

# energy EXCHANGE

A publication of the National Energy Education Development Project

March 2006

## Bush Calls for Increased Biofuels in State of the Union

President Bush announced the Advanced Energy Initiative during his State of the Union address in January. The initiative increases clean energy research by 22 percent and calls for a 75 percent



Photo Credit: Eric Draper

reduction of oil imports from the Middle East by 2025. The focus of research is on transportation and power generation for homes and businesses.

Electric power generation investments include zero-emission coal-fired plants and new solar and wind technologies. Transportation research will include better batteries for hybrid and electric cars, vehicles powered by hydrogen, and new methods of making ethanol with wood chips, stalks, and switch grass. The president called for the production of ethanol to be practical and competitive within six years.

## Renewable E-Field Trip

“Renewable Energy: POWERful Choices” is a web-based e-field trip developed by the Department of the Interior’s Bureau of Land Management in partnership with Distance Learning Integrators. The program features information focusing on what renewable energy sources are available, what challenges exist, and the role public lands serve in meeting our nation’s energy needs. A student journal to assess learning and an “ask the expert” section are also available. To take a POWERful trip, visit [www.efieldtrips.org](http://www.efieldtrips.org).

## The ENERGY STAR Challenge – Build a Better World 10 Percent at a Time

The buildings in which we work, shop and educate our children use about \$80 billion worth of electricity and natural gas each year. These buildings use much of their energy at peak times, helping drive the need for new power generation and more natural gas. They also contribute about 20 percent of our national emissions of greenhouse gases. EPA, in partnership with business and community leaders, is challenging building owners and operators across the country to improve the efficiency of their buildings by 10 percent or more. Leaders across the country already are showing that energy use in buildings can be reduced more than 30 percent with proven practices and technologies that pay off financially and environmentally. In light of events across the United States, President Bush

has called on American citizens, businesses, and organizations to do their part by conserving energy. For more information about the Energy Star Challenge, visit [www.energystar.gov](http://www.energystar.gov).



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The NEED Project is a 501(c)(3) nonprofit education association providing professional development, innovative materials correlated to the National Science Education Content Standards, ongoing support and recognition to educators nationwide.

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A list of NEED sponsors is available on our website and in our Annual Report.

Energy Exchange is published five times a year by NEED for educators and students, and is available at [www.need.org](http://www.need.org).

NEED welcomes questions, comments, and suggestions. Please contact [info@need.org](mailto:info@need.org).

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# Calendar of Events

For more information, email [info@need.org](mailto:info@need.org) or call 800-875-5029

## March

- 1 NEED Workshop – Wayne, MI
- 6 NEED Workshop – Santa Barbara, CA
- 7 NEED Workshop – Indianapolis, IN
- 8 NEED Workshop – Ventura, CA
- 10 NEED Workshop – Terre Haute, IN
- 10 NEED Workshop – Cove Point, MD
- 11 Energy Smart Students Session at STANYS Eastern Section Lab Day – Schenectady, NY
- 12-16 National Hydrogen Conference – Long Beach, CA
- 17 NEED Workshop – Indianapolis, IN
- 22 Energy Smart Students Program at STANYS Southern Section Book Fair – Endicott, NY
- 23 Energy Smart Students Workshop – Farmingdale, NY
- 23-24 Kentucky High Performance Schools Workshop – Hebron, KY
- 23-25 Puerto Rico NEED Workshop – San Juan, PR
- 24 BP's A+ for Energy Texas Applications Due
- 25 NEED Workshop – San Joaquin, CA
- 25 Energy Smart Students Sessions at SCONYC Conference – Manhattan, NY
- 28 Energy Smart Students Workshop – New Paltz, NY
- 28 North Carolina NEED Workshop – Roanoke Rapids, NC
- 28-30 National Ocean Industries Association Meeting – Washington, DC
- 29-30 School Energy Management Conference – Indianapolis, IN
- 29-31 Energy Smart Students Sessions at New York State Technology Education Association Conference – Syracuse, NY
- TBA PG&E Solar Schools Workshops – PG&E Service Area

