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Incentives Matter: Assessing Biofuel Policies in the South

J. Corey Miller and Keith H. Coble

As a result of the increase in the real cost of fossil fuel-based energy in recent years, federal and state governments have taken a more active role in energy policy by creating incentives to develop alternative sources of energy, including biofuels. However, policymakers often become focused on the specific type of energy and not the energy services consumers ultimately value. The lack of recognition of energy as a commodity results in policies that ignore the characteristics of the associated markets: easy entry and exit, no barriers to entry, and sensitivity to changes in supply and demand. Consequently, energy industries may fail to arise because entrepreneurs must be able to account for all costs and earn—at a minimum—a competitive return on the investment. This article evaluates the options available to policymakers related to biofuels, which are of particular concern to the South, and includes an assessment of the knowledge base on which policy decisions are made.

Key Words: alternative energy, biofuels, energy policy

JEL Classifications: Q41, Q42, Q48

Perhaps no business has impacted agriculture more in such a relatively short period than the burgeoning U.S. biofuels industry. To be sure, sustained increases in crude oil prices continue to generate ripple effects throughout crop and animal agriculture; however, government policy affects the biofuels industry equally if not more extensively than traditional agriculture. Agricultural economists in particular are uniquely positioned to analyze the interrelationships among agriculture, bioenergy, and government policies.

In the southeastern United States, agricultural economists can potentially contribute even more to the public policy discussions regarding biofuels because of the supply responsiveness of the region's land. Liang et al. (2011) suggest much more elastic crop acreage exists in the Southeast compared with the Midwest. Whereas the Midwest and Great Plains clearly possess comparative advantages in the production of corn and soybeans—the most important farm-raised biofuel components to date—the southeastern United States arguably holds more alternative uses for its land. For example, according to the Natural Resource Inventory, of the nation's rural land, the Southeast contains only 13% of total crop land but 40% of total forest land and 31% of total pasture land (U.S. Department of Agriculture, National Resources Conservation Service and Center for Survey Statistics and Methodology, Iowa State University, 2007). In addition, the Southeast includes 9% of the nation's rural acres in Conservation Reserve Program (CRP)

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contracts, representing another potential land source. Figure 1 indicates the share of rural land found in the Southeast[1] by category.

Shifts in crop acreage began approximately five years ago as a result of the effects of biofuels on corn and soybean production; as technologies for the production of cellulosic and advanced biofuels progress, potential production areas for alternative energy sources will increasingly compete for the rural land of the southeastern United States. Similarly, the role of the agricultural economist will become increasingly valuable, both in the analysis and development of agricultural, energy, and environmental policies.

Federal Incentives

The federal government, and in some instances state governments, continues to devote significant levels of subsidies to encourage the development of biofuel and renewable energy industries. We focus primarily on federal subsidies and initiatives because in terms of absolute magnitude, these programs tend to overshadow state and local subsidies. For over 50 years, the U.S. government actually taxed ethanol, initially at the rate of $2 per gallon to help finance the Civil War (U.S. Department of Energy, U.S. Energy Information Administration, 2010). Congress removed the tax early in the 20th century, and the federal government remained largely uninvolved in the biofuels market until the mid-1970s. Once the United States began the shift to exclusively unleaded gasoline, interest in ethanol revived, primarily as a result of its potential to increase octane levels in gasoline. The Energy Tax Act of 1978 defined ethanol blended into gasoline—called "gasohol"—such that it was effectively exempt from the $0.40 per gallon excise tax on gasoline. This subsidy increased to $0.50 per gallon in 1983, $0.60 per gallon in 1984, decreased to $0.54 per gallon in 1990, $0.53 per gallon in 2001, $0.52 per gallon in 2003, $0.51 per gallon in 2005, and finally to its current level of $0.45 per gallon in 2009. Without further Congressional action, the Volumetric Ethanol Excise Tax Credit (VEETC) will expire on December 31, 2011. The impacts of the VEETC remained relatively small until the increase in petroleum-based fuel prices that occurred in 2005 coupled with the increasing use of ethanol as an alternative to Methyl Tertiary Butyl Ether as an oxygenate in gasoline (U.S. Environmental Protection Agency, Office of Transporation and Air Quality [USEPA], 2010a). In the following paragraphs, we discuss the effects of this type of subsidy and contrast them with those of what we contend is a more significant policy mechanism, the National Renewable Fuel Standard Program, more commonly known as the Renewable Fuel Standard (RFS).

