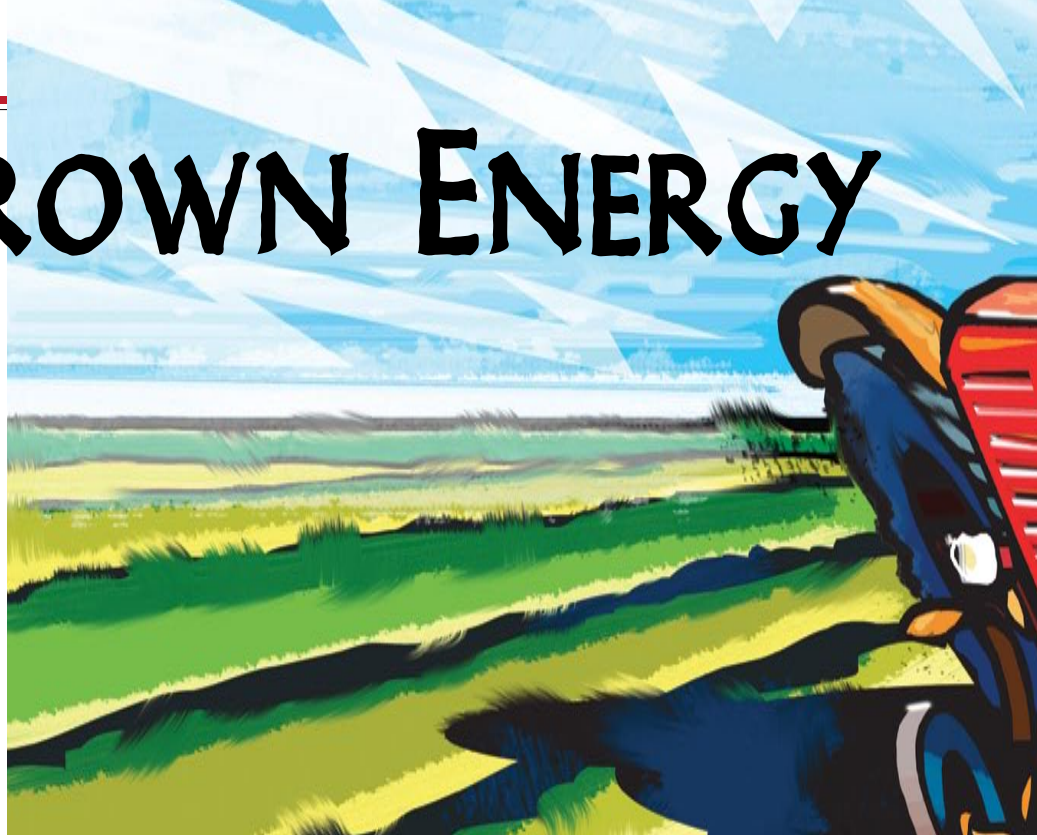
Homegrown Energy



As America copes with climate change, many see hope in biofuels.

BY GLEN ANDERSEN

Henry Ford designed his first automobiles, beginning with the Model T, to run on ethanol made from hemp and corn. At the beginning of the last century, biofuels were a major competitor with oil—the first diesel engines relied on vegetable oil until the 1920s. An ardent proponent of biofuels nearly 100 years ago, Ford knew that the world needed a substitute for gasoline. "The day is not far distant when, for every one of those barrels of gasoline, a barrel of alcohol must be substituted," he said.

Ford, like many modern biofuels advocates, believed in a future where renewable energy would boost rural economies and cut America's reliance on imported energy.

His vision faded when ethanol lost favor to cheap oil, but recent developments—including escalating oil prices, climate change and energy security concerns—have pushed biofuels to the fore once again. Biomass will be "the new petroleum," says James McMillan, manager of Biorefining Process R&D at the National Renewable Energy Laboratory. "Agriculture will provide feed, fiber and fuel."