## April

- 4 Energy Smart Students Workshop – Buffalo, NY
- 5-9 NEED Sessions at National Science Teachers Association Conference – Anaheim, CA
- 7 BP's A+ for Energy California Applications Due
- 7-8 Technology Students Association Competition – Oswego, NY
- 10 Energy Smart Students Workshop – Binghamton, NY
- 12 Sandwich High School Energy Fair – Sandwich, MA
- 15 NEED Energy Project Scrapbooks Due – Washington, DC
- 17-21 National School Building Week
- 18 Energy Smart Students Workshop – Yorktown Heights, NY
- 26 NEED Youth Awards Review – Washington, DC
- 27 NEED Take Your Kid to Work Day Workshops at U.S. Department of Energy – Forrestal and Germantown
- 27 Energy Smart Students Workshop – Spencerport, NY
- 28-30 NEED Teacher Advisory Board – Washington, DC
- TBA North Carolina NEED Workshops
- TBA PG&E Solar Schools Workshops

## Correction

The January 2006 Energy Exchange Primary Activity Racing Jars should read:

At first, the water-filled jar moves down the ramp faster than the empty one. This happens because a solid object will pick up more rotational speed than an empty, or hollow, object—even if both have the same mass. The water-filled jar is more like a solid object and begins to rotate more quickly. The empty jar is left behind.

But as the jars begin rolling along the carpet, the greater mass of the full jar causes more friction between the jar and the carpet than with the empty jar. The full jar slows down, allowing the lighter, empty jar to take the lead!

Visit [www.need.org/guides.htm](http://www.need.org/guides.htm) for a corrected activity sheet.

# Calendar of Events

## May

- 9 Kentucky NEED Youth Awards Luncheon – Frankfort, KY
- 9-10 4-H/NASULGC Light and Lighting Module Training – TBA
- 16-19 U.S. Department of Energy’s Hydrogen Project Review – Arlington, Virginia

## June

- 12 BP’s A+ for Energy Celebration – Space Center Houston, TX
- 12-16 Kentucky Energy Tour – Eastern KY
- 23-26 NEED Youth Awards Program for Energy Achievement – Washington, DC

## July

- 7 American Solar Energy Society Legacy School Workshop/NEED Schools Going Solar Workshop – Del Pueblo Elementary School – Denver, CO
- 9-11 BP’s A+ for Energy Conference – Galveston, TX
- 9-13 NEED National Energy Conference for Educators – Denver, CO
- 10 BP’s A+ for Energy Celebration – Universal City, CA
- 16-19 BP’s A+ for Energy Conference – Austin, TX
- 16-20 NEED National Energy Conference for Educators – Boston, MA
- 23-26 BP’s A+ for Energy Conference – Pasadena, CA
- 23-26 BP’s A+ for Energy Conference – San Antonio, TX
- 26-30 NEED National Energy Conference for Educators – Seattle, WA
- 30-Aug 2 BP’s A+ for Energy Conference – Sacramento, CA
- TBA Pacific Gas and Electric Company’s Solar Schools Conference – TBA

## August

- 6-9 BP’s A+ for Energy Conference – Long Beach, CA
- 29-30 Commuter Transport Association Meeting – Boston, MA

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## Biofuels in the News

### Coolfuel Roadtrip

Think it’s impossible to travel across America without using any gasoline? One man, his dog, and a camera crew have done it! They traveled 16,000 miles across 30 states in vehicles powered only by “coolfuels.” These fuels are everything but gasoline. Imagine a plane powered by ethanol, a Hummer using biodiesel, and a solar canoe. All of these vehicles and more can be seen on the 18 part television series.

Visit [www.coolfuelroadtrip.com](http://www.coolfuelroadtrip.com) for local listings, pictures of coolfuel vehicles, and downloadable lesson plans.

### Diesel Engines on Center Stage

In January, automakers around the world converged on Detroit to show the best and the brightest upcoming vehicles. In the spotlight were several clean diesel vehicles. The new generation of passenger diesel vehicles is 20-40 percent more fuel efficient than their gasoline powered counterparts. Additionally, clean diesel technology allows for these new engines to emit 10-20 percent fewer greenhouse gases than gasoline engines. According to the U.S. Environmental Protection Agency, switching out one-third of the light-duty gasoline vehicles on the road today for clean diesel vehicles would save up to 1.4 million barrels of oil a day.