Created by the Energy Policy Act of 2005, the RFS represents the first renewable fuel mandate by volume in the United States (USEPA, Office of Transportation and Air Quality, 2010b). This initial program, often referred to as RFS1, required the blending of 7.5 billion gallons of renewable fuel into gasoline by 2012. The Energy Independence and Security Act (EISA) of 2007 expanded the RFS, referred to as RFS2, to require the blending of 36 billion gallons of renewable fuel by 2022. RFS2 also includes diesel fuel along with gasoline and incorporates specific types of renewable fuel by volume such as cellulosic ethanol. Although the RFS stipulates the requirements by category of renewable fuel, EPA can revise the standards annually as it did in 2009 and 2010. In 2009, the agency adjusted the cellulosic biofuel requirement for 2010–6.5 million gallons down from the 100 million gallons specified by EISA. The U.S. EPA also modified the biomass-based diesel requirement for 2010 by combining the 2009 statutory level of 500 million gallons with the 2010 statutory level of 650 million gallons for a total requirement of 1.15 billion gallons in 2010. Similarly, the U.S. EPA revised the cellulosic biofuel requirement for 2011–6.6 million gallons down from the 250 million gallons specified by EISA (USEPA, Office of Transportation and Air Quality, 2010c). The agency did not adjust the 2011 biomass-based diesel requirement, however. The total renewable fuel requirements for both 2010 and 2011 remain unchanged. Table 1 indicates the renewable fuel volume requirements of EISA, including the revisions for 2010 and 2011.

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[1] In this study "Southeast" includes the states of Alabama, Arkansas, Louisiana, Mississippi, Tennessee, Georgia, North Carolina, and South Carolina.

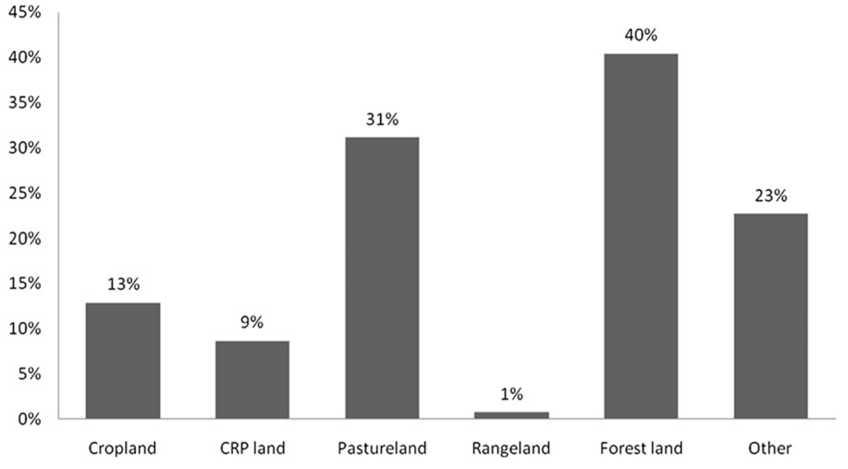

Figure 1. Southeast Region's Share of U.S. Rural Land

Because EPA can modify the RFS annually, and the agency plans to issue notices of changes to standards each spring, its actions can result in important policy implications. For example, if an annual cellulosic biofuel target cannot be met, a situation that will be known well in advance of a potential ruling, will EPA simply increase the levels for conventional biofuels to make up the difference as it has the last two years?

A significant aspect of U.S. biofuels policy—which includes the RFS—involves the definition of "advanced biofuel." The 2008 farm bill defines an advanced biofuel as "derived from renewable biomass other than corn-kernel starch" (Miller, Coble, and Linton, 2010). The U.S. EPA, however, defines biofuels as per the EISA according to their life-cycle greenhouse gas emissions, which vary by category. The emission thresholds are based on the reductions from the 2005 baseline. For example, ethanol from corn starch can meet the definition of "renewable fuel" if it provides a 20% reduction in baseline emissions and if it is produced at "a new natural gas-fired facility using advanced

Table 1. Revised Energy Independence and Security Act Renewable Fuel Volume Requirements (billion gallons)