BREAKING THE OIL ADDICTION

Americans have a voracious appetite for gasoline. At only 5 percent of the earth's population, we consume nearly a quarter of the world's oil. The problem with this addiction has become all too obvious in the last few decades—60 percent of the oil consumed in the United States is imported, making the U.S. economy vulnerable to volatile energy markets and political instability in other countries. The United States spent more than $251 billion on imported oil in 2005. But the external costs—which include capital leaving the country, loss of domestic investment, military investments to ensure safe passage of oil from unstable regions and the cost of periodic oil supply disruptions—added $780 billion to that number, according to National Defense Council Foundation. The foundation says these "hidden costs" add $4.10 to each gallon of gasoline made from imported oil.

Robert McFarlane, former national security adviser to President Reagan, says the economic threat of terrorism on the world's oil supplies is real. A recent terrorist attempt to blow up the world's largest oil processing facility in Saudi Arabia, where two-thirds of that country's oil is processed, demonstrates our precarious situation. The attackers came within 100 yards of the plant. Had they succeeded, they would have taken 6 million barrels of oil a day off the market for a year, tripling oil prices to more than $150 per barrel and sending the United States and the rest of the world into deep recession.

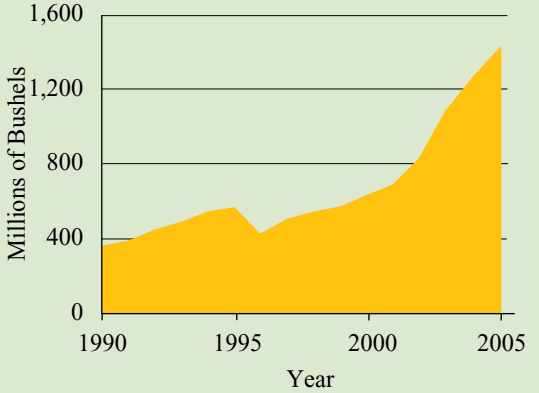
"It's only a matter of time before one of these attacks is successful," says McFarlane. At the Colorado Energy Summit in March, he stressed the importance of reducing U.S. oil independence through biofuels, plug-in hybrid vehicles, and increased fuel economy.

Kansas Representative Carl Holmes says energy security is "definitely a factor" in searching for alternatives to oil. "Whether you look at the threat from terrorism or hurricanes hitting the Gulf Coast, it just makes sense to look at all fuel sources."

Representative Jackie Dingfelder, who carried the renewable fuels standard that recently passed the Oregon House, concurs. "Energy independence and promoting the growth of industry in Oregon has played a large role in our support of biofuels," she says. "We would rather be keeping money in

REPRESENTATIVE
CARL HOLMES
KANSAS

CORN PRODUCTION



Source: National Corn Growers Association (2005).

Glen Andersen tracks environmental issues for NCSL.

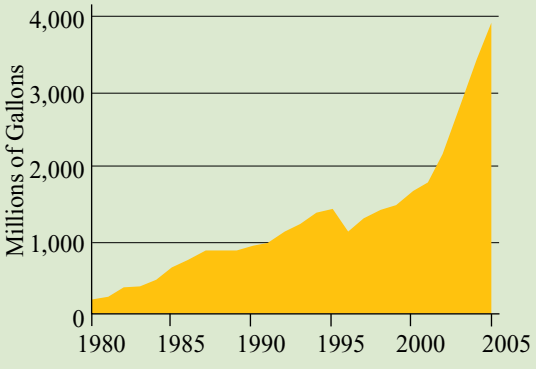
the state than sending it to fund petroleum exploration and development in foreign countries."

BIOFUELS TO THE RESCUE?

Many see biofuels as the most readily available and technologically feasible oil substitute, one that

REPRESENTATIVE
JACKIE DINGFELDER
OREGON

U.S. ETHANOL PRODUCTION SINCE 1980



Source: 1980-1997: Renewable Fuels Association, 1998-2005: Energy Information Administration, Monthly Oxygenate Report

Brazil's Ethanol Miracle

Brazil started a national ethanol program in 1975 to lower fuel costs and decrease dependence on foreign oil. The government provided low-interest loans for ethanol plants, guaranteed pricing and contracts for ethanol producers, and mandated that all gasoline be blended with 20 percent to 25 percent ethanol. Critical to Brazil's success, according to Mark S. Langevin, national organizer for the Brazil Strategy Network and professor at the University of Maryland, were public-private partnerships and incentives to produce "flexfuel" vehicles that can run on more than one type of fuel.

