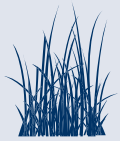
Center for American Progress

Biofuels 101

The Science Behind the Farm Bill

Congress gears up to debate the Farm Bill this week, which among other things looks to curb the growing energy crisis by using America's farm economy as a source for biofuels. Biofuels—liquid fuels produced from agricultural crops and wastes—have the potential to deliver a secure and stable supply of fuel to supplement our growing energy demands. In the midst of the debate—especially one involving cutting-edge science and technology—it may be easy to confuse, or even forget, the specifics of the potential biofuels. To help, CAP has put together Biofuels 101: A Beginner's Guide to Renewable Energy. Congress, be sure to take notes.

				
	Gasoline **Bad** A non-renewable fossil fuel produced by refining crude oil; emits large quanities of CO_2 upon combustion.	**Biodiesel** **Good** A renewable alternative to petroleum diesel produced from animal fat or vegetable oil.	**Corn-derived Ethanol** **Transitional** The main source of ethanol in the U.S. But growing corn is energy-intensive and requires large amounts of fertilizer made with fossil fuel.	**Cellulosic Ethanol** **Potentially Great** Production results in the same ethanol that corn produces, but the feedstocks, especially switchgrass, are inexpensive and easy to grow and the process of refining them is environmentally friendly.
Net Energy Balance *	N/A	3.20	1.34	2.62
Reduction in Greenhouse Gas Emissions	None (1 gallon produces 19 lbs of CO_2)	67.7%	21.8%	91%
Cost (per gallon)	$3.10	$2.90 average	$2.55 (E85)	$2.55 (E85)
Gallons/Acre	n/a	Varies by feedstock Rapeseed: 127	328	Varies by feedstock Switchgrass: 1000
Current U.S. Production (gallons/year)	79 billion	75 million	4.9 billion	(no current production at commercial scale)
Availability	114,974 stations	1,485 Stations	1,133 E-85	1,133 (E85)

***Net Energy Balance:** Biofuels are a potential source for renewable energy, but the production of useable fuel from crops comes at a cost. Farming, transportation, and processing are necessary steps that require an input of energy. That means we must use some energy to make more. Thus, the ratio of how much energy goes into production versus how much energy results is in each unit of biofuel is important to consider. The figures below depict the current effectiveness of biofuel production. As technology advances and the processes are streamlined, experts expect greater efficiency and higher energy balance ratios.

Ethanol

Ethanol is a biofuel that has growing popularity and significant promise. It is a clear, colorless alcohol that can be derived from numerous sources. There is a common misconception that ethanol comes only from corn. Although the vast majority of today's U.S.-based ethanol is produced from corn, sustainable cellulosic production has opened the door to numerous other sources of ethanol, most notably switchgrass. Though the processes are different, both corn-based and cellulosic production result in the exact same biofuel: ethanol.

Consumers usually find it blended with gasoline, as in E-85, which is 85 percent ethanol and 15 percent gasoline. Now sold at over a thousand retailers across the country, more and more cars can take advantage of this alternative fuel. At the same time, we need to make E-85 more available to drivers by installing more E-85 pumps at retail gas stations in every state.

Flexible-fuel vehicles can run on either E-85 or gasoline, though the former burns cleaner and produces 22 percent fewer greenhouse gas emissions than gasoline. Using E-85 in flex-fuel vehicles results in the overall consumption of 40 percent less fossil fuel energy than would burning pure gasoline due to free energy from the sun, improved crop yields, and efficient processing. Congress needs to call on the auto companies to improve both the overall fuel economy standards for the nation and the fuel economy of flexible-fuel vehicles. In addition, Congress should act to close the flexible-fuel vehicle fuel economy "loophole" that allows car manufacturers to receive extra fuel-efficiency credits for flexible-fuel vehicles without actually demonstrating the vehicle's use of E-85.

Ethanol blenders producing fuels like E-85 receive an income tax credit of 51 cents-per-gallon of pure ethanol used in the blending process. This credit will expire in 2010. An import tariff of 54 cents per gallon is levied on ethanol entering the United States from other countries as a means of offsetting the 51-cent income tax credit available to all ethanol blenders. Duty free imports are currently allowed from Caribbean Basin Initiative countries, but the import tariff, in general, is a significant trade barrier.

The Center for American Progress recommends phasing down the import tariff in order to encourage competition in the ethanol production market. In combination with an increase in the overall Renewable Fuel Standard, the United States should gradually begin the phase-down of the current 54 cent-per-gallon tariff on imported biofuels. All countries must take reciprocal action to remove trade restrictions on biofuels.

Additionally, CAP recommends a Market Responsive Counter-cyclical Federal Subsidy for ethanol production. This simply means that the United States should reduce the subsidy or tax credit for blending ethanol as the price of oil increases.