Year	Cellulosic Biofuel Requirement	Biomass-Based Diesel Requirement	Total Advanced Biofuel Requirement	Total Renewable Fuel Requirement
2010	0.0065[a]	1.15[a]	0.95	12.95
2011	0.0066[a]	0.80	1.35	13.95
2012	0.50	1.00	2.00	15.20
2013	1.00	At least 1.0[b]	2.75	16.55
2014	1.75	At least 1.0	3.75	18.15
2015	3.00	At least 1.0	5.50	20.50
2016	4.25	At least 1.0	7.25	22.25
2017	5.50	At least 1.0	9.00	24.00
2018	7.00	At least 1.0	11.0	26.00
2019	8.50	At least 1.0	13.0	28.00
2020	10.5	At least 1.0	15.0	30.00
2021	13.5	At least 1.0	18.0	33.00
2022	16.0	At least 1.0	21.0	36.00

[a] Revised statutory requirement by annual rulemaking.
[b] The U.S. Environmental Protection Agency will specify the amount through future rulemaking.

efficient technologies." Other biofuel categories have higher emission thresholds: "advanced biofuels" and "biomass-based diesel" both require 50% reductions, whereas "cellulosic biofuels" require 60% reductions from 2005 levels. In addition, the U.S. EPA must test the "pathways" for specific feedstocks to determine if they meet these requirements. For example, diesel derived from soybeans, waste oils, fats, or greases can be considered biomass-based diesel based on the U.S. EPA's determinations. Categorizing biofuels by their life-cycle greenhouse gas emissions also has significant policy implications. Entrepreneurs seeking to develop new feedstocks for biofuel production may be required to wait until EPA completes pathway testing for the particular fuel being produced. Until such testing is completed—if ever—the producer may not qualify for a variety of federal incentives and programs because the type of fuel has not been established.

Commodity Markets and Energy

One of the hallmarks of the economics of agriculture as an industry is that most of the products are commodities—mass-produced and unspecialized. Bioenergy markets, despite the lack of recognition by policymakers, share many of the same characteristics. As Dale (2008) notes, consumers ultimately value not the energy itself, but the services it provides: heat, light, and mobility. Thus, policymakers may ignore three important traits bioenergy markets share with agriculture: ease of entry and exit, no barriers to entry, and sensitivity to changes in supply and demand.

The development of the U.S. biofuels market means entry and exit into energy has become transitory. Agricultural producers, foresters, and landowners have or potentially have a new outlet for their products. The consequences of budding biofuel industries have already been felt by southeastern agriculture, as evidenced by the increase in the number of row crop acres devoted to corn and soybeans over the last 4–5 years. Figure 2 depicts this increase along with the decrease in cotton acreage over the same period (NASS, 2010). Whether the corn or soybeans harvested from these southeastern U.S. acres actually found its way into fuel is immaterial; the increase in production reflects a response to the price increases resulting from the increase in the quantity of biofuels demanded, generated in part by government edict. Similarly, owners of forest tracts must decide into what market they will sell their timber, which impacts their production and harvest decisions that are longer-term than those in typical row crop agriculture. Owners of rural acres not in row crops or timber, marginal land in particular, also likely must decide if producing biofuel crops, including perennial grasses and small woody crops, represent a new opportunity cost. Because of the interrelationships between commodity markets,

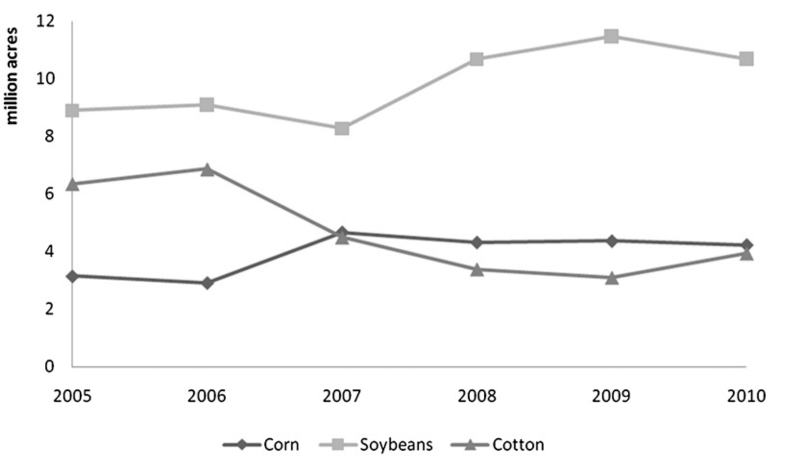

Figure 2. Planted Acres in Southeastern United States for Corn, Soybeans, and Cotton, 2005–2010

the production of biofuel feedstocks affects other agricultural industries. Cotton acreage, for example, represents a primary opportunity cost in the Southeast in the production of additional corn and soybeans. Moreover, poultry and livestock industries, traditional outlets for corn and soybean production, continue to experience higher input costs because of the increase in feedstock demand by biofuels. Clearly the pace of change observed in the biofuel feedstock industry is a function of its ease of entry.