Despite a leveling out of oil prices in the '80s and '90s, Brazil saw the benefit of energy independence and continued to expand its ethanol program. The Brazilian government has since ceased its subsidies to the ethanol industry, which is now profitable, expanding and producing ethanol at prices below the cost of gasoline. "To get to this point, Brazil has made very interesting investments in research and development from the ground up," says Langevin. "They worked to improve the genetics of sugarcane, develop nonpetroleum-based fertilizers, and implement green harvesting techniques," which maintains soil nutrients and lowers energy consumption. Government incentives for vehicles that burn both gasoline and ethanol have also been successful—more than 90 percent of the cars sold in 2006 were flex-fuel. Due to lower oil imports, the country saved $43.5 billion between 1976 and 2000. Part of the success is owed to ingenious production techniques. Many ethanol plants in Brazil are powered by electricity generated from burning sugarcane waste, eliminating the need for fossil fuels. This method not only reduces greenhouse gas emissions, but allows facilities to produce more energy than they use, selling excess energy back to the utilities.

It is important to note that while we can learn from Brazil's successes, they can't be replicated in the United States for two main reasons. 1) Sugar cane is very different from corn, and requires less fertilizer, water and care, contributing to a much higher energy balance. Brazil has an excellent climate for growing sugar cane; the United States does not. 2) The United States consumes much more fuel per person. Brazil uses just 3 percent as much gasoline, so it can displace a large amount of its gasoline consumption with much less ethanol. Brazil consumes less fuel since it has fewer cars, more public transit and more fuel efficient vehicles.

WARREN GRETZ

Current ethanol production is primarily from the starch in kernels of field corn. NREL researchers in the DOE Biofuels Program are developing technology to also produce ethanol from the fibrous material (cellulose and hemicellulose) in the corn stalks and husks or other agricultural or forestry residues.

could reduce the reliance on imported fuel and provide economic growth for a brand new domestic energy sector that produces a clean, reliable and stable source of energy.

The possibility of creating a whole new industry, one that grows energy crops in addition to food crops, could shift the current energy paradigm dramatically. It could change the nature of agriculture in the United States and elsewhere.

"Rural economies in Oregon have really been hard hit and this is an option for them—there are already ethanol facilities being constructed in two rural communities," says Dingfelder. "Those are good paying jobs in rural areas that don't normally have a lot of economic diversity."

Both federal and state policymakers see this potential and are scrambling to become leaders and exporters of both bioenergy and the technology to produce it, a move which could have profoundly beneficial effects on what many consider a painful U.S. trade deficit.

America has been ramping up ethanol production the last 15 years, and is now responsible for 45 percent of what's made worldwide. More than 40 percent of the gasoline sold in the United States contains 10 percent ethanol. Ethanol and biodiesel are the most common biofuels. Ethanol is usually produced from sugar or starch crops such as corn. Biodiesel comes from vegetable oils or animal fats.

HOW MUCH OIL CAN BIOFUELS DISPLACE?

Biofuel alone can't quench America's thirst for gasoline. But it could if we can reduce demand, says McMillan from the National Renewable Energy Laboratory. If fuel efficiencies increase significantly, hybrid vehicles become standard and public transportation becomes more popular, the country would need significantly less fuel. Then, says McMillan, "biofuels could absolutely supply 100 percent of the market. If fuel efficiency does not increase … biofuels will do little to displace growing oil consumption."

