Biofuels and Agriculture

A Factsheet for Farmers

Biofuels For Sustainable Transportation

American farmers have a great opportunity, now and in the coming years, to help make the nation more self-sufficient in energy, and to reduce air pollution, including emissions of "greenhouse gases". Advances in technologies for making "biofuels" like ethanol and biodiesel mean that new markets are opening up. These can provide extra farm income, help to revitalize rural communities, and improve the environment at the same time. Corn ethanol has been around since the 1970s, but national production is going up fast and costs are coming down – and now there are new ways to make ethanol from a variety of agricultural raw materials, as well as growing markets for other biofuels like biodiesel.

What are biofuels?

Biofuels (short for "biomass fuels") are liquid transportation fuels that substitute for petroleum products such as gasoline or diesel. They include ethanol and biodiesel (a vegetable oil product) made from agricultural crops and residues, forest residues, or other kinds of plant-based "biomass feedstocks".

Ethanol is typically made from plant biomass by pretreatment, fermentation and distillation, in much the same way that beer and liquors are produced. Many vegetable oils, such as soybean oil, as well as animal fats, and recycled cooking greases can be chemically converted to diesel-like fuel called biodiesel. These fuels can be used in conventional engines with little or no modification.

Did you know that Henry Ford expected the first Model T automobile to run on ethanol, and Rudolf Diesel designed his prototype engine to run on peanut oil?

Raw materials for making biofuels, now and in the future

A range of raw materials are available, some already in use and others which will supplement them in the near-term and longer-term future. For example, fuel ethanol is currently produced from the easily fermented sugars and starches in grain and food processing wastes. Biodiesel is made from oil-seed crops such as soybean and canola.

Soon, new technologies will be economically viable for converting plant fiber to ethanol. A portion of the agricultural and forestry residues (stalks, leaves, branches) which are presently burned or left in the field may therefore be harvested for biofuel production. Residues such as corn stover may represent a very large resource – over 100 million tons nationwide. The U.S. Departments of Energy and Agriculture are cooperating on research to determine how much corn stover can be removed sustainably.

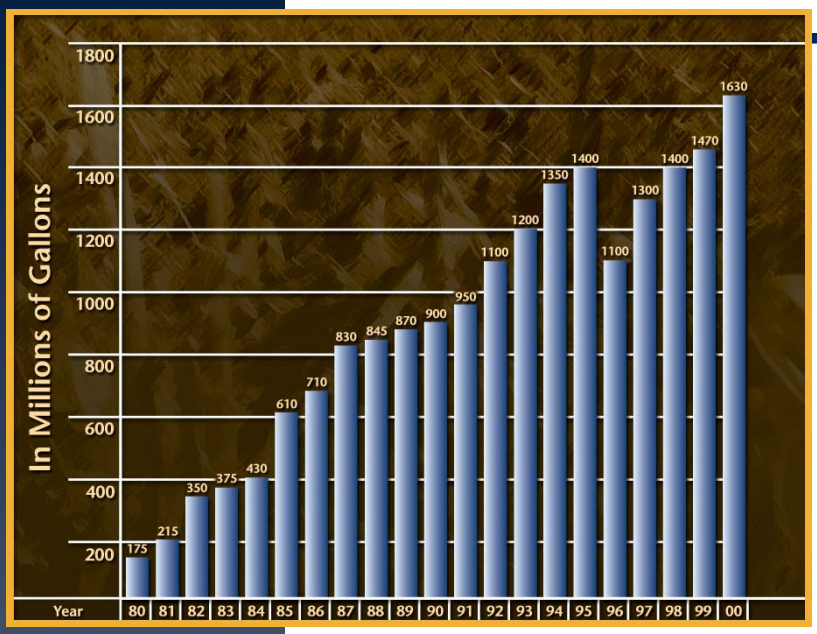
New crops may be grown specifically for biofuel production, including native grasses and trees, as well as new high-yielding varieties of oil-seed crops. In time, these energy crops may be planted in place of millions of acres of surplus arable crops, surpassing even corn stover as an energy resource. Switchgrass is a high-yielding perennial grass that grows well over most of the central and eastern United States. Fast-growing trees, which are usually harvested every 3-10 years and can be harvested repeatedly, include poplar and willow in cooler regions, and sycamore and sweetgum in warmer regions.

Current biofuel production and growth opportunities

Ethanol Production

The ethanol industry currently employs about 200,000 people (directly and indirectly), and saves $2 billion a year in terms of oil imports. However, America's present trade deficit in crude oil is over $50 billion, so there is plenty of room for growth. Ethanol's total benefits in terms of farm incomes are greater - about $4.5 billion. There are over 60 ethanol production plants in operation or under construction,

Ethanol production plant, Nebraska.



Growth in U.S. fuel ethanol production. (source: Energy Information Administration/ Renewable Fuels Association)

with the capacity to produce more than 2 billion gallons (7.6 billion liters) a year. Ethanol plants are found in 20 states, mostly concentrated in the corn-growing region of the Midwest. 22 of these plants are farmer-owned facilities, representing one-quarter of total capacity.