Cellulosic Ethanol

Cellulosic biofuel production results in the same ethanol that corn produces, but the feedstocks are inexpensive and easy to grow and the process of refining them is more environmentally friendly.

Cellulosic ethanol is derived from cellulose, the main component of wood, straw, and many plants. A variety of biomass materials yield considerable amounts of energy from this process, but dedicated energy crops such as switchgrass are the most promising. The cellulosic biofuel industry has not yet reached the scale of the corn ethanol industry, but cellulosic fuels can yield twice the energy output per unit of energy input than corn ethanol.

The process to derive ethanol from cellulose involves using enzymes to break down the tough and resistant cellulose in plant cell walls

into sugars. Microbes then convert the sugars, which ferment into liquid ethanol.

Fuels made from cellulosic biomass offer the promise of dramatically lower production costs while lessening the potential impact of production on land use and on our capacity to grow food, feed, and fiber. Congress has the opportunity to end U.S. dependence on foreign oil and energize American agriculture by enacting business, tax, and trade incentives to grow the cellulosic biofuel market to commercial scale, beginning immediately.

Transportation costs, fuel use, greenhouse gas emissions, and other high energy costs can be minimized if we expand our ability to grow energy crops in a broader geographic area and our capacity to disburse the sites of biorefineries in multiple regions close to population centers throughout the entire nation. Almost half the ethanol refineries in the United States are farmer-owned. As more and more biofuel producers have entered the market, the share of production capacity dominated by large producers has actually declined in recent years. Biorefineries owned and operated by farmers in rural communities can take advantage of economies of scale and improved access to investment capital to provide new jobs and support for family farms. Due to transportation costs, most biorefineries are disbursed throughout rural areas and need to be located close to feedstock supplies and local farms.

Corn-Based Ethanol

Corn is currently the main source of ethanol in the United States. Whereas the cellulose in plants is used in cellulosic ethanol production, the starch in corn is a key ingredient in corn-based production. The starch is fermented and distilled into simple sugars, which are then fed to microbes that produce ethanol. Once purified to a desired concentration, this alcohol is usable as a practical energy source.

The sugars that ferment into ethanol extract more easily from starch than from cellulose, and corn is already one of the country's leading crops. Increased corn-ethanol production has the potential to benefit farmers by increasing demand for corn crops and creating more jobs in rural areas.

But corn-based ethanol does have its drawbacks. The process requires a substantial energy expenditure, which in turn reduces the net energy profit. In addition, corn production is land- and water-intensive and uses tremendous amounts of fossil fuel-based fertilizers. Moreover, some have raised concerns over the effect that the increased demand for corn as a biofuel will have on our food and feed supply. As a result, CAP advocates the immediate implemention of transparent certification and labeling criteria to encourage sustainable production of biofuels in a voluntary Renewable Fuels Certification Program.

With these considerations, CAP believes that sustainably produced corn-based ethanol can play a minor role as a transitional fuel to help us improve our distribution and infrastructure while we redouble our efforts to move beyond corn and to ensure cellulosic ethanol is made commercially available to reduce the demand for fossil fuels in the United States.

Biodiesel

Biodiesel is a renewable alternative to petroleum diesel produced from animal fat or vegetable oil. It is biodegradable, nontoxic, and less harmful to the atmosphere than regular diesel. Biofuel has gained tremendous popularity in Europe and is slowly gaining a foothold in the United States. The greatest appeal to biodiesel is its practicality: It can serve as fuel in all regular diesel engines with few or no modifications. It is commonly sold in two forms: pure B100 and oxygenate additive B20 (20 percent biodiesel, 80 percent petroleum diesel).

Biodiesel production involves using an alcohol, usually methanol, to convert vegetable oils, commonly from soy or rapeseed. The production process has a significantly higher energy balance than the production of ethanol (corn-based or cellulosic), and the end product—biodiesel—has the ability to capitalize off pre-existing transport infrastructure, as vehicles built to run on petroleum diesel can burn biodiesel with little or no modification.

Biodiesel is currently the fastest growing and most cost-efficient fuel, primarily because it is clean burning and easy to use. Biodiesel releases 78 percent less carbon dioxide than gasoline. According to the National Biodiesel Board, over 39,000 jobs could be created in a variety of economic sectors with increased biodiesel production. Moreover, the industry expects to produce 250 million gallons in 2007, a dramatic increase from the 75 million in 2005. Biodiesel, though still developing as a petroleum replacement, shows great promise in the years to come.

Biodiesel producers and distributors are eligible for a federal excise tax credit of $1 for every gallon of biodiesel that is blended with conventional diesel. Currently, the most common biodiesel blend in the United States is B20, which is comprised of 20 percent biodiesel and 80 percent conventional diesel.