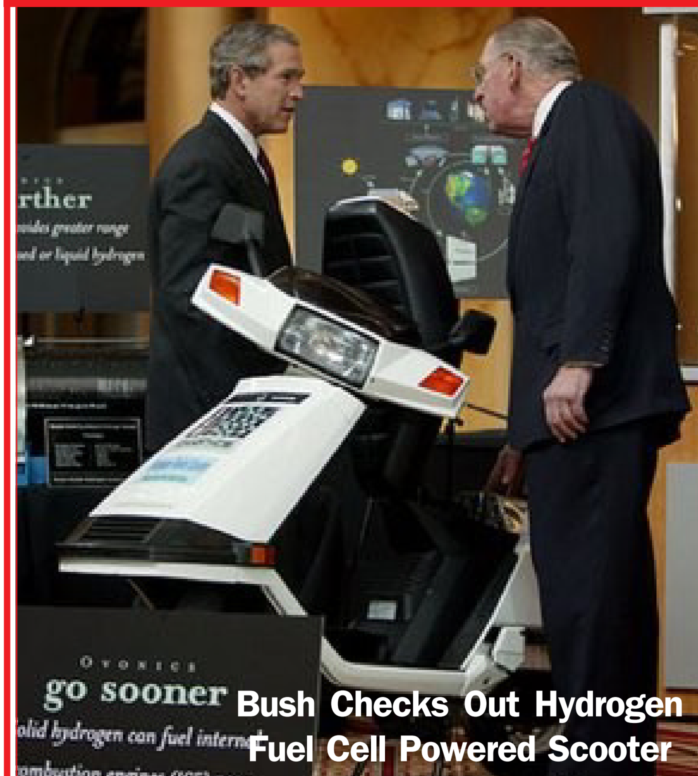
Energy EXCHANGE

A publication of the National Energy Education Development Project

MAR–APR 2003



Bush Checks Out Hydrogen Fuel Cell Powered Scooter

NEED Students Hear Bush Speak

Students from NEED schools in the Washington, DC area had an opportunity to hear President George W. Bush promote his initiative for hydrogen and fuel cell research. The 92 students and 12 chaperones gathered February 6, 2003, at the National Building Museum to hear the president's remarks. They also took part in hands-on NEED activities and explored hydrogen-fueled gadgets and automobiles.

President Bush addressed the students directly, saying, "I also want to thank the...science and technology students who are here, our future scientists, those who are going to take what appears to be dramatic innovation today and improve on it in the coming years. And so thanks for your interest and thanks for caring about your country. Keep studying hard." He added, "Don't watch too much TV. Read a lot."

The students attend Thomas Jefferson Middle School (Arlington County, VA), Barnard Elementary School (Washington, DC) and Alexandria Country Day School (Alexandria, VA). The schools are involved in NEED's partnership with the Department of Energy's Rebuild America/EnergySmart Schools program.

Shauni Nix Leaves OEP

The NEED Project is sad to announce the departure of Shauni Nix, longtime Executive Director of the Ohio Energy Project. Over the past 13 years, Shauni has guided energy education in Ohio to new heights—with thousands of teachers and hundreds of thousands of students reached each year. Shauni's leadership launched programs such as the Energy Bike, This Mine of Mine coal activity, Ohio EnergySmart Schools, and more.

We are excited that OEP has grown so successfully that Shauni can spend some well-deserved time focusing on her family. Shauni will remain involved as a member of the OEP Board of Directors; NEED will be drawing on her expertise, too! To honor Shauni's commitment to energy education, NEED has established the Shauni Nix Energy Excellence Award. This award includes sponsorship to a NEED Energy Conference for Educators each summer for one teacher from Ohio. Shauni and the Ohio Energy Project will select the teacher to receive the award.

Inside this issue....

The NEED Project

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

Energy Exchange is published five times a year and is available on NEED's website.

CALENDAR OF EVENTS

For more information, email info@need.org or call 1-800-875-5029

March

1 ILEED Energy Training Certification for Middle School/High School – Rolling Meadows, IL
7-8 West Virginia NEED Conference – Morgantown, WV
5 American Solar Energy Society Legacy School Ribbon Cutting: Barnard Elementary – Washington, DC
11 North Carolina NEED EnergySmart Schools Conference – Asheville, NC
13 North Carolina NEED Workshop – Asheville, NC
17-21 NEED Week: Celebrate 23 years of energy education on NEED Day, March 21! For activities to do this week, go to **www.need.org/guides.htm**.
19-20 NEED session at the U.S. Department of Energy, Seattle Regional Office, Rebuild America Peer Exchange – Santa Monica, CA
21 Cape Cod Cooperative Extension Electricity 101 Workshop – Hyannis, MA
24 BP/NEED Solar Schools Ribbon Cutting: Washington Junior High School – Naperville, IL
27-31 NEED workshops at the National Science Teachers Association National Convention – Philadelphia, PA. A NEED teacher reunion is planned; if you are attending, contact mspruill@need.org.

April

11-13 NEED Teacher Advisory Board Annual