Future Market Potential

Today, about 12% of US gasoline contains ethanol as a fuel additive, which boosts octane and reduces carbon monoxide and other emissions. Another 25% of US gasoline contains an additive called MTBE which has caused concerns about water pollution. State legislation in California and nine other states to ban MTBE in reformulated gasoline by 2003/2004 is likely to generate a significant new demand for ethanol. USDA has estimated that this would result in an extra $1 billion in farm cash receipts annually, while ethanol production could more than double within the next 5 years. An estimated one billion gallons of new ethanol production capacity is already on the drawing board, about 35% of this based on non-grain feedstocks such as agricultural and forestry residues. Doubling ethanol production would create a demand for an additional 800 million bushels of corn, or 20-25,000 tons of corn stover, other residues, or switchgrass.

Corn Stover

With good planning and sufficient research and development, the first commercial plants producing ethanol from stover could begin operation as early as 2010. However, there are important reasons for farmers to be thinking about collecting stover today. Depending on your own particular conditions, this may require significant changes to your harvesting and tilling practices. Some small-scale markets for stover already exist, e.g. mulch production, so it may be worth while experimenting with an eye to future markets. Farmers are likely to play a key role in making cellulose-to-ethanol technology a success. For obvious reasons, corn stover is already available in the same areas where corn-to-ethanol plants are located, and this may enable the development of more cooperatively-owned ethanol plants.

Biodiesel Production

The biodiesel industry is much smaller, but growing fast. Enabling legislation to promote biodiesel use is advancing rapidly, and more state and federal vehicle fleets (e.g. the U.S. Postal Service) are starting to use this fuel. About 20 million gallons (76 million liters) of biodiesel were actually produced in 2001, but U.S. capacity is already 50 million gallons (190 million liters) per year, and growing.

Biodiesel can now be used in blends of 20% and higher to meet federal and state alternative fuel vehicle fleet requirements, due to legislation under the Energy Policy Act. A number of city bus fleets, such as Cincinnati and St. Louis, are beginning to use biodiesel on a large scale, and legisla-

tion requiring statewide use of a 2% biodiesel blend have been proposed by the legislatures of Minnesota and North Dakota. These two states alone would create a market for 20 million gallons (76 million liters) per year. The ultimate market for biodiesel over the next few years could reach as much as 2 billion gallons (7.6 billion liters) per year, or about 8% of highway diesel consumption.

Overall Economic Benefits

Establishment of major new biofuel industries in rural areas is likely to have substantial economic impacts. Preliminary estimates by Oak Ridge National Laboratory suggest that ethanol production from corn stover alone could result in $8.9 billion in industrial output and $3.8 billion in value added, creating about 76,000 permanent jobs. Another study, for switchgrass production, found that total US farm income could increase by $6 billion. At the local level, a USDA study estimated that a 100 million gallons/year (380 million liters/year) ethanol production facility would create 2,250 local jobs for a single community. The National Biodiesel Board estimates that inclusion of just 1% biodiesel (partly replacing sulfur as a lubricity additive) in all road diesel fuel would generate demand for 300 million gallons (1.1 billion liters) of biodiesel adding more than $800 million to gross farm incomes.

Environmental Benefits

Biofuels, when blended with conventional fuels, reduce air pollutant emissions such as sulfur, particulates, carbon monoxide and hydrocarbons. Ethanol and biodiesel are also less of a hazard if they spill or leak, since they are rapidly biodegradeable in water. Substituting biofuels for one gallon of gasoline or diesel saves up to 20 pounds of carbon dioxide emissions to the atmosphere, since they are made from carbon "recycled" by plants instead of carbon dug out of the ground in the form of fossil fuels.

Growing perennial energy crops in place of surplus annual crops can reduce soil erosion and compaction, as permanent deep root systems develop and enrich the soil. Perennial crops need less tilling and less agrochemical inputs, so they may help to improve the quality of waterways. Their sturdy root systems and more permanent canopies offer a wider variety of habitats for birds and beneficial insects, compared with annual row crops. Levels of soil carbon may increase under perennial crops, helping to offset some fossil-fuel carbon dioxide emissions. Soil carbon sequestration may even occur under intensively-managed annual crops with limited residue removal, such as the harvest of about half the available corn stover. However, the optimal sustainable level of stover removal will depend on many factors, including erosion control, moisture retention and planned tillage reduction, and will be highly specific to local conditions and topography.

In the future, there may even be financial opportunities for farmers through rewards for good stewardship of the land in terms of "carbon credits". A number of US electricity utilities are already showing an interest in future trading of carbon emissions and offsets.

Great times ahead for biofuels

So next time you hear your neighbors complaining about fuel prices, tell them what U.S. farmers can do! American agriculture can help not only to reduce our dependence on imported oil - a growing domestic biofuels industry will also assist in ironing out the ups and downs of energy costs, and can also contribute to storing carbon in the soil. In a few years your neighbors will probably be using biofuels themselves, or will know someone who does!

Conversion factors for biofuels

- A bushel of soybeans (60 lb or 27 kg) yields about 11 pounds (5 kg) of soybean oil, making 1.5 US gallons (5.7 liters) of biodiesel
- A bushel of corn (56 lb or 25 kg) yields about 2.5 US gallons (9.5 liters) of ethanol
- A ton (2000 lb or 980 kg) of corn stover will yield about 80-90 US gallons (300-340 liters) of ethanol, and a ton of switchgrass will yield in the range 75-100 US gallons (285-380 liters)

For more information:

U.S. Department of Energy's
National Biofuels Program,
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America needs biofuels.

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