing the phosphorus.

Ten participants took the position that more sugar farming would be unlikely to occur, and/or would not be likely to impact the Everglades ecosystem. These respondents generally felt that more sugarcane farming in South Florida, especially within the EAA, is an improbable idea. For example, Alan W. and Sam S., both associated with agricultural organizations, stated that further sugar production will not occur in watershed lands that would impact the Everglades, although sugarcane is the least intensive crop in the ecosystem. Ethanol lobbyist Rick B. affirmed that sugar acreage in South Florida is most likely at peak; only a decrease will probably occur because of the environmental

awareness surrounding sugar production. With the pending State of Florida acquisition of U.S. Sugar Corporation lands to restore the natural flow of water from Lake Okeechobee to the Everglades, it seems highly unlikely that new permitting would be allowed even if sugarcane land was available. Drew S. stated that increasing sugar acreage near the Everglades would be counter-productive to the restoration of the ecosystem because it effectively offsets what the state is trying to accomplish.

Fifteen participants expressed uncertainty with regards to how increasing sugar acreage would affect the Everglades ecosystem. Congressional representative Rita B. stated that effects would depend on where new sugarcane acreage will be developed. Environmentalist Adam L. further explained the difficulty with assessing the impacts properly:

> It really depends on where more sugar acreage is grown and what impact there will be on the water flow from the Kissimmee Valley to the EAA. Currently, there is a push to purchase U.S. Sugar Corporation lands by the state to repair water flow. Part of that drive is to get that land out of production. Other lands are not as impactful on the water flow regime. Those lands could be used for agriculture, sugar ethanol use, and not impact the Everglades. That is the goal we are after. The verdict is out if the State can repair the natural land - still under negotiation.

It seems therefore that any legitimate push for further sugar acreage would have to move north, away from the EAA, but climate limitations would come into effect so that this expansion probably could not occur beyond the Orlando region (Eric S., agricultural stakeholder). Moreover, lands outside the EAA consist of sandy soils which are not as attractive as the muck soils for sugarcane farming. While farming is possible

on sandy soils, and it does occur, it would inevitably be more expensive due to higher fertilizer application rates and water requirements. It is possible therefore that the discussion could shift away from sugarcane and other crops such as sweet sorghum would become more attractive (Ted M., ethanol stakeholder)

Given that the economic viability of devoting sugarcane to food production, as opposed to ethanol production, is higher, the main obstacle in increasing ethanol acreage seems to be the price supports offered to sugar and the continuing utilization of sugar for food. Within interview respondents, environmental factors are not deemed as important in stymieing the growth of sugar ethanol. The popularization of sugar ethanol thus turns out to have more to do with sugar itself than with the politics and economics of oil or environment.

CHAPTER 6

CONCLUSION

This thesis has drawn on a diversity of stakeholders to understand how issues of oil dependence, crop-fuel debates, and environmental impacts are shaping the trajectory of sugar ethanol in Florida. Overall, four findings become especially pertinent within the various, often conflicting, positions taken by participants in the interview, and these relate to the four main sub-questions of the thesis: role of government policies, relationship between oil and ethanol, agricultural issues related to sugar cultivation, and environmental impacts of oil and ethanol production on Florida coasts and wetlands. First, even as a wide range of factors, from energy security the availability of viable feedstocks, are driving the sugar ethanol landscape, an especially significant aspect is the role of government policies. Such policies include state-level mandates which encourage domestic production as well as small grants, conferences, and support for research activities which form a foundation for commercialization of renewable energy technologies. Another important feature of the role of the state is the ethanol tariff. While respondents provided reasons to support as well as be critical of the tariff, it seems clear that the removal of the ethanol tariff would encourage overseas ethanol production destined for the U.S. market which would thwart domestic initiatives in the long-run.