A joint study by the U.S. Departments of Energy and Agriculture in 2005 estimates that resources are available to eliminate 30 percent of 2004 oil consumption by replacing it with homegrown biofuels. The report, called the "Billion Ton Study," assumes a very aggressive, concerted effort to make this transition. Meeting this target will require a five-fold increase in the harvesting of biomass, which includes crop residues, wood, perennials such as prairie grass, and other plant-based materials.

The role of vehicle efficiency as a counterpart to biofuels policy is not lost on state lawmakers. "We are interested in integrating fuel economy, but states are not allowed to set corporate average fuel economy standards," says Representative Dingfelder. Still, Oregon has adopted California greenhouse gas auto emissions standards, which may require biofuels and better fuel economy.

YELLOW GOLD?

The drive to produce ethanol from corn, currently the main feedstock for ethanol, has helped double corn prices in the last year, making it a much more profitable crop. Much of this has been driven by government policies, which include a federal incentive of 51 cents per gallon of ethanol produced (paid to the company that blends the ethonal with the gasoline) on top of state incentives and mandates. The United States also has a 2.5 percent duty plus a 54-cent tariff on imported ethanol to protect domestic processors. Since 1990, farmers have more than tripled the amount of corn produced in the United States. This massive increase has helped fuel a 4-fold rise in ethanol production since 1990. An estimated 5 billion gallons were produced in 2006, using 20 percent of the corn harvest, according to USDA. Ethanol now replaces a little more than 3 percent of U.S. gasoline consumption.

Although the push for ethanol has been an undeniable boon for some farmers, its impact has spread far beyond the corn field. Cropland values have increased and the demand for corn has driven up the prices of some foods, particularly those that rely on corn feed, such

Biodiesel, the Other Biofuel

CHARLES BIENSINGER AND RENEWABLE ENERGY PARTNERS OF NEW MEXICO

Biodiesel is made from crops like soybeans, rapeseed and palm oil, and from waste fats and cooking oils as well. It is already being used to supplement diesel fuel consumption, either by mixing it with diesel or replacing it entirely. Although biodiesel is more expensive to produce than ethanol, it has a much better energy balance, producing 3.2 units of energy for each unit invested, according to the U.S. Department of Agriculture. It also burns far cleaner than diesel which reduces greenhouse gas emissions. The United States produces far less biodiesel than ethanol, about 200 million gallons of biodiesel in 2006, which is just 0.3 percent of total diesel consumption. The pump cost of 100 percent biodiesel is still higher than diesel, even with federal tax credit of $1.00 per gallon. Still, biodiesel prices should come down as production increases and technology advances.

Although biodiesel production will be increasing, it may not yet be competitive enough with the cost of diesel to be produced in large quantities, unless technological advances in processing are made, or cheaper commodities are found to use in production. Biodiesel also has the problem of diverting important crops, such as soybeans, from the food supply. Non-food sources for biodiesel, such as farmed algae, may provided a source of biodiesel in the future.

as dairy and meat products. Chicken and hog farmers have seen production costs rise along with corn, because corn-feed makes up to 60 percent of total production costs for pork and 40 percent of production costs for chicken. Iowa pork producers, whose costs have gone up 40 percent, want ethanol tax credits and import tariffs eliminated. Officials in China are so concerned that ethanol demand has driven up food prices that they will allow no further increases in the amount of food commodities to be used to make ethanol. Instead, the Chinese government is investing heavily in new technologies to produce ethanol from wood chips and other plant materials.

Using corn to produce ethanol can also have negative environmental consequences. Corn tends to deplete the soil and relies heavily on fertilizer, which can pollute streams, lakes and underground aquifers. Water use is also an issue. Not only does corn take more water to grow than many other crops, a conventional ethanol plant uses four gallons of water for each gallon of ethanol produced. Technology is changing this figure, however; newer plants do not use as much water and there is potential for even more efficient plants in the future.