Similarly, a lack of barriers to entry also characterizes the development of biofuel feedstocks. Unlike traditional fossil fuel industries such as petroleum and coal, production of biofuel feedstocks can start with much lower startup costs and less government regulation. Thus, once government incentives become part of the impetus for an industry without barriers to entry, participants can anticipate the experiences observed in the interrelated corn and ethanol industries in recent years. Experience also demonstrates in the case of cellulosic ethanol, however, that technological barriers can trump government incentives.

Related to the first two attributes, sensitivity to changes in supply and demand is another characteristic associated with biofuel feedstocks. Clearly the supply response of corn and soybeans to the increase in demand for biofuels in the Southeast and elsewhere as well as the nascent production of cellulosic biofuels kindled in no small measure by government incentives reflects the responsiveness of biofuel feedstock production. The boom–bust–boom nature of ethanol production observed since 2006 also indicates the commodity nature of energy. This characteristic may also be a comparative advantage for southeastern states, as landowners can move land into and out of production of row crops such as corn and soybeans, which has already occurred. Acres in a number of midwestern states, on the other hand, may be limited to a corn–soybean rotation.

Marginal lands in the Southeast represent perhaps the most important opportunity cost in the production of biofuels and biofuel feedstocks. Although defining "marginal land" can be problematic, consider rural acres not currently dedicated to row crops or prime timber. These acres may be used for livestock, enrolled in the CRP, or idle. According to the U.S. Department of Agriculture's Natural Resource Inventory, approximately 19% of the rural acres in the United States are found in southeastern states. Although the Southeast already contains a large portion of forest land (40%), it also includes a considerable share of pastureland (31%). These latter acres could potentially become production areas for biofuel feedstocks. However, for land owners or other entrepreneurs to bring this land into production of biofuel feedstocks, or any other use, they must be able to earn at least a competitive return on their investment, which means accounting for all costs. For the investment to occur, the entrepreneur must also be able to account for the risk–return tradeoff. These factors help explain in part why the government incentives for the production of cellulosic and other advanced biofuels thus far have resulted in relatively small impacts on production. The RFS and the credit for production of cellulosic biofuels, currently $1.01 per gallon, have not stimulated production of cellulosic ethanol because of their relatively small effects on the risk–return tradeoff. Extensive production of perennial grasses and small woody crops has not occurred because of the lack of market outlets for these crops. In turn, production facilities for cellulosic ethanol have not been built because of the relatively high costs still associated with the technology required for feedstock conversion (Schnepf, 2010). Until this process becomes more efficient, biorefineries cannot account for all costs, and the opportunity cost of producing cellulosic feedstocks will remain too high.

Policy Mechanisms

Figure 3 illustrates the case in which supply and demand curves fail to intersect, resulting in no market. The cost of production exceeds any price buyers are willing to pay and thus no market exists. In effect, this diagram represents attempts by the renewable fuels industry to compete with low-cost petroleum-based fuels and energy sources such as coal in the absence of federal incentives.

Figure 4 depicts the effects of a subsidy tax credit on the production costs of an industry. This diagram exemplifies how providing a subsidy shifts the supply curve downward, resulting

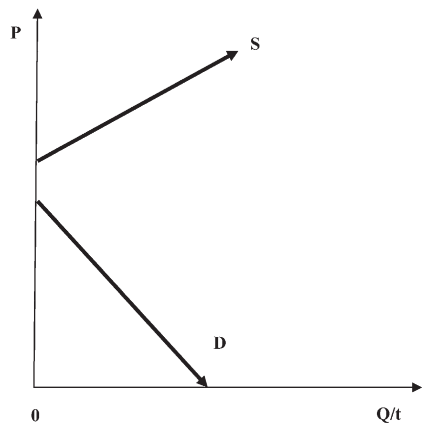

Figure 3. Conceptual Supply and Demand for Renewable Fuels in the Absence of Government Incentives

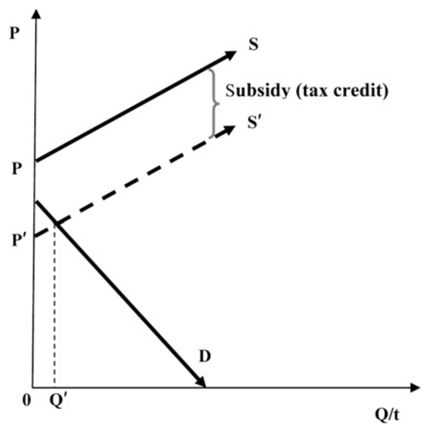

Figure 5. Conceptual Operation of Volumetric Ethanol Excise Tax Credit in the Ethanol Market

in the development of an industry likely unable to exist under free market conditions. The subsidy creates a market by reducing production costs to a level where the demand curve and (subsidized) supply curve intersect. This behavior by a subsidy is well known; moreover, such a subsidy represents genuine budgetary costs that result in the type of political scrutiny received by programs that require federal expenditures.