Second, the relationship between ethanol and oil production, while often projected as a key element of the economics of ethanol production, is not viewed as such by

research participants. Thus, oil has more uses beyond being used as transportation fuel, so that a rise in ethanol production may not always lead to a drop in oil production. Then, the feedstocks associated with ethanol, for instance, corn and sugar, are publicly traded commodities and hence subject to speculation. Oil prices alone therefore do not determine the viability of ethanol. Alongside, the infrastructure for ethanol transport has not yet been out in place, which especially hampers the transport of sugar ethanol from Florida. However, if domestic ethanol production succeeds through cellulosic processes, which are not yet commercially viable, then the role of ethanol on the national scene could increase exponentially. It seems worth noting though that the amount of petroleum fuel consumed in the U.S. is enormous, and while ethanol will not substitute fully, it can play a significant role in promoting renewable options and enhancing energy security.

In terms of the economies of sugar itself, it seems clear that the sugar producing community in Florida is interested in ethanol production, but factors such as land availability, and, more significantly, sugar price supports, favor the commercialization of sugar food over sugar fuel. Currently, all domestic sugar is allocated for food production in the US, with another 15-20% imported annually. The price supports directed by the USDA artificially increase the price of the US sugar commodity price to the point where it is more attractive to produce and sell sugar for food. However, farmers are generally interested in any new revenue production solution for their agricultural products, and sugar farmers are no different. The successful development of cellulosic ethanol process technologies will present an opportunity for Florida's sugar growers to collect more revenue, assuming that processing facilities are created by the large sugar mills. Participants also pointed out that since the state government was in the process of

acquiring U.S. Sugar Corporation, it was likely that the discussion of sugar ethanol was moot.

An especially interesting finding was the low value given to environmental impacts in shaping the production of sugar ethanol. A number of interview participants viewed sugarcane as a crop with minimal environmental impacts, especially in terms of run-off, and argued that the Everglades were less likely to be impacted is sugar cultivation continued. Moreover, many interview participants argued that oil exploration has no connection with amount of ethanol production, so that the oil industry would continue with its activities based on the economics of oil rather than the economics of ethanol.

Ultimately, the shift to sugar ethanol in Florida will be connected to political will, investment in new technologies and infrastructure, and the economic strength of the sugar industry and its need for alternatives. Given that other biofuels, including alternative crops and grasses as well as cellulosic feedstocks are being considered, it is possible that the diversion of sugar in Florida towards ethanol will not take off to the same degree as either corn in the Midwest or sugar in Brazil. But to the extent that a large group of stakeholders associated with both ethanol and sugar continue to be prominent in Florida, the issue is likely to be at the center of energy debates for a number of years.

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APPENDICES

Appendix A: Interview Questionnaire for Stakeholders

General Questions

1. According to you, what are the main factors shaping ethanol development in Florida? (government policies, oil prices, agricultural interests, environmental concerns, wider economic issues, other factors)
2. Is sugar-based ethanol being promoted in Florida, and what factors are driving its potential usage?
3. What barriers exist which will hinder the growth of sugar ethanol in Florida?
4. Do you think that the Florida state government has been supportive of ethanol development, and more specifically sugar-based ethanol development?
5. In what ways are universities and other research institutions in Florida contributing to better understanding of sugar ethanol?

Ethanol and Oil Economies

6. To what extent will ethanol substitute for oil demand over time?
7. Is lack of adequate ethanol fuel supplementation for oil driving more oil exploration in the U.S.?
8. Can ethanol production substitute for offshore drilling in the Florida marketplace? Can a correlation be made between ethanol production and offshore drilling?
9. What implications could sugar ethanol in Florida have for the national energy market?
10. Should the ethanol tariff be eliminated? How does the ethanol tariff affect sugar-based ethanol?

Sugar Economies

11. What is the current economic condition of Florida's sugar farmers? To what extent are farmers supportive of sugar ethanol?
12. What factors have to be in place for more sugar acreage to be used for ethanol production in Florida?
13. How would sugar-based ethanol affect the commodity price of sugar potentially?
14. How would the demand of sugar be affected if more sugar ethanol companies are established in Florida?
15. At what level could sugar-based ethanol reduce the need for sugar subsidies in Florida? Do you think a sugar subsidy should be in place?

