The History of Ethanol in America

Skills: Social Studies, Language Arts

Objective: Students will explore the production of biofuels from the 1850's to the present.

Background

Ethanol is a clear, colorless chemical compound made from the sugars found in crops such as corn, sugar beets and sugar cane.

In the 1850s nearly 90 million gallons of ethanol were produced every year in the US. At that time it was used as a fuel for lamps. It could also be consumed as an alcoholic beverage. In 1862 the Union Congress put a $2 per gallon excise tax on alcoholic beverages to help finance the Civil War. The tax made ethanol too expensive to use for lighting, so people started using kerosene and methanol instead.

In 1896, Henry Ford built his first automobile, the quadricycle, to run on pure ethanol. In 1906, the liquor tax was repealed, and Ford declared ethanol the fuel of the future. Ford designed his Model T to run on a mixture of gasoline and ethanol.

During World War I, ethanol use increased rapidly, not only as a fuel but in the manufacture of war materials also. The year 1919 brought Prohibition, and a denaturing process was developed which made ethanol poisonous and undrinkable. In the 1920s ethanol was replaced as a booster to gasoline by other products.

Prohibition ended in 1933, and ethanol production rose to 600 million gallons a year to meet the needs of World War II. After the war, production once again declined because there were no more government contracts. Farmers began exporting grain formerly used to make ethanol to help feed countries whose agriculture had been destroyed by the war. Large supplies of cheap foreign oil made gasoline less expensive than ethanol.

In the 1970s the US placed embargoes on gasoline supplies from foreign sources, and interest in ethanol as an alternative fuel rose again. Concerns about global warming and dependence on foreign oil have caused interest in ethanol as an alternative fuel source to grow in recent years. In 2006, 112 ethanol plants, mostly in the Midwest, produced about 5 billion gallons of ethanol.

Unlike gasoline, ethanol is biodegradable. It quickly breaks down into harmless substances if spilled. When small amounts of ethanol are added to gasoline, usually less than 10 percent, there are many advantages. Ethanol reduces the emissions of carbon monoxide and other toxic pollution. It keeps engines running smoothly without the need for lead or other chemical additives. Because ethanol is made from crops that absorb carbon dioxide and give off oxygen, it helps reduce the total volume of greenhouse gas emis-

P.A.S.S.

GRADE 6

Social Studies— 1.1,3; 2.2; 4.2
Reading— 1.1; 3.1b,2a; 5.1ab,2a
Writing— 1.2; 2.3a,7
Oral Language— 1.1,2; 2.1,2

GRADE 7

Social Studies— 1.1; 2.4; 5.2; 6.1
Reading— 1.1; 3.1a,2a,3d; 5.1ab,2a
Writing— 1.2; 2.3a,8
Oral Language— 1.1,2; 2.1.2

GRADE 8

Social Studies— 1.1,2,3,5; 2.2
Reading— 1.1; 3.1a,2a.3b; 5.1a,2a
Writing— 1.2; 2.3b,8
Oral Language— 1.1,2; 2.1,2

sions.

There are several ways to make ethanol from crops. One process uses yeast to ferment the sugars and starch in crops like corn, barley, wheat, rice, sorghum, sunflower, potatoes, sugar cane and sugar beets. Currently, most ethanol produced in the US is made from corn because corn is plentiful and cheap.

Since ethanol is created by fermenting sugar, sugar crops are the easiest ingredients to convert into ethanol. Brazil, the world's largest producer of ethanol, makes most of its ethanol from sugar cane. Many cars in Brazil are engineered to operate entirely on ethanol made from sugar cane.

A new experimental process breaks down cellulose in woody fibers to make "cellulosic ethanol." With this process ethanol can be produced from trees, grasses, and crop wastes. Trees and grasses require less energy for production than grains, since grains must be replanted every year.

Switchgrass, a grass that is native to Oklahoma, is of special interest to researchers for use in ethanol production. It has been chosen by the US Department of Energy as one of the main perennial crops for use in the production of ethanol. Switchgrass is a seeded, warm season grass native throughout North America.

Switchgrass converts and stores more solar energy per acre than any of the grain crops currently used to produce ethanol for fuel. It holds 66 percent more potential energy than corn. Switchgrass can be grown on marginal cropland and uses water and fertilizer efficiently. Since it is perennial, it comes back every year without replanting. At harvest, it would yield approximately 300-700 gallons per acre, compared to corn, at approximately 350 gallons per acre.

Background sources: Cleaner Energy Partnership; Energy Information Administration, US Department of Energy; USDA Agricultural Research Service

Grains and grasses suitable for biofuel production

forestry products
corn
soybeans
sugarcane
sugar beets
barley
wheat
rice
sorghum
sunflowers
potatoes
switchgrass

Resources Needed

Computer and library access

physical, political and product maps of the US

geographical references (see “Extra Reading for Students.”)

