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NEW MARKETS FOR BIO-BASED ENERGY AND INDUSTRIAL FEEDSTOCKS

Biodiesel – Will There Be Enough?

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Introduction:

Biodiesel is a term that covers a broad array of fuels and fuel additives derived from various feedstocks each having specific properties. Biodiesel is commonly defined as a methyl or ethyl ester derived from vegetable oils, animal fats or various waste fats and oils.

Raw vegetable oils and fats, while exhibiting some characteristics of petroleum oil, are generally unsuitable for use in modern diesel engines without either modification to the engine or the fat source. A process known as esterification modifies the fat source in the case of biodiesel. In esterification the fat source is reacted with an alcohol in the presence of a catalyst. The reaction breaks the fat tryglyceride into its various individual components and yields a crude glycerin byproduct.

The esterification reaction converts the raw fat source into a material that is highly compatible with modern diesel fuels and diesel engine technology. In Europe the fat source is primarily rapeseed oil while the US primary feedstock is soybean oil.

Market Penetration:

The question posed by USDA Outlook Conference Organizers, “Will there be enough?”, can not be answered without the answer to another question. For what?

Nearly 75 percent of diesel fuel use is for on-road transpiration. Rail, marine and other off-road applications consume the transportation balance. Diesel fuel use in these applications dwarfs the current and future production capabilities of the vegetable oil and animal fat industry. Hence, petroleum based hydrocarbons will continue to be the workhorse for diesel engines as far as the eye can see.

Does that mean that there is no place for biodiesel? No. Keep in mind that ethanol, a fuel that has been in commercial production since the 1930’s, now has a market penetration of just over one percent of the gasoline pool. That one- percent market penetration accounts for over 500 million bushels of corn – or about 5 percent of the crop. While a drop in the gasoline bucket, ethanol is an important contributor to the total demand for corn.

It will be a long time before biodiesel reaches the market penetration level of ethanol. However, there are niche markets where the unique properties of biodiesel have their place. These niches are beginning to open up and will continue to emerge due to factors I will discuss a little later.

First lets take a look at the current and potential raw material availability.

Raw Material Availability:

Soybean oil is the mother of all oils in the United States. Soy has about an 80 percent market share that has held steady for over 20 years. In addition, soybean acreage has recovered to levels not seen since 1980. Around 10 million acres of soybean were lost in

the early 1980's due to depressed returns and the attractiveness of farm program crops such as wheat, feedgrains, cotton and rice. Provisions of the 1980 Farm Bill allowed farmers to grow their program crop base. Soybeans did not have a target price or deficiency payments at that time so farmers reacted to the government signals by switching to protected crops. The 1985 farm bill corrected the "race for base" signal but did not allow planting flexibility or subsidy neutral income and price supports. By 1990, "triple base" and 0/92 provisions began to encourage market-based planting decisions. Soybean planting began a slow rise as a result. The 1996 Freedom to Farm legislation decoupled income supports from planting decisions and unleashed pent up demand for soybean crop rotations. Today soybean acres and production are at historically high levels. Most analysts see some continued increase in soybean acres but then a leveling off as farmers reach an agronomic equilibrium.

Near Term Soybean Oil Availability:

For purposes of this paper I will assume a near term soybean crop of around 3 billion bushels, domestic crush of 1.8 billion bushels and oil yield of 11 pounds per bushel.

I will also assume that human food use will always prevail in the demand equation. This is logical from an economic perspective since there are few substitutes for food and many substitutes for energy and industrial feedstocks. As evidence one need only look to the market response of ethanol producers in 1995 when corn prices reached historically high prices. Ethanol plants, even with tax exemptions for their product, could not compete with feed markets when corn was rationed by price.

Soybean oil carryover has drifted between 1 and 2 billion pounds over the recent past. For assumption purposes I believe that biodiesel could only count on being able to pull 1 billion pounds from the available domestic carryover without raising short-term prices beyond those that would curtail the biodiesel industry. At a conversion rate of 7.7 pounds per gallon, about 130 million gallons could be produced from the expected soybean oil carryover. Other edible oils have been disregarded for this exercise. They account for around 2 billion pounds of total consumption and are from sources such as corn, cotton and sunflower Oils from these feedstocks are typically higher priced than soy and unlikely to be used for industrial purposes.

Assuming a total transportation diesel fuel use of over 40 billion gallons, 130 million gallons represents just three tenths of percent of total use. However, 1 billion pounds of soybean oil represents nearly 7 percent of total domestic soybean oil use of around 15 billion pounds.