Environmental Issues

16. Is sugar the more worthy feedstock in terms of water, soil, and air quality issues when compared to other potential ethanol feed stocks?
17. According to you, what are the most striking differences between sugar ethanol and corn ethanol? Do you think one is more advantageous than the other?
18. What is the most threatening environmental impact for Florida from sugar-based ethanol production?
19. How would increasing sugar acreage affect the Everglades ecosystem?

Concluding Question

20. Are there any other issues that have not been raised so far that you would like me to consider?

Appendix B: List of Interview Participants

Stakeholder Category	Pseudonym	Date of Interview	Length of Interview
Academic	Eric P.	1/20/2009	39 minutes
	Lance Y.	2/3/2009	41 minutes
	Bob G.	2/12/2009	42 minutes
Agriculture	Nick C.	1/23/2009	43 minutes
	Edward D.	1/28/2009	41 minutes
	Neil M.	1/29/2009	45 minutes
	Daniel R.	1/30/2009	69 minutes
	Edward D.	2/10/2009	39 minutes
	Kirk R.	2/13/2009	57 minutes
	Eric S.	5/3/2009	34 minutes
	Sam S.	5/4/2009	59 minutes
	Ann M.	1/28/2009	47 minutes
Environmental	Paul D.	2/9/2009	43 minutes
	Conrad M.	2/9/2009	11 minutes
	Adam L.	2/11/2009	36 minutes
Ethanol	Maurice L.	1/9/2009	40 minutes
	Steven O.	1/12/2009	37 minutes
	Nicolas S.	1/29/2009	41 minutes
	Richard C.	1/29/2009	51 minutes
	Juan	1/29/2009	35 minutes
	Rick B.	1/29/2009	48 minutes
	Drew K.	1/30/2009	60 minutes
	Gina M.	1/30/2009	22 minutes
	Cameron S.	2/3/2009	33 minutes
	Mike G.	2/3/2009	32 minutes
	Mike E.	2/3/2009	55 minutes
	Ted H.	2/5/2009	28 minutes
	Herman K.	2/9/2009	24 minutes
	Sean D.	2/10/2009	28 minutes
	Ted M.	2/12/2009	45 minutes
	Greg C.	2/20/2009	56 minutes
Government	Anthony O.	1/9/2009	74 minutes
	Devon E.	1/23/2009	25 minutes
	Matt R.	1/28/2009	58 minutes
	Kevin N.	1/30/2009	25 minutes
	Rita B.	2/4/2009	32 minutes
	Oliver W.	2/6/2009	29 minutes

Appendix B: (Continued)

Government	Alan W.	2/11/2009	32 minutes
	Thomas C.	2/13/2009	48 minutes
	Todd M.	2/13/2009	34 minutes
	Lance L.	2/5/2009	33 minutes
	Rick K.	2/10/2009	33 minutes
Oil	Victor M.	1/13/2009	46 minutes
	Joseph M.	1/28/2009	42 minutes
	Bill C.	2/3/2009	17 minutes
	Bobby H.	2/4/2009	31 minutes
	Terence F.	2/6/2009	33 minutes
	Alexander W.	2/15/2009	32 minutes
	Teresa S.	2/20/2009	31 minutes

ABOUT THE AUTHOR

Joshua F. Berger received a Bachelor's Degree in Geography from the University of Florida in 2006. Since then he has enrolled for two graduate degrees at the University of South Florida, an M.S. in Environmental Science and Policy in the College of Arts and Sciences, and an M.S. in Entrepreneurship in Applied Technology in the College of Business. From 1999 to 2003, Joshua served honorably in the United States Navy as an Intelligence Collection Specialist, where he served at duty station locations worldwide.