What We Know and What We Need to Know

On Biofuels, Food, and Feed Tradeoffs[1]

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My charge this morning is to try to summarize based on this conference and other sources our current state of knowledge in the renewable fuel area with respect to tradeoffs between biofuels, food, and feed. As you know, the title of this presentation is what we know and what we need to know. Summarizing our knowledge base in this area is a daunting and huge task.

One thing we know that applies to all of the areas that I will discuss later is that we are dealing with huge uncertainty. We are dealing with large shocks to the food and agricultural system, which makes it very difficult to model. Our conventional modeling techniques usually work well with small shocks and incremental changes. In the biofuels arena, today we are not in that realm; rather, we are dealing with very large shocks, and understanding the impact of those shocks brings us into uncharted waters. We will need to use simulation models and other techniques to try to get a better handle on what the ultimate impacts of this new course will be.

My summary will be divided into four general topic areas: corn based fuels, cellulose based fuels, global impacts, and economic analysis. For this paper version of my remarks at the conference, I have chosen to present the material in table format. Table 1 summarizes the corn based fuels; Table 2, the cellulose based fuels; Table 3, global impacts; and Table 4, economic analyses.

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[1] Presentation concluding the Farm Foundation/USDA conference on "Biofuels, Food, and Feed Tradeoffs," St. Louis, MO, April 12-13, 2007.

Table 1 – Corn Based Fuels

What We Know	What We Need to Know
• We know that the technology works and works well. We also know that under the current policy regime and oil prices, production will continue to grow until the price of corn chokes off increased growth. Most people feel that with no change in policy or oil prices that is likely to be around 15 billion gallons of corn ethanol.	• We don't know what will happen to the price of ethanol as production increases. At today's ethanol production levels, ethanol commands a premium because of its value as an octane enhancer and oxygenate. However, most feel that as production increases and the oxygenate and octane additive values diminish, ethanol pricing likely will move towards gasoline on an energy equivalent bases. In other words, ethanol ultimately could be valued at about 70% of gasoline price. However, there are many uncertainties associated with that path and its timing.
• We know that corn and other feed ingredient prices will be substantially higher than historical norms. We also know that other markets will adjust to these substantial price changes. • We do expect that food prices will increase because of the higher ethanol demand, but perhaps not at a very high rate locally and globally at least initially. That is mainly true because agricultural commodity prices are a small fraction of food item costs except for livestock products.	• Some of the models that we've seen at this conference show that most of the response is in export markets. Others show that a good bit of the response is in domestic feed markets. The bottom line is that we really don't have a good idea what the reactions in other markets are going to be for a change this large. • We do not understand what will be the political reaction to rising food costs especially if shocks are larger than currently perceived.
• We do know that increased corn production will have some adverse environmental consequences.	• We don't know how large the environmental consequences will be either of the substantial increase of corn production or ethanol production.
• We can see early signs of considerable supply response capability in the United States in reaction to the higher corn prices.	• We don't have a good idea of what the supply response potential is in the rest of the world except perhaps for sugar cane in Brazil. Brazil has about 35 million hectares of land that could be put into sugar cane production without reducing area in soybeans.

• With the low stocks to use ratio project for the next few years, we know that we are more vulnerable to supply shocks. It is quite likely that commodity prices will be more variable than by historic norms.	• We don't have a good idea about how other markets will adjust in the rest of the world either to the higher commodity prices or the increased variability.
• If we stay with current government policy of a fixed subsidy per gallon of ethanol, we know that the government cost will rise quickly as ethanol production increases. • While most believe that corn ethanol will peak out around 15 billion gallons, some believe it could go much higher.	• We don't have a good idea of the government cost and other impacts if variable subsidy policies or fuel economy standards were to be enacted. • We have not evaluated the impacts of renewable fuel standards that might be partitioned between corn ethanol and cellulose based ethanol production.
• We know that there are tremendous logistical and transportation infrastructure implications of this energy revolution.	• We do not have a good understanding of all the logistics and transportation infrastructure changes. There will be changes in the flow of corn that will move toward ethanol plants instead of feed use or export markets. There will be changes required to bring the ethanol to market. There will be changes required to bring the distillers dried grains to feed and export markets. We simply do not have good analysis of the total impacts of all these massive changes in product flows.