# NEED News

## California

### Pacific Gas and Electric Company

Apply for “Bright Ideas” Grants! PG&E is providing up to \$200,000 of grants for schools interested in increasing their classroom solar energy education efforts. These grants are available for public schools in the PG&E service area. Grant applications open in mid-March with grants awarded in late spring. For more information about the “Bright Ideas” Grants and the PG&E Solar Schools Program Workshops facilitated by NEED, visit [www.need.org/pgesolarschools](http://www.need.org/pgesolarschools) or email [info@need.org](mailto:info@need.org).



### BP's A+ for Energy Program

BP has launched the third year of the A+ for Energy Program for California teachers. For more information and to apply for a \$5,000 or \$10,000 grants, visit [www.aplusforenergy.com](http://www.aplusforenergy.com).

## Indiana

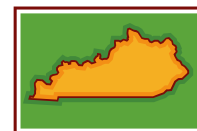
### Indiana Energy Management for Schools Conference

Thanks to the support of Cinergy/PSI, Vectren, Citizens Gas, and Indianapolis Power & Light, NEED is pleased to host the Indiana Energy Management for Schools Conference March 29-30, 2006, in Plainfield, IN. This conference is packed with two days of valuable energy management sessions for practitioners and those interested in launching a school energy management program. Registration is \$75.00 and includes conference materials and meals. For more information or to register, visit [www.need.org](http://www.need.org) or email [info@need.org](mailto:info@need.org).



## Kentucky

Schools across Kentucky continue to receive NEED materials, training and opportunities thanks to the support of the Kentucky Office of Energy Policy, ULH&P/ Cinergy, Dart Container, the Kentucky Oil and Gas Association, Equitable Foundation, Kentucky Propane Education and Research Council and Kentucky River Properties. Kentucky NEED's teacher/student workshops train hundreds of students each year to teach others about energy. The Kentucky High Performance Schools Workshop, facilitated by Kentucky NEED, is scheduled for March 23-24 at the Marriott Airport in Hebron, Kentucky. To register, contact Karen Reagor at 859-578-0312.



### 26<sup>th</sup> Annual Youth Awards for Energy Achievement

The 26<sup>th</sup> Annual Youth Awards for Energy Achievement will host over 600 students, teachers, and parents in Washington, D.C. June 23-26, 2006. This four-day celebration of energy, student leadership, and educational excellence recognizes students for their innovative energy education efforts and allows energy groups around the country to come together to network and share ideas. Be sure to submit your projects by April 15! For more information, visit [www.need.org](http://www.need.org).

### NEED Energy Conferences for Educators

The NEED Energy Conferences for Educators are designed to energize participants and their classrooms. The conferences are not for the faint-of-heart, but past attendees have indicated that it was the best conference they ever attended. The conferences are scheduled for Denver, Colorado (July 9-13); Cambridge (Boston), Massachusetts (July 16-20); and Seattle, Washington (July 26-30). Great field trips are planned as part of the exciting agendas. To request a copy of the conference brochure, visit [www.need.org](http://www.need.org), email [info@need.org](mailto:info@need.org), or call 800-875-5029.

### Second Annual Passport to Energy Careers Fair

The Second Annual Passport to Energy Careers Fair is scheduled for June 23, 2006, at the Hyatt Regency Crystal City. Companies, agencies and organizations interested in hosting a booth or table should contact NEED at 800-875-5029 for more information. In 2005, Dominion, the National Ocean Industries Association, the U.S. Department of Energy, the U.S. Energy Information Administration, American Electric Power, the American Public Power Association, Cape Light Compact, and the Texas Independent Producers and Royalty Owners Association participated. Join us!



## PRIMARY Story: Biogas

Mai lives on a farm in China with her mother and father. They raise pigs on their farm. They grow corn to feed the pigs.

Every morning, Mai helps her mother feed the pigs. Every evening after school, Mai helps her father feed the pigs.

On Saturday, they pick out the biggest pig and butcher it.