In a remarkable contrast, Figure 5 describes how the federal government can mandate the use of a particular amount of a product through a quota, as in the case of the RFS. This mechanism creates an artificial perfectly inelastic demand curve that can potentially intersect with the supply curve, establishing an industry that would not otherwise exist. Thus, these two mechanisms reflect two different approaches to largely accomplish the same policy goals. Interestingly, however, the significant difference between the quota and the subsidy is that the quota, although imposing a welfare loss on society, does not do so through lost tax revenues beyond its administration costs. Thus, in tight budget environments, policymakers may focus more on quotas. Accordingly, individuals contemplating investments in renewable industries or technologies should primarily concentrate their attention on the RFS.

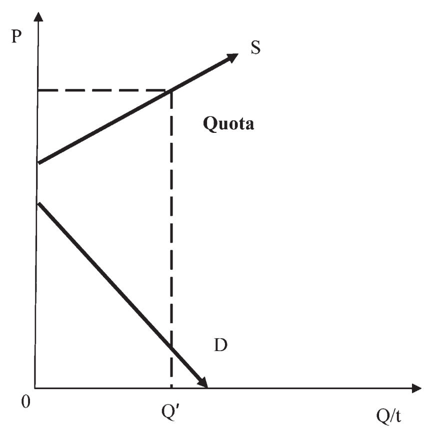

Figure 4. Conceptual Operation of Renewable Fuel Standard in the Renewable Fuels Market

Implications for the South

The preceding discussion leads to the question of what types of renewable energy can potentially play a significant role in the southeastern economy. As previously noted, the available agricultural land and forest resources in the region suggest cellulosic fuels from wood and grass hold the most promise. Before continuing, however, this section describes the impacts of the primarily midwestern corn-based ethanol industry on the South based on the nature of the competitive markets for biofuel feedstocks. Some critics charge that, as a region, the Southeast failed to capitalize on the economic opportunities of corn-based ethanol when these plants located in the Corn Belt and other areas. In our opinion, however, such criticisms are overly simplistic.

First, as a result of the transportation cost of grain, ethanol plants tend to locate near relatively cheap sources of corn. The expenses associated with hauling corn compared with the final product, ethanol, largely drive such costs. In the United States, ethanol production tends to occur principally in the upper Midwest with its relatively low corn prices compared with other regions. Transportation costs and export markets drive these spatial relationships, resulting in the traditional system in which corn prices increase as proximity to the New Orleans export market increases. The major livestock industries in the Southeast reinforce these circumstances by using large quantities of grain, resulting in a historically grain-deficit area. However, as previously noted, consuming significant quantities of corn for ethanol production clearly benefits row crop producers in the Southeast and elsewhere through increases in the price of corn and other crops.

Conversely, livestock producers nationwide experienced substantial increases in input prices and feed prices, causing price shocks for industries such as the poultry industry, highly concentrated in the Southeast. Debate continues regarding the impact of biofuels on the magnitude of these effects, although such a topic lies beyond the scope of the current discussion. The present state of corn-based ethanol as it affects the Southeast can be summarized thusly: the industry largely has not located in the region, row crop producers are benefitting significantly, livestock producers are losing, and the region remains unlikely to capture the indirect economic activity associated with corn-based ethanol plants.

As the Southeast focuses on cellulosic feedstocks, policymakers and investors should recognize the competition occurring within the biofuels sector among the various technologies and feedstocks. Individuals interested in biofuels production in the Southeast should concentrate on the differences between the relative economic costs of producing corn-based ethanol and cellulosic ethanol. The relatively less energy-dense nature of most cellulosic feedstocks compared with corn creates a challenging dilemma in terms of moving the feedstock to the plant and the optimal economies of scale in production. The total costs of shipping a bulky feedstock can be reduced by building relatively small, widely dispersed plants. However, if such plants remain relatively cost-inefficient, then they will not be cost-competitive with other renewable fuels. Haque and Epplin (2010) and others suggest such a dilemma for cellulosic feedstocks; this situation merits further research to determine methods to overcome these logistical issues, if possible, or designing a relatively cost-efficient production system even on a small scale.

