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AGRICULTURAL BIOFUELS:

Opportunities and Challenges in Michigan

by

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INTRODUCTION

Recent developments in the Middle East, an increasing awareness of the environmental impact of burning fossil fuels, and the economic struggles of rural communities have renewed interested in a class of alternative fuels produced from agricultural biomass. "Agricultural biomass" typically refers to agricultural crops, residue, and waste generated from the production and processing of agricultural products (such as soybeans and corn), food processing waste (such as used cooking oil), or animal waste (such as manure). Fuels made from biomass, often referred to as biofuels, have the potential to reduce the country's dependence on foreign oil, improve the quality of air and water in the State, and provide a value-added market for agricultural products. This paper provides a brief overview of three types of biomass energy: ethanol, biodiesel, and methane gas converted from manure. It also reviews biofuel use in Michigan and describes recent legislation designed to promote these alternative fuels.

ETHANOL

Background; Federal Initiatives

Ethanol is likely the most well-known and long-used type of biofuel. Produced by fermenting and distilling starch crops (traditionally corn) that have been converted into simple sugars, it was widely used as a lamp fuel in the 19th century and later was used to power the Model T. Eventually, cheap petroleum imports, the rising price of corn, and the higher energy content of petroleum compared with ethanol made gasoline the standard transportation fuel.

Although ethanol was used during World War II, demand for it after the war dwindled until the 1970s, when an embargo against the United States by OPEC (the Organization of Oil Exporting Countries) raised awareness of this country's dependence on imported petroleum products. Also, the passage of the Clean Air Act in 1970 allowed the U.S. Environmental Protection Agency (EPA) to regulate more closely emissions standards for pollutants like sulfur dioxides, carbon monoxide, ozone, and nitrogen oxides, which ethanol was shown to reduce.

In 1977, a blend of 10% ethanol and 90% petroleum, known as "gasohol", E-10, or unleaded plus, was introduced as a fuel extender. Shortly after gasohol was introduced, cases of improperly blended fuel caused some car parts to corrode. As a result, Michigan and other states adopted blended fuel standards and required pump labels to identify gas that contained ethanol. While some viewed this as a way to promote ethanol, others predicted that consumers would perceive the labeling requirement as a warning, rather than a promotion. Others worried that, without information about ethanol, consumers would choose gasoline not containing ethanol. This regulation remained in Michigan until Public Act 116 of 2003 removed the labeling requirement. More than 30% of all automotive fuel sold in the United States contains ethanol, according to the Renewable Fuels Association.[1]

More recently, ethanol has been used to increase octane and improve the emissions quality of gasoline. In 1990, amendments to the Clean Air Act mandated that areas with severe ozone pollution use reformulated gasoline, and that areas with high carbon monoxide pollution use oxygenated fuels during the winter months. The most commonly used additives for reformulated and oxygenated fuels are ethanol and Methyl Tertiary Butyl Ether (MTBE). The latter, however, has been discovered to contaminate groundwater and has been banned in 12 states, including Michigan. This has led to the increased use of ethanol as an additive.

Another Federal law, the Energy Policy Act of 1992 (EPAct), includes a number of both voluntary and mandatory measures meant to boost alternative energy use. The U.S. Department of Energy (DOE) implements these measures through two programs: the EPAct Fleet Regulations and Clean Cities. The Fleet Regulations require both Federal and state governments to acquire vehicles that run on alternative fuels. Since 2001, 75% of new vehicle purchases by state governments have been required to be alternative-fueled vehicles, or AFVs. Natural gas, propane, methanol, ethanol, and biodiesel all qualify under EPAct as alternative fuels. As of early 2003, the State of Michigan vehicle fleet included more than 500 AFVs, according to the Michigan Department of Agriculture.[2]

In partial response to EPAct's AFV requirements, in the mid-1990s auto companies began manufacturing vehicles that could run on two types of fuel: any blend of ethanol up to 85% (E85) and petroleum, or pure petroleum. These vehicles are known as flexible fuel vehicles (FFVs) and meet the AFV standards under EPAct. Flexible fuel vehicles usually cost the same as standard vehicles, and are more common than most realize. The Chrysler Town and Country 3.3L Minivan, the Ford Ranger Pickup 3.0L, the Chevrolet K 1500 Suburban and Tahoe 5.L, all are standard-equipped as E85 flexible fuel vehicles.