On Sunday, they go to the outdoor market in the village. They sell the meat. They buy things they need.

Mai's farm is in the country. There is no electricity in her house. But Mai's house has lights and a stove. They run on a special kind of gas, called biogas. Mai's family makes the biogas on their farm.

Every day, Mai and her parents gather corn stalks from the fields. They gather the corn cobs that the pigs don't eat. They collect manure from the pig pens. They save their own waste.

In Mai's back yard, there is a big container. They put all of the waste into it. They are careful not to let in any air.

As the waste decays, it makes biogas. The biogas flows through a pipe into Mai's house. It flows to the lights to keep the house bright. It flows to the stove. Mai's mother uses it to cook food and keep the house warm. The biogas is clean. It doesn't make any smoke.

Mai's father empties the container when the waste has decayed. The waste that is left makes good fertilizer. He spreads it on his fields. The corn grows tall to feed the pigs.

## PRIMARY Activity: Biogas

Concepts: Plants and food decay.  
As organic materials (like food) decay, they produce carbon dioxide and methane gas.

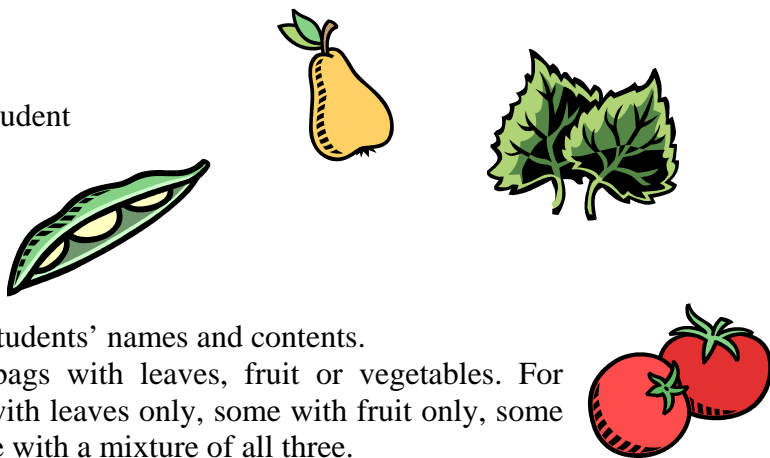
Time: One-two weeks for data collection

Materials: One zip-closure sandwich bag per student  
Leaves, fruit or vegetables  
Yeast  
Water

Procedure:

1. Label all of the bags with the students' names and contents.
2. Have the students fill their bags with leaves, fruit or vegetables. For comparison, have some bags with leaves only, some with fruit only, some with vegetables only, and some with a mixture of all three.
3. Add a pinch of yeast and a little water to each bag.
4. Force out as much air as possible before sealing the bags.
5. Place the bags in a warm place.
6. Observe the bags once a day for one to two weeks.

Conclusions: Ask the students how the leaves, fruit and vegetables changed during the week.  
Ask the students which material decayed the most.  
Ask the students which bags filled with the most biogas. Remind the students that biogas can be used to heat homes and cook food.



## ELEMENTARY Article: Energy Pioneers

### George Washington Carver

#### A Humble Beginning

George Washington Carver was born around 1864. He was born a slave on a small Missouri farm. He worked in the house, doing chores like washing and cleaning. During his youth on the farm, Carver took long walks through the woods, exploring nature and learning what he could by observing the trees, insects and flowers.



Pond near Carver's boyhood home in Missouri.  
Credit: National Park Service

#### A Great Student

Even though he had a great curiosity about the world around him, Carver was not allowed to attend the local school because he was African American. The farm owners, Moses and Susan Carver, allowed him to leave the farm and attend a school for African American children. He paid for his food, a place to stay and the cost of school by doing laundry and cooking. Whenever Carver could afford to go to school, he did.

When he graduated, Carver started a small farm in Kansas. He was a better student than a farmer and went back to school in Iowa in 1890. Carver took art classes at Simpson College. He drew and painted very detailed plants and flowers. After a while, he switched to studying agriculture so he could focus on nature and his desire to help farmers. In 1891, Carver began attending Iowa Agricultural College. He earned both his college degree and an advanced degree.