Table 2 – Cellulose Based Biofuels

What We Know	What We Need to Know
• We know that liquid fuels can be made from cellulose materials using a variety of technologies – the famous technology pathways that have been outlined by DOE. We also know that with today's technology the cost of producing cellulose based ethanol is around $100 per barrel of crude oil on an energy equivalent basis.	• We do not know by how much the cost of producing cellulose based biofuels can be reduced nor over what time period that can happen. It is unlikely that the DOE goal of $1.07 per gallon of ethanol can be achieved, at least in the near term, meaning the next 5-10 years.
• We will be able to make substantial progress in reducing biofuels cost only with substantial investments in research and development, which we like to call an Apollo program for energy security.	• Even if we launch an Apollo program for energy security, we don't know how much we can bring down the cost nor how much time will be required to do so.
• We know that cellulosic raw materials are likely to cost $50-80 per delivered dry ton except in niche markets. The figure of $30 of dry ton that you often see is simply not in cards except in very special circumstances.	• We have some localized case studies of cellulose cost, but we need many more. As Tom Dorr indicated, cellulosic biofuel is a distributed system and will be local by its very character. • There has been very little analysis of the logistical implications of transporting all this cellulose to local plants. We must do more in depth studies on this topic.
• Cellulose yields are likely to be in the 5-8 tons per acre, perhaps as much as 10, but not the 20 tons per acre some are claiming.	• Cellulosic crops will have to compete for land with corn at $3.50 to $4.50 per bushel and other high value crops. We have not studied the implications of the interaction between high commodity prices and what it would take to increase substantially area in cellulosic crops.

Table 3 – Global Impacts

What We Know	What We Need to Know
• We know that the impacts seen in the U.S. markets for corn, soybeans, and wheat are not just U.S. impacts but are global impacts because the U.S. prices are really world prices.	• We do not know what these price changes will mean in terms of global production, trade, prices or poverty increases or decreases.
• We know that US and EU policies will have impacts that reach into every corner of the world.	• We do not know who will win and who will lose globally especially in developing countries. We simply must get a better understanding of these global impacts of rich country policies aimed at using more of their biological resources for energy instead of food and feed.
• We know that Brazil has tremendous potential to export sugar cane based ethanol to the US and other countries.	• We have not evaluated the impacts of a reduction or elimination of the US tariff on ethanol. We need to look at innovative policy alternatives that would permit some growth in ethanol trade that could, in fact, enhance use of renewable fuels in the United States as cellulosic ethanol is taking off.
• We know that there could be important greenhouse gas (GHG) consequences of a growing biofuel economy. Renewable fuels can have very positive GHG reduction impacts.	• We do not know quantitatively how important the greenhouse gas emissions reductions will be, and most importantly, we have not linked our own policies or economic incentives to greenhouse reduction. We need more work on innovative policy alternatives to credit renewable fuels for their contribution to GHG reduction.

Table 4 – Economic Analysis

What We Know	What We Need to Know
• Over the course of this conference we have seen four models with their different analyses of particular issues. The models use different assumptions regarding cost, yields, supply response, etc., and so they get different answers. In general, the size of the shocks supplied to the models, with perhaps one exception, are fairly small, so they don't give us a good idea of the implications of the large shocks we are now witnessing.	• While it may be impossible for analytical and or political reasons to get the models on the same page in terms of assumptions, we might want to get closer than we are now just to see if we can understand what the key drivers of the differences are.
• We know that we need better systems research that evaluates in a systems context the pros and cons of different energy options.	• A good example of where we need better systems research is in the use of distillers dried grain with solubles (DDGS). In this conference we have seen some good papers on this topic but we need more. Systems work is hard and requires us to interact closely with other disciplines, and for some of us, that takes us out of our comfort zone. But if we are going to be able to solve these problems, it is absolutely imperative that we do more of the systems work.
• We know that there is plenty of work that needs to be done and much of it needs to be done quickly.	• It is not at all clear that in the rush to fund technology research, our friends in DC will provide enough funding for economics and policy research. We must continue to work toward increased funding in these areas.
• We know that given all the uncertainties in moving to cellulose based energy production, finding ways of public/private risk sharing will be important.	• We need to do much more research into the risk reduction, government cost, and other impacts of a wide range of policy alternatives.
• We know that the policy choices and policy pathways that we follow will be absolutely critical.	• Let's figure out how we can do the analysis that is needed so that, as Keith Collins said, we leave it to choice, not chance.

No doubt I have left out many important points. I have tried to highlight the areas that seem to me to be most important. I thank you for your participation in this excellent conference. We have all learned a lot.