The EPAct's Clean Cities program contains voluntary measures to help communities develop the infrastructure necessary to decrease petroleum use. The program is organized around more than 80 volunteer coalitions throughout the country. According to the DOE, these coalitions "develop public/private partnerships that promote the use of alternative fuels and vehicles, expand the use of fuel blends, encourage the use of fuel economy practices, increase the acquisition of hybrid vehicles by municipal and private fleets and consumers, and advance the use of idle reduction technologies in heavy-duty vehicles".[3] In Michigan, the Cities of Ann Arbor, Detroit, and Lansing have established Clean Cities coalitions.

Environmental Benefits

According to the Renewable Fuels Association, the use of ethanol-blended fuel reduces every pollutant regulated by the EPA. Because it contains oxygen, ethanol-blended fuel contributes to a cleaner, more efficient burn of gasoline. The use of fuel ethanol lowers exhaust emissions of carbon monoxide and nitrous oxides (both of which contribute to the formation of harmful smog and ozone) and particulate matter (a contributing factor in respiratory disease).

Also, biofuels have the potential to reduce (or avoid contributing to) global warming by releasing less carbon dioxide into the atmosphere when the fuel is burned, compared with the amount released when fossil fuels (e.g., petroleum) are burned. This is because plant-based fuels have a "closed carbon cycle", which means that the carbon dioxide released when they are burned is later used by plants, which are then used as a feedstock to produce more biofuel. In contrast, when petroleum products are burned, they release into the atmosphere carbon dioxide that has been stored for millions of years; plants are able to recycle some, but not all, of the gas.

(Global warming is often confused with the greenhouse effect, which refers to the naturally occurring process that causes the earth's surface to be warmer than it would have been in the absence of an atmosphere. The greenhouse effect results because certain "greenhouse gases", including water vapor, carbon dioxide (CO_2), nitrous oxide, and methane, essentially "trap" energy from the sun and permit a life-sustaining environment. Global warming, on the other hand, refers to an increase in the earth's average temperature caused by human activity, particularly the burning of fossil fuels that release CO_2 into the atmosphere. Sometimes called the *enhanced* or *runaway* greenhouse effect, global warming has the potential to result in climate changes. Claims that global warming has been detected are controversial, however, and estimates of present and future effects are far from certain.)

Economic Benefits

Ethanol and its by-products add value to corn's raw value, and ethanol factories add jobs to rural communities. An acre of U.S. corn yields about 328 gallons of ethanol.[4] According to the Renewable Fuels Association, 195,000 people are directly or indirectly supported by the nation's ethanol industry, which includes jobs in agriculture, manufacturing, engineering, and construction.[5] Increasing the availability of ethanol could promote the growth of the ethanol infrastructure, leading to an increased demand for the product. Also, ethanol plants provide an opportunity for farmers to invest in the fuel's production; according to a report completed by LECG, LLC, a private consulting firm, farmer-owned ethanol plants account for 40% of total industry capacity.[6]

Challenges

The EPAct established a goal of 10% replacement of petroleum fuels by 2000 and 30% replacement by 2010. The 2000 goal was not met. A lack of consumer awareness and, more significantly, a lack of infrastructure for alternative fuels have contributed to this failure. Michigan, for example, has only three gas stations that sell E85 fuel. This is in part because ethanol cannot be transported via petroleum pipelines due to its corrosive properties, and because it can suffer water contamination or cross contamination with other petroleum products. Instead, it must be transported by truck or railroad to a blender or distributor to be mixed with gasoline. This increases the price of ethanol, as pipelines are much less expensive sources of transportation.

Further hindering ethanol use is that it must be 100% pure to be used for fuel, making it difficult to produce pure ethanol through conventional distillation techniques. As many as three distillation steps are needed to separate the 8% ethanol from the 92% water.