Carver in a farm field.  
Credit: National Park Service

#### The Heart of a Teacher

In 1896, Carver became a teacher at Tuskegee Institute in Alabama. Carver wished he could teach rural farmers about ways to improve their crops. He created moveable schools to take the classroom to the farmers. Classes were often taught in farm fields from the back of a wagon. Carver taught about crop rotation and natural fertilizers. By 1930, the moveable schools had a nurse, a home demonstration agent, an agricultural specialist, and an architect who shared the latest information with rural people.

#### The Mind of a Scientist

Carver wanted to help African American farmers be able to support their families with the crops they grew. He discovered practical new uses for crops. Carver worked in an area of chemistry known as chemurgy. A chemurgist finds industrial uses for crops. Carver mostly studied the peanut, soybean and sweet potato. He found more than 300 new uses for the peanut, 100 for sweet potatoes and 100 for soybeans.



Credit: Library of Congress

Henry Ford was very interested in the work that Carver was doing with soybeans. Carver consulted with Ford on many projects. In 1942, Ford developed a vehicle that used a bushel of soybeans in its construction. Ford and Carver both believed that petroleum supplies were limited. They worked together on projects that replaced petroleum with crops to produce rubber, plastic and fuel. Today, the fuel that Carver made from soybeans is called biodiesel.

#### The Spirit of a Gentle Man

During his free time, Carver would draw, paint, crochet, knit or do needlework. He enjoyed making useful items for his friends from natural materials. Carver was also interested in natural pigments. He would use soil, berries and plants to make bright and bold colors for paint and fabric dyes. Upon making a new color of paint, Carver would often take it to a local farmer and help paint the outside of the house. Improving the lives of others both on and off the fields was important to Carver.

#### A Great Legacy

George Washington Carver is an energy pioneer because of his work with soy fuels. He developed many products from crops that we still use today. Carver taught practical things, always wanted to learn more, and wanted to help other people have better lives.



Statue of Carver at George Washington Carver National Monument, MO.

## INTERMEDIATE/SECONDARY Article: New Approach to Biomass

### Biomass Program

Developing new technologies to release the energy stored in plants is one of the targets for the Biomass Program of the U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy (EERE). Two areas currently in development are known as the sugar platform and the thermochemical platform.

### Sugar Platform

Current technology converts plant sugars and starches to ethanol. Easy to extract sugars and starches are typically found in plant seeds. The EERE sugar platform focuses on the bulk of plant material—cellulose, hemicellulose and lignin. Using cellulose and hemicellulose to make ethanol requires breaking them down into their component sugars. Once in sugar form, the cellulose and hemicellulose can be used by a biorefinery to make ethanol or other chemicals that are building blocks for industrial uses. Lignin can be used as a fuel for generators or converted into chemicals.

Breaking down bulky plant material can be done in a variety of ways. Current industry practice involves using either concentrated or dilute acid solutions to break down the cellulose and hemicellulose into sugars. Since both of these practices have been researched and in use for some time, EERE believes they have reached much of their sugar extracting potential. Thus the focus of the Biomass Program is on enzymatic hydrolysis.

**Enzymatic hydrolysis** starts with mechanical milling, or physically breaking down the plant material. Next, a pretreatment of a dilute acid occurs. This step breaks down the hemicellulose and starts to deteriorate some of the lignin surrounding the more resistant cellulose. EERE Biomass Program researchers are currently determining the best pretreatment process. Cellulase, an enzyme that breaks down cellulose into sugars, is then introduced into the solution. The resulting batch of sugars can be fermented into ethanol or processed into other products. The EERE Biomass Program is also researching a process that involves the simultaneous enzymatic breakdown of cellulose and fermentation of sugars into ethanol by microbes.