Near Term Animal Fat and Waste Grease Availability:

Unlike soybean oil, animal fats and waste greases do not have a large supply carryover from which to draw. Animal fats and waste greases are rendered or processed for use primarily in the feed markets as a cheap sources of energy. They are consumed as they are made available. Supply is a byproduct of other activities such as animal slaughter and fast food preparation. Products clear the market at whatever prices it takes. Although not always true, the

price of these fat sources generally rises and falls with the price of soybean oil.

The price discount between these feedstocks and soybean oil can vary from 25-75 percent. An apples to apples biodiesel price comparison using different feedstock assumptions is difficult without knowing the quality of soybean oil and the quality of alternative feedstock used as a beginning point in the conversion to biodiesel. Generally, conversion yields are lower and processing losses higher for lower quality feedstocks with higher free fatty acid contents. It is estimated that total raw material availability from these sources is around 2 billion pounds. At the right price and assuming no technical barriers, a significant portion of these feedstocks could be bid away from their current feed uses toward energy and industrial feedstocks uses.

However, a significant demand increase from the fuel side will quickly drive non-soy feedstock prices up to the price of soybean oil. This result can be predicted due to the byproduct nature of the raw materials. There is little domestic supply response as a result of a demand increase. At some price point users will either reduce usage and/or switch to soybean oil and vegetable oil byproducts as substitutes for the animal fat and waste grease materials.

For purposes of this paper, and without a complex computer model, I have assumed that biodiesel could pull .500 to 1.0 billion pounds of material from the non-soybean oil sectors. This converts to between 65 and 130 million gallons of biodiesel.

Total Current Domestic Availability:

130 million gallons from soybean oil

65-130 million gallons from alternative feedstocks

Total equals 195 to 260 million gallons or at maximum, six tenths of one percent of total diesel fuel use.

Esterification Capacity:

It is important to note that the above domestic availability does not consider the available esterification capacity. There are few reliable estimates of actual esterification capacity. The literature evidences 10-15 million gallons of dedicated biodiesel capacity. However, these numbers are dwarfed by the esterification capacity of the oleochemical industry. Esterification and transesterification are processes long used by the oleochemical industry as front-end processes in the manufacture of soap, detergents, cosmetics and other products. Again, few reliable estimates are available to document the surplus or swing capacity of the oleochemical industry to make biodiesel. One oleochemical company has claimed surplus domestic capacity of over 40 million gallons.

If demand were sufficient, this author believes that between 50 and 100 million gallons of capacity could be called on in the immediate or near future without significant construction of new plants.

Future Raw Material Availability:

Future raw material availability for biodiesel production is significant. Additional sources include expanded soybean acreage, higher oil soybeans, higher oil soybean substitute crops, and high oil substitute crops for non soybean areas, greater domestic crush of soybeans otherwise going to the export market and imports of foreign oils or their esters.

Expanded soybean acreage:

Soybeans could capture another 10 million acres due to global increases in demand for protein fed meat such as poultry and pork. These acres will primarily be drawn from small grains such as wheat where US comparative advantage is slim or nonexistent. If all the additional oil were available for fuel, the supply impact would be an additional 500 million gallons.

Higher oil soybeans:

If the soybean oil yield were to increase from 18 percent to 20 percent – a level already achievable – soy oil availability would increase by 10 percent. At an assumed future domestic crush of 1.8 billion bushels the additional oil would amount to 1 pound per bushel or 1.8 billion pounds or 230 million gallons.

Higher oil crops:

Sunflower and canola are crops with higher oil content than soybeans. Depending on yield assumptions either crop could produce 10 gallons per acre more oil than soybeans. Additional oil could come from switching out of soybeans to these oil crops or from switching out of other crops to sunflower or canola. Alternative oilseeds are climatically compatible with the northern tier and high plains states. These are primarily wheat and other small grains growing areas. Coincidentally, these are the areas with the highest concentration of Conservation Reserve Programs (CRP) government idled ground. Ten to fifteen million acres could be freed up to plant oil crops simply through release of the government ground. A conservative 10 million-acre CRP release could yield 600 million gallons of biodiesel raw material without drawing acres from other crops.

Another 20 million acres could switch from lower value small export grains to higher value domestic oil crops. Switched acres would come from those currently used to supply the highly competitive and still distorted export markets for wheat and other small grains. These acres could yield another 1.2 billion gallons of raw material.