Also, when derived from the kernels of corn, E100 is not as fuel-efficient as is pure gasoline. Compared with a car fueled by pure gasoline, a car running on E100 averages 20% to 45% fewer miles per gallon.[7]

Despite the popularity of corn-based ethanol in the farming community, a Cornell University agricultural scientist concluded in a 2001 study that ethanol made from corn suffers from a fundamental input-yield problem; i.e., it takes more energy to make ethanol than the combustion of ethanol produces.[8] The Cornell researcher found that planting, growing, and harvesting an acre of corn required about 140 gallons of fossil fuels and cost about $347 per acre. The processing plants required even more energy to crush, ferment, and produce the pure ethanol for mixing with gasoline. The study concluded that about 70% more energy is required to produce ethanol from corn than the net energy it provides. Also, the study asserted that the environmental impacts of growing and harvesting corn are severe: Soil is eroded 12 times more rapidly than it can be reformed, and the use of groundwater to irrigate corn is 25% faster than the natural recharge rate of groundwater.

Although pure ethanol is more expensive to produce per gallon than is pure petroleum, some claim that government tax incentives and credits have lowered its cost so that ethanol can be marketed for a net cost below the price of wholesale gasoline. This means that ethanol can be blended with gasoline at no extra charge to the consumer, thus extending petroleum and reducing the cost of gasoline at the pump. On the other hand, critics contend that government subsidies should not indefinitely prop up a commodity that cannot support itself.

Future of Ethanol

There is little doubt that ethanol production is on the rise. One report estimated that ethanol production in 2004 would be about 3.5 billion gallons, 25% more than the 2003 record production of 2.8 billion gallons.[9]

In 2002, Michigan's first large-scale ethanol production facility opened in Caro. Michigan Ethanol, LLC, produces 40 million gallons of ethanol each year, and 30% of its stock is owned by Michigan corn-growers. The Caro plant also sells two valuable by-products of ethanol production: dried distillers grain, a high protein livestock feed; and carbon dioxide, which is captured and sold to the soft drink bottling industry and is used in a variety of other manufacturing applications.

Although corn has long been the most popular feed crop for ethanol, barley and wheat increasingly are becoming common feedstocks. Recently, ethanol has been produced from "cellusolic biomass" such as trees and grass (willow, poplar, and switchgrass, for example). Ethanol made from cellusolic biomass has comparatively higher fuel efficiency: Its miles-per-gallon are almost on par with the rate for petroleum.[10] In fact, an increasing number of ethanol production facilities are now using feedstocks other than corn. Georgia Pacific Paper, located in Washington State, produces 7 million gallons of ethanol per year from a pulping by-product.[11]

BIODIESEL

Background

Like ethanol, biodiesel is a renewable transportation fuel alternative to petroleum. As its name implies, biodiesel is used in diesel engines, rather than in gasoline engines. While diesel is a petroleum product, biodiesel is made from plant oils or animal fat through a chemical process called transeterification, in which the glycerin in fat or vegetable oil is extracted. The process leaves behind two products: methyl esters, the chemical name for biodiesel, and glycerin, a by-product usually sold for use in soaps or other products. Because the United States produces more soybeans than any other crop, domestic biodiesel is typically made from soybean oil. (In Europe, biodiesel is made from rapeseed oil.) Biodiesel also may be made from recycled vegetable oils, such as cooking grease from restaurants, although the Michigan Soybean Promotion Committee asserts that the use of virgin vegetable oils results in a higher-yielding fuel of more consistent quality.[12]

Similar to Henry Ford's Model T designed to run on ethanol, the first diesel engine to run on peanut oil was designed by Roland Diesel in 1899. Petroleum replaced vegetable oils a few years later as the standard transportation fuel, although vegetable oils were occasionally used for diesel fuel during the 1930s and 1940s.

Like ethanol, biodiesel can be used in its pure form ("neat" biodiesel, or B100) or in blends with petroleum diesel (denoted BXX, with XX representing the percentage of biodiesel). Unlike ethanol, any blend of biodiesel can be used in vehicles with little or no vehicle modification. Also unlike ethanol, biodiesel is compatible with the existing diesel refueling infrastructure, such as pipelines, storage trucks, and dispensing facilities.