Investment Analysis

This section discusses the implications for investments in renewable fuels for the Southeast. Policymakers and others continue to ask how a viable industry that provides job opportunities and economic development can arise in the region. In our opinion, agricultural economists should address several issues for their clientele in their responses to such queries.

Technological Uncertainty

Importantly, agricultural economists should emphasize to other disciplines and policymakers at the state and federal levels the significance of technologic uncertainty regarding the various processes under research and development at a number of universities and private entities. Evaluating a bench-top production system and projecting the cost of production for that system if expanded to full commercial scale is extraordinarily difficult. In many cases, economists simply cannot ascertain the economies of scale of specific technologies. Nevertheless, a considerable number of studies and cost reports regarding the breakeven costs of producing renewable fuels omits discussion of these significant issues. Consequently, in our opinion, the findings of these studies continue to be highly speculative because the economies of scale remain unknown.

Theoretically, investors in the biofuels industry may also face a dynamic investment problem because in the near future, more cost-effective technologies can supersede current technologies. However, in our view, current technologic progress becomes less of a concern than the ability of cellulosic technologies to compete with corn- or petroleum-based feedstocks.

As a result, engineers and scientists must answer the question, "What is the actual likelihood that a breakthrough in technology will occur, allowing cellulosic ethanol to become cost-competitive with corn-based ethanol, not to mention petroleum?" Therefore, producing a "commodity fuel" from a "commodity agricultural product" necessitates being the low-cost producer.

Policy Risk

Significant policy risks confront investors or producers interested in participating in the biofuels industry. As previously mentioned, the VEETC continues to founder in political limbo and, as of this writing, its future beyond 2011 remains unclear. Accordingly, in our view, long-term prospects for continuing the VEETC as well as the biodiesel tax credit remain poor and if either survives Congress again will likely reduce the current levels of each. Cellulosic and corn-based ethanol producers will likely compete against each for political support, which has already occurred in the form of modifications to the RFS for 2011. The inability of cellulosic and other advanced biofuels to meet the quotas established in the EISA continues to result in a political push by corn-based ethanol advocates to capture some of that production quota for the latter biofuel. Therefore, stakeholders should monitor the relative political support for the various feedstocks, particularly in light of the current budget uncertainty for biofuel incentive programs.

As a final assertion, a number of significant contractual issues must be overcome for a nontrivial biofuels industry to arise in the Southeast—in particular, developing an economically viable supply chain of feedstock production facility end-users. Many proposed biofuel production systems will require vast volumes of feedstocks. With the exception of large-scale timber companies, large private landowners will likely comprise most producers of these feedstocks, which also will require an extensive number of contractual relationships to provide the volume needed to operate a cellulosic-based facility. Owners of these facilities will need to provide long-term guarantees for producers to establish the crop. Consequently, both the feedstock producer and the facility operator will likely encounter significant risk management issues in terms of yields and throughput requirements, respectively.

Conclusions

First and foremost, we maintain agricultural economists who evaluate biofuel opportunities in the Southeast must move beyond simple net present value analysis to do this industry justice. As we note, the biofuels industry faces technologic, policy, market price, and input supply risks. Therefore, economists, investors, and policymakers must understand the necessity of a mechanism that accounts for these risks for significant investments in new technologies to occur. Moreover, such risks will require continued management by the investors and producers contemplating entry into biofuel industries. Second, as expectations increase for agricultural and applied economists to work with the "hard" scientists investigating new technologies and production systems, the former should constantly remind the latter of the stark differences between technical feasibility and economic feasibility. Furthermore, technology is of little or no value until it becomes economically feasible. In the development process, economists should remind other scientists to include all of the relevant costs when evaluating a technology and recognize the economies of scale repeatedly demonstrated in commodity-based production systems. Investors, who actually fund the development and construction of new production systems, will require more proof than word of mouth that such economies do not exist. Finally, agricultural economists should focus on the current government incentives driving investment in biofuels, in particular the Renewal Fuel Standard (RFS). Agricultural economists should continue to investigate its effects on crop and livestock markets, especially because the RFS can represent a nonstatic quota in some instances. In conclusion, if agricultural economists can concentrate on these three objectives, in our opinion they can significantly contribute to the debate and dialogue in this emerging agriculture-related sector.

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