Activities

1. Read and discuss the background information and vocabulary.
   —Students will discuss some of the events that impacted the ups and downs of ethanol production in US history.
2. Students use online search engines or the library to locate parts of the US where the crops used in ethanol production (listed at left) are produced.
   —Students locate areas on maps.
   —Students use resources/maps to compare and contrast the growing areas for these grains and grasses.
3. Provide copies of the reading included with this lesson.
   —Students create a graphic organizer of the reading into historical timelines.
   —Review “How to Write a Research Paper” and “How Reliable Are Your Sources?” in the “Resources” section.
   —Students work in groups of two or three to research online or in the library the historical periods mentioned in the reading.
   —Students will each write a one-page paper on one of the historical peri-

ods and related issues listed on the reading page.
—Each group will select an event from their research to dramatize as though they are reporters reporting it as news.

4. Students discuss the impact of switchgrass and other crops used for making alternative fuels on the economy of Oklahoma, the US and on the world market.
—Could this alternative fuel curb our dependency on oil imports?
—What would be the impact on the environment?
—How soon might alternative fuels show significant impacts on our society as a whole?

Extra Reading for Students

Bridgman, Roger, *1000 Inventions and Discoveries*, DK, 2003.

Carless, Jennifer, *Renewable Energy: A Concise Guide to Green Alternatives*, Walker, 1993.

DK State-by-State Atlas, DK, 2004.

King, David C, *DK Smithsonian Children's Encyclopedia of American History*, DK, 2004.

O'Hearn, Michael, *Henry Ford and the Model T* (Inventions and Discovery), Capstone, 2006.

Peterson, Christine, *Alternative Energy*, Children's, 2004.

Povey, Karen D., *Biofuels—Our Environment*, KidHaven, 2006.

Stanchak, John, *Civil War,* DK, 2001.

Wilson, Janet, *Imagine That!*, Stoddart Kids, 2001.

Zarzycki, Daryl Davis, *Henry Ford: Cars for Everyone* (Robbie Readers), Mitchell Lane, 2004.

Zuehlke, Jeffrey, *Henry Ford* (History Maker Bios), Lerner, 2007.

Extra Reading for Teachers

Renewables Are Ready – A Guide to Teaching Renewable Energy in Junior and Senior High School Classrooms, Union of Concerned Scientists, 1994.

Paul, Greg, *Biodiesel: Growing a new energy economy*, Chelsea Green Publishing Company, 2005.

Vocabulary

biofuel—fuel made from living organisms

denaturing—to make (alcohol, etc.) unfit as food or drink without spoiling for other uses

embargo—any restriction imposed on commerce by law; especially, a prohibition of trade in a particular commodity

ethanol—a colorless, limpid, volatile, flammable, water-miscible liquid produced by the fermentation of sugars from certain grains and grasses

fossil fuel—oil, coal, natural gas – nonrenewable energy sources from ancient life

fermentation—turning sugar into alcohol or lactic acid during anaerobic respiration

lignin—the cementing agent that holds plant cell walls together

marginal cropland—land with conditions that make it difficult for growing crops

perennial—living over a period of many years

petroleum—an oily liquid solution of hydrocarbons occurring naturally in the rock strata of certain geological formations

switchgrass—a panic grass (Panicum virgatum) native to North America and used as rangeland forage and hay

Name _____

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Prohibition ended in 1933, and ethanol production rose to 600 million gallons a year to meet the needs of World War II. After the war, production once again declined because there were no more government contracts. Farmers began exporting grain formerly used to make ethanol to help feed countries whose agriculture had been destroyed by the war. Large supplies of cheap foreign oil made gasoline less expensive than ethanol.

In the 1970s the US placed embargoes on gasoline supplies from foreign sources, and interest in ethanol as an alternative fuel rose again. Concerns about global warming and dependence on foreign oil have caused interest in ethanol as an alternative fuel source to grow in recent years. In 2006, 112 ethanol plants, mostly in the Midwest, produced about 5 billion gallons of ethanol.

1. Develop a timeline of the events mentioned above.

2. Write a one-page paper on one of the following historical periods and related issues.

   1850s—Ethanol was widely used as fuel for lighting lamps. What other fuels were used as lighting or to meet other fuel needs? What fuels were used for cooking? What were some other fuel needs?

   Civil War—How did the excise tax on ethanol effect the daily lives of people during the war? What other daily hardships were caused by the war? What is an excise tax?

   1908—Repeal of liquor tax and Henry Ford's Model T

   The uses for ethanol and other fuels during World War I

   The impact of Prohibition on the production of ethanol

   The uses for ethanol and other fuels during World War II

   The oil embargo of the 1970s and its effects on the US

   The resurgence of interest in ethanol as an alternative fuel today

Produced by Oklahoma Ag in the Classroom, a program of the Oklahoma Cooperative Extension Service, the Oklahoma Department of Agriculture, Food and Forestry and the Oklahoma State Department of Education, 2008.