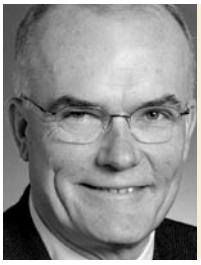
THE ENERGY EQUATION

The U.S. Department of Agriculture estimates that for each unit of energy put into producing ethanol from corn, approximately 1.34 units of energy are produced. (Using sugarcane, Brazil gets around 8 units of energy out for each unit of energy in.) Some also argue that when fossil fuels are used in the production of corn-based ethanol, it does nothing to reduce climate change emissions, especially when compared to other renewable sources, such as wind, or Brazilian ethanol.

But McMillan says these arguments often use "worst-case scenarios that don't take into account modern advances that are being made in corn-ethanol production."

Taking a cue from Brazil, producers in Minnesota and elsewhere are beginning to use straw and other plant wastes to generate the energy used to produce ethanol.

"This helps decrease fossil fuel consumption," says Minnesota Senator Gary Kubly. One Minnesota plant that switched to using corn waste "will save $750,000 a year in energy costs since they won't have to buy fuel," he says. Using plant waste for energy greatly decreases greenhouse gas emissions



SENATOR
GARY KUBLY
MINNESOTA

as well as production costs, and significantly increases the amount of ethanol produced for each unit of fossil fuel used to produce it. Other technologies that will improve efficiency and decrease greenhouse gas emissions include modifying corn specifically for ethanol production and using farming methods that require less energy.

ARE BIOFUELS REALLY GREEN?

"Biofuels have been proven to produce less harmful air emissions," says Representative Dingfelder. "That makes them a good fit for the climate change strategies we are trying to promote in Oregon."

Ethanol and biodiesel blends do decrease emissions, and can help states meet EPA air quality requirements. Using biofuels can significantly reduce the emission of carbon dioxide, since transportation is responsible for around 33 percent of U.S. emissions. Some research has shown that the reduction in greenhouse gases from using corn ethanol or cellulosic (plant waste) ethanol in cars instead of oil to be around 20 percent and 80 percent respectively.

One key environmental issue is the manner in which biofuels crops are cultivated. Certain growing techniques can actually lock carbon in the soil, reducing the amount of greenhouse gases released into the atmosphere. If low-yielding, input-intensive crops like corn are used and forests are cut down to grow them, biofuel production could provide little benefit for reducing climate change, while contaminating water supplies and depleting the soil of nutrients.

THE PRIZE—CELLULOSIC ETHANOL

Technology to make ethanol from cellulose—which is found in plant stalks, wood and other plant debris—is advancing rapidly, and it is expected to be cost-competitive with corn-based ethanol by 2012. Cellulosic has a much larger energy balance than corn-based ethanol. It utilizes non-food crops, such as prairie grasses, which can be grown on low

Wood residues from pulp and paper manufacturing, lumber mills, and other industrial wood users are frequently used for producing biomass electricity. Using sound forest management practices, some regions also harvest wood specifically for power production. Many agricultural waste products such as rice husks, nut shells, and orchard prunings can be used as fuel for electricity production, thus turning serious residue disposal problems into valuable products.

grade land with little or no added water or fertilizer. Municipal, agricultural and forestry waste can also be used. Although many pilot studies have shown that cellulosic ethanol production is possible, the cost of commercialization remains a challenge. To help accelerate mass production, the DOE announced in February 2007 that it would provide $385 million in grants to fund six cellulosic ethanol plants, accounting for 40 percent of the investment costs. The plants will produce 140 million gallons per year, which is only about 3 percent of the current total U.S. ethanol production. Cellulosic ethanol production has a long way to go before it makes a significant difference.

The 2007 Farm Bill, which has not yet passed, also proposes to support cellulosic ethanol research and production by providing more than $500 million in funding over five years. Other countries are also interested in developing cellulosic technologies—the Chinese government announced in 2006 that it would be spending $5 billion on cellulosic ethanol production over the next 10 years.

It's not clear yet what role biofuels will play in meeting future fuel demands. The answer is not likely to be a silver bullet, but a lot of silver BBs—renewable fuels, plug-in cars, energy efficiency and other measures.

"We know that biofuels are not a panacea, but that they are one step along the way toward reducing oil imports," says Oregon Representative Dingfelder.