Environmental Benefits

The lower environmental impact of biodiesel use has been well-documented. A comparative life cycle analysis of petroleum diesel and biodiesel fuels conducted in 1998 by the National Renewable Energy Laboratory within the Department of Energy confirmed this.[13] (Life cycle analyses estimate environmental impacts of the entire life cycle of a product; in this case, from feedstock extraction to fuel production, transportation, distribution, storage, and vehicle use.) The study concluded that B100 use reduced carbon dioxide emissions by 78%, compared with petroleum diesel; and B20 use in buses reduced CO_2 emissions by about 16%.

In June 2000, biodiesel became the first and only alternative fuel successfully to complete the testing requirements of the Clean Air Act. This testing compared biodiesel emissions in B100 fuel with petroleum diesel emissions and found that the overall ozone (smog) potential from biodiesel was 50% less; carbon monoxide from biodiesel was 50% lower; sulfur oxides and sulfates (major components of acid rain) from biodiesel were eliminated; and hydrocarbons (which contribute to smog and ozone) were 95% lower.[14]

Other environmental benefits include biodiesel's ability to biodegrade four times more rapidly than conventional diesel fuel. In the event of a fuel leak from an underground storage tank, the severity of water pollution would be greatly reduced.[15] Also, biodiesel's mutagenicity effect (the tendency to cause mutations in mammals) is substantially lower than that of diesel. Further, biodiesel has a higher flashpoint than conventional diesel, meaning it is less explosive. This makes movement and storage of biodiesel easier and less costly.[16]

In addition, the production of biodiesel is energy-efficient because it has a higher energy balance than any other fuel: For every unit of energy needed to produce biodiesel, 3.2 units of energy are gained. In contrast, a gallon of conventional diesel has a .9 energy balance, meaning that petroleum consumes more energy than it provides.[17]

Economic Benefits

The use of soy biodiesel provides an additional, value-added market for soybeans. One bushel of soybeans converts to about 1.45 gallons of B100.[18] Although soybeans are Michigan's second-largest crop, most of it is shipped to processors in Ohio, Indiana, and Illinois. The use of more soy biodiesel in Michigan would increase soybean demand in-State and likely raise the price of soybeans. (According to the National Biodiesel Board, a study conducted by AUS Consultants showed that, if the country increased its renewable fuel use to 4% by 2016, soybean prices would increase an average of 68 cents per bushel.[19]) Soybean farmers and the communities in which they live would stand to benefit. Further, increased soybean production could encourage biodiesel production plants to build in Michigan, resulting in more jobs and money kept in-State.

Other Benefits

Biodiesel substantially increases engine lubricity. While petroleum diesel is an excellent lubricant, protecting the engine, fuel injection pumps, and other parts from normal wear and tear, this is largely a result of the components of the fuel itself, including sulfur, rather than its viscosity. New EPA rules, set to take effect in 2006, will require that diesel fuel contain 97% lower levels of sulfur than currently allowed, which will significantly lower diesel's lubricity. Biodiesel, which contains no sulfur, acts as a solvent by loosening deposits from the inside of an engine. Biodiesel blends as low as 1% of biodiesel in conventional diesel have been shown to increase engine lubricity by 65%,[20] making it an ideal replacement for standard diesel under the new EPA rules.

Challenges

Biodiesel's lubricity can cause some engine parts of older vehicles to clog because it loosens old deposits that can choke the fuel filter. To remedy this, many recommend replacing the fuel filter shortly after using biodiesel. Also, since biodiesel breaks down rubber components, some parts in older systems, such as fuel lines and fuel pump seals, may have to be replaced after biodiesel use.

Biodiesel proponents maintain that biodiesel provides essentially the same fuel economy and engine torque and power as petroleum diesel. Others counter that, in some engines, there can be a slight decrease, about 10%, in fuel economy and power.[21] The National Biodiesel Board claims that, when used in blends at B5 or lower, no noticeable effect on fuel economy will occur. Although biodiesel emissions contain substantially fewer pollutants, the percentage of nitrous oxides (NOx) actually increases. Nitrous oxides are a contributing factor in the formation of smog and ozone. Pure biodiesel emissions contain 10% more NOx than do emissions from pure petroleum, while B20 contains 2% more NOx. According to the National Biodiesel Board, an additive developed by Clean Diesel Technologies can reduce NOx emissions 5% below those of petroleum diesel.[22]

Currently, the cost of biodiesel is higher than the cost of petroleum diesel, although the estimates of biodiesel costs vary significantly. The variables depend on feedstock costs, type, and size of the production plant, and estimated revenue from by-products. The website How Stuff Works reports that B100 can cost anywhere from $1.95 to $3.00 per gallon, while a B20 blend costs about 30 to 40 cents more per gallon than standard diesel. Other estimates put B20 at only 15 cents more per gallon than regular diesel.[23] According to the Michigan Soybean Promotion Committees, "It is obvious that unless diesel prices increase significantly, biodiesel would require either incentives or mandates to successfully substitute petroleum diesel."[24]

Federal Initiatives

To offset the higher price of biodiesel fuel, the U.S. Department of Energy has provided incentives and education programs through state energy offices. Michigan's Energy Office has a Michigan Biomass Energy Program located within the Department of Labor and Economic Growth (DLEG), and receives its primary funding from the Great Lakes Regional Biomass Energy Program. The Michigan Biomass Energy Program offers funding for State project grants, facilitates an ethanol working group, and works to increase the biofuel infrastructure in Michigan. Recently, the Program awarded $24,500 to the City of Ann Arbor to install public B20 fuel pumps at two Meijer fueling stations. The Ann Arbor Clean Cities Coalition, the Soybean Promotion Committee, and Meijer, Inc. contributed money to cover the balance of the project's cost.

Under a 1998 amendment to EPAct, state and Federal fleets may obtain AFV credits if the vehicles are fueled by at least a B20 blend. The Biodiesel Fuel Credit, as the amendment is known, took effect in 2001.

Future of Biodiesel

Fleets of city and school buses increasingly are using B20 fuel. In June 2004, the City of East Lansing received a $24,500 grant from the Biomass Energy Program to build a new biodiesel refueling storage tank for its city buses. In 2002, the St. Johns school district, located just north of Lansing, became the first school district in Michigan to use B20 in all of its buses. The district's record-keeping has demonstrated a cost saving since the district switched to B20 because, due to biodiesel's lubricity, engine oil is changed less frequently and fuel pumps last longer. Also, the district demonstrated that biodiesel use has increased the buses' fuel efficiency, from 8.1 miles per gallon (mpg) to 8.8 mpg. As of 2004, at least 18 school districts were fueling buses on biodiesel blends.[25]

According to the National Biodiesel Board, there were 21 biodiesel production plants in the United States (none in Michigan) as of 2003.[26] Farmers, universities, national and state parks, state and local government agencies, bus companies, nature centers, marines, and electric utilities increasingly are users of biodiesel.

METHANE DIGESTERS

Background

The conversion of animal manure into renewable energy has been the focus of research for decades. In the 1970s, methane digesters were built on farms to capture the methane emitted from the decomposition of manure and turn it into electricity.

Methane gas is produced by the anaerobic (without oxygen) decomposition of organic materials. It occurs naturally in swamps, water-logged soils and rice fields, deep bodies of water, and the digestive systems of termites and large animals. (Aerobic decomposition, or compositing, requires large amounts of oxygen and produces heat.) Methane digesters are concrete tanks or covered lagoons that take advantage of anaerobic digestion. This process produces two products: biogas, which is a mixture of methane and carbon dioxide and may be burned off or used to generate heat or electricity; and the remaining effluent.

The history of using methane for electricity mirrors that of ethanol and biodiesel. In 1890s, English scientists began recovering methane from sewage treatment facilities and used it to fuel street lamps. Again, when coal- and petroleum-based fuels became more readily and cheaply available, most of the Western world lost interest in methane recovered from waste as a source of energy. Methane-powered electricity saw a brief resurgence during World War II and then diminished until the 1970s, when the energy crisis created an interest in renewable domestic fuels.

Smaller-scale, lower-technology digesters have been used in the East for decades to provide biogas for cooking and heating, with varying degrees of success. China has begun to install large underground methane digesters as a method of manure management. In Europe, particularly Germany and Denmark, digesters have been used for both manure management and biogas production on large-scale farms.[27]

Environmental Benefits

Because a single dairy cow produces about 120 pounds of wet manure daily, managing animal waste is a significant part of farming. Most farmers apply manure to fertilize their fields, but doing so can result in strong odors that bother neighboring residents. In addition, spreading raw manure can cause pathogens like *E. coli* to be flushed into waterways, contaminating lakes and rivers. Spreading the effluent from a methane digester nearly eliminates the bacteria and odor found in manure, and adds essential nutrients (ammonia, phosphorus, potassium, and many trace elements) to the soil.