Expanded Domestic Soybean Crush:

About 1 billion bushels of soybeans can be exported assuming a crop of around 3 billion bushels and a domestic crush of 1.8 billion bushels. If the value of oil began to exceed the value of protein, crush would expand and additional oil would be available. Similarly, if protein were to lead the way, crush could expand and additional oil would be available. The bottom line is that roughly 11 billion pounds of oil leaves the United States in the form of raw soybeans. At the right oil or protein price levels crush will expand and additional oil will become available. The biodiesel raw material equivalent is 1.4 billion gallons.

Imports:

Lurking out beyond our shores are hundreds of millions of pounds of raw materials in the form of animal fats, waste greases, and raw fats from various sources. At the right price, our virtually open boarder policy will allow the entire planet to supply US demand for biodiesel.

Obviously, for a domestic biodiesel producer the prospect of imports is not savory. However, reality is that commodities will find a home where their value is greatest when borders are open. Any significant run up in domestic prices will draw imported materials to meet the demand.

In this sense, imports provide a consumer supply safety net should spot shortages of domestic demand occur due to weather or other unforeseen circumstances.

Conclusions:

As you can see from the above, current and future raw material availability far exceeds current and future predicted demand based on the expected price uncompetitiveness of biodiesel versus diesel. Without significant tax exemptions or use requirements biodiesel must slug it out in the alternative fuel market or as a small component of diesel fuel formulations. I have estimated near term raw material availability at 195-230 million gallons or three tenths of one percent of transportation diesel fuel use.

My longer range estimates of availability from increased soybean oil acres, soybean oil content, idle acres, switched acres, increased domestic soybean crush amount to nearly 4 billion gallons

However, as I said at the outset, is a niche fuel or fuel additive and in this sense does not compete against diesel. In fact, neat or high blend (20 percent) biodiesel only makes sense in those markets where alternatives to diesel have been demanded by the government or consumers. In the non-alternative fuel markets, lubricity, health and environmental benefits of biodiesel may give it a place in the diesel fuel formulation. Ag Processing Inc and our marketing subsidiary, Ag Environmental Products LLC see diesel and diesel technology as the only viable short term solution to increasing transportation efficiency. In their government sponsored effort to find the 80-mile per gallon car, auto manufactures have come up with the diesel/electric hybrid. A new idea? Not really, locomotives have used this concept for 40 years. The point is that if the United States were ever to get serious about fuel economy, the medium duty (yes that means pickups and SUV's) and the light duty fleet would need to be converted to diesel technology. Ironically, in the rest of the world were fuel is not so cheap, diesel is a major force in the light and medium duty market.

While inherently more efficient and therefore more environmentally friendly, the US environmental structure is more hostile to diesel than in other countries. NOx and particulate matter emissions are a real challenge for diesel given the US EPA and California Air Resources Board (CARB) direction on air pollution. Over time however, we believe that biodiesel will have a role to play in helping diesel through a transition to becoming a cleaner and more environmentally friendly fuel. For example: ultra low sulfur fuel is being considered in California. The lubricity problems with low sulfur fuel could be a fit for biodiesel. On the health front, some components of diesel particulate matter have been identified as potential carcinogens. Recent EPA Tier I health effects testing show very positive results for biodiesel speciated particulate matter emissions.

In addition, if the talk about the need to reduce greenhouse gases ever turn into something real, biodiesel value will increase substantially due to the closed carbon loopnature of a renewable fuel source.

Back to the question. Will there be enough biodiesel? The "For what?" question can be answered with some already scripted or conceptual goals. The Energy Policy Act set a goal of alternative fuel displacement of 10 by 2000 and 30 percent by 2010. We are nowhere close. However, under the right set of incentives or use requirements the supplies would be available to at least get to the 10 percent level by 2010.

Executive Order 13134 set goal to triple use of biobased products which could certainly be reached under the material availability scenario laid out above.

A proposal has been drafted by the Administration to require an 8 percent renewable energy portfolio as part of the energy deregulation policy.

Again, with the proper incentives or standards the goal could also be met in the transportation sector.

A less ambitious, but probably more practical proposal has been floated on Capitol Hill to require a two percent renewable content standard for fuels over time. For diesel, assume a 40 billion gallon baseline, the renewable standard would require 80 million gallons of biodiesel. While these numbers seem small compared to the availability outlined above, it would in my mind be an achievable target that if phased in over time could be met by domestic sources without disruption to the agricultural or energy markets. It would require over 600 million pounds of raw material and a probably doubling of production capacity.

The University of Missouri-Columbia (FAPRI) has estimated that this level of increased demand would boost the value of the crop by $300 million annually (if all the demand was supplied by soybean oil). Last year Congress provided $475 million in extra assistance for soybean farmers due to low prices. Maybe now is the time to consider demand oriented policies rather than unpredictable and highly political emergency farm legislation.