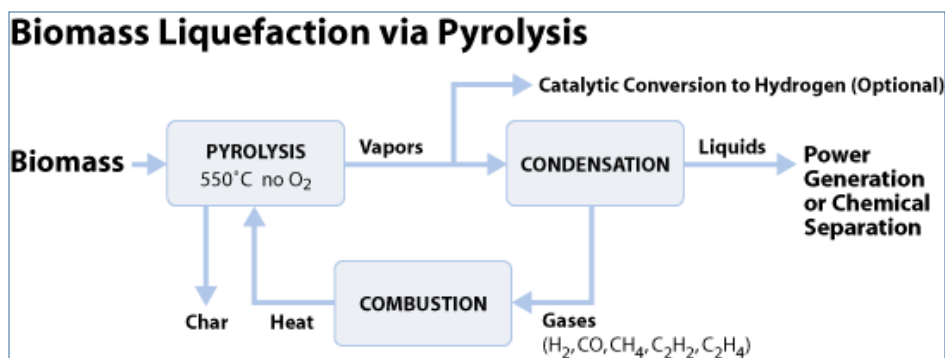
The goal of the new technology is to enable biorefineries to produce valuable chemicals and products that will alleviate the nation's dependence on foreign oil and reduce net greenhouse gas emissions with plant materials not fully utilized with current technologies.

### Thermochemical Platform

While burning solid biomass has been a primary way of drawing energy out of plants since prehistoric times, it is a fairly inefficient process. The EERE Biomass Program is researching gasification and pyrolysis methods of converting solid biomass to either gaseous or liquid fuels to better tap into the stored energy.

**Gasification** involves heating biomass with little to no oxygen present. This process does not allow the biomass to combust. Instead, it gasifies into a mixture of carbon monoxide and hydrogen known as synthesis gas or **syngas**. As gaseous fuels mix more readily with oxygen than solid fuels, syngas burns more efficiently and cleanly than solid biomass. Additionally, syngas can be burned in more efficient gas turbines to make electricity or mixed with chemical catalysts to make liquid fuels.

**Pyrolysis**, causing something to change due to heat, is another way to change solid biomass into a more efficient form, in this case a liquid. Similar to gasification, pyrolysis involves heating solid biomass in a limited oxygen environment. Biomass liquids can be used directly as fuel for power generation, converted to transportation fuels, or used to produce high-value chemicals and materials. Current research looks at reducing the energy and financial costs associated with pyrolytically produced biofuels.



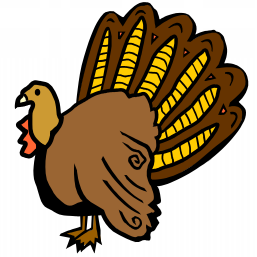
Credit: DOE EERE Biomass Program

For more information about biomass technologies, visit [www1.eere.energy.gov/biomass/technologies.html](http://www1.eere.energy.gov/biomass/technologies.html).

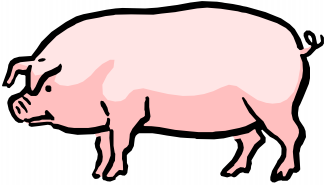
# Short Circuits

## Electric Turkey Leftovers

Construction has begun on the first power plant in the U.S. to generate electricity using turkey manure. Located in Benson, Minnesota, Fibrominn will generate 55 megawatts of power using about 700,000 tons of turkey litter and other agricultural waste each year. Fibrominn should be operational in 2007. Locations for additional turkey power plants include Maryland and Mississippi. For more information, visit [www.fibrowattusa.com](http://www.fibrowattusa.com).



## Pig Power



Smithfield Foods worked with North Carolina State University to find useful ways to deal with pig waste. One project produced electricity, hot water and fertilizer. Anaerobic bacteria digest pig manure to create methane gas. The gas is used to generate electricity for the pig farm. Heat waste from the generator is captured and used to heat water for the production facility. The liquid waste from the digester is used as a fertilizer for greenhouse tomato plants grown on the farm. For more information, visit [www.cals.ncsu.edu/waste\\_mgt/smithfield\\_projects/ambient%20digester/ambientdigester.htm](http://www.cals.ncsu.edu/waste_mgt/smithfield_projects/ambient%20digester/ambientdigester.htm) or [www.smithfieldfoods.com/Enviro/Technology/Default.asp](http://www.smithfieldfoods.com/Enviro/Technology/Default.asp).

Youth Awards  
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