Perhaps most significantly, methane digesters greatly reduce the amount of methane that escapes into the atmosphere. According to the EPA, methane is 20 times more effective in trapping heat in the atmosphere than carbon dioxide over a 100-year period.[28] In excess, methane potentially may contribute to global warming. Most methane escapes when manure is managed in a liquid system, such as ponds, anaerobic lagoons, and holding tanks that are not covered. Installing a digester to burn off the methane can significantly reduce a major pollutant.

The waste treatment, odor reduction benefits, and methane reduction abilities of methane digesters are especially important to large-scale livestock operations such as dairies, feedlots, and slaughterhouses. Operations that stable or confine at least 700 dairy cows, 2,500 swine, or 10,000 sheep, among other animals, are defined by the EPA as Concentrated Animal Feeding Operations, or CAFOs. Compared with smaller operations, CAFOs are more likely to use ponds, lagoons, and holding tanks to manage manure, so methane emissions are more problematic. Further, manure odor from CAFOs is the single largest cause of complaint from the farms' neighbors. Methane digesters can help CAFOs reduce methane emissions and reduce odors.

Economic Benefits

Because methane digesters require energy to keep bacteria at a consistent temperature, their net energy output can be negligible. The Federal Office of Energy Efficiency and Renewable Energy estimates that biogas production for generating cost-effective electricity requires manure from more than 150 large animals.[29] Large digesters may produce electricity to cover some or all of a farm's electrical needs and, occasionally, produce enough electricity to be sold back to the electric company for a small profit. Increasingly, however, digesters are considered by most, including the Federal government, as a manure treatment option first and as a source of energy second.

Even a digester's small profit, however, can be an economic incentive to farmers. Conventional manure disposal generates no income and often is considered a liability because of its pollution potential. In addition to methane, other by-products of digesters may be profitable to farmers and diversify farm income. For example, when dried, the effluent can be used as a feed additive for livestock. The effluent itself may be sold as fertilizer.

Also, it can be argued that methane digesters could improve rural economies by employing individuals to provide, install, and maintain digester system equipment.

<u>Challenges</u>

Despite the promise of methane digesters, their use in most areas of the United States is limited. They are expensive to install and maintain, and may take at least five years to become profitable.[30] In addition, digesters suffer from a high failure rate. According to a 1998 study by the National Renewable Energy Laboratory, the average failure rate for all digesters is about 50%. Even those types of digesters with the best track record, covered lagoons, fail about 22% of the time.[31] This seems to be due to a number of factors, including: poor design, sand from livestock bedding making its way into the digester, processes that separate the methane from the carbon dioxide, and failure to control the temperature adequately. Overall, digesters that are additions to a farming operation, rather than part of its original design, tend to have a higher failure rate.

While methane digesters may help CAFOs better manage manure, they do not eliminate the farms' manure problems. Effluent produced from digesters still contains high levels of phosphorus and nitrogen which, when spread on fields, can seep into groundwater or run off into surface water. Excess nutrients in the water lead to low dissolved oxygen levels in lakes and streams, which can kill fish and destroy the natural habitat. Although methane digesters do reduce the methane that may contribute to global warming, they can increase the emissions of ammonia, another greenhouse gas, unless a separate ammonia stripper is installed. Further, while digesters do reduce the odor from CAFOs, they do not eliminate it. Excess manure in holding ponds emits odors, as do the exhaust fans installed in CAFO barns. With or without methane digesters, CAFOs face the fundamental problem of disposing of vast amounts of manure on a limited land area.

<u>Federal Initiatives</u>

The Federal government's AgSTAR program promotes the use of methane digesters in order to reduce methane emissions from livestock waste management operations, typically swine and dairy farms. Among other things, the program conducts extension events and conferences; operates a toll-free hotline; provides project development tools; and collaborates with Federal and state renewable energy, agricultural, and environmental programs.

The 2002 Farm bill created the Environmental Quality Incentives Program (EQIP) and the Renewable Energy Systems and Energy Efficiency Improvements Program. (The "Farm bill" is a reauthorization of Federal programs related to agriculture.) These programs offered grants for fiscal year 2003 to projects that improved environmental quality or developed renewable energy systems, respectively. Methane digesters qualified under both programs. Under EQIP, the grants covered up to 75% of the costs of certain conservation practices; under the Renewable Energy Program, the grant money paid up to 25% of eligible project costs, to a maximum of $500,000.

In addition, the Michigan Biomass Energy Program within DLEG distributes Federal grants that promote energy produced from digesters. Recently, the Biomass Energy Program provided a grant to Michigan State University to demonstrate a "fixed film" methane digester, and one to

Michigan Allied Poultry Industries for a feasibility study of the use of poultry litter to generate energy.

Future of Methane Digesters

Because the trend in farming is increasingly toward large-scale operations like CAFOs, it seems likely that methane digester use will expand. Due to the high cost of digesters and the public health benefits of reducing excess greenhouse gases, it also appears likely that government funding will continue to provide incentives for agricultural producers to build and use digesters. In order to improve its digester success rate, Michigan might want to study the use of methane digesters in other states, such as Colorado and Minnesota, as well as those in Germany, which has thousands of working digesters.

STATE LEGISLATION PROMOTING BIOFUELS

During the 2003-2004 session of the Michigan Legislature, several bills were introduced to promote agricultural biofuels or the use of alternative energy sources. With one exception, the bills were not enacted. Table 1 provides a summary of these bills and their status at the end of the session.

Table 1

Bill Number	Description	Status
H.B. 4010	Permit local units of government to extend property tax abatements to plants that manufacture biodiesel, and to electric generating plants fueled by biomass.	Public Act 5 of 2003.
H.B. 5942 (H-4)	Require all diesel fuel sold to include at least 2% biodiesel.	Reported from committee to the full House on 9-29-04.
H.B. 4015 & 4090 (identical)	Require the Public Service Commission (PSC) to establish a "net metering program" applying to all electric utilities and alternative electric suppliers in the State.*	Referred to House Committee on Energy and Technology on 1-28-03.
H.B. 4970	Require utilities to produce 9% of their electricity from renewable sources by 2007, increasing to 15% by 2013.	Referred to House Committee on Energy and Technology on 7-16-03.
S.B. 953	Provide for State loans up to $5 million to eligible farmers for the construction and operation of ethanol plants and methane digesters.	Vetoed by the Governor on 11-19-04.
S.B. 954	Require PSC to establish a net metering program*.	Referred to Senate Committee on Agriculture, Forestry and Tourism on 2-4-04.
S.B. 955	Exempt methane digesters from property tax.	Vetoed by the Governor on 11-19-04.

* "Net metering" allows a customer with an electric generator to interconnect with electricity distribution facilities, feed surplus power back to the electricity grid during periods when the customer's production exceeds consumption, and pay the electric supplier only for the net amount of electricity used over a billing period.

CONCLUSION

Agricultural biofuels offer a promising source of domestic, renewable, clean energy. Ethanol and biodiesel offer an additional value-added product for farmers of corn and soybeans, and perhaps, in the future, for growers of cellulostic biomass. The additional use of ethanol, biodiesel, and methane digesters could add jobs to rural communities and increase the demand for these renewable resources. Increased use of all three fuels would improve atmospheric and public health by reducing poisonous emissions that contribute to smog, excess greenhouse gases, and respiratory illness.

Of the three biofuels discussed in this paper, biodiesel appears to have the most promise for the immediate future. Biodiesel has the highest energy ratio, offers significant environmental benefits in addition to increased engine performance, and can be easily integrated into the existing petroleum infrastructure.

There is a long way to go, however, before ethanol, biodiesel, or methane gas will significantly reduce this country's dependence on imported petroleum products. This is due, in part, to a lack of infrastructure for the alternative fuels, and the lower price of petroleum compared with the cost of biofuels. If the price of gasoline and other coal products continues to climb, and technologies continue to evolve, alternative fuels are likely to become a less expensive, more readily available alternative to fossil fuels, for transportation and other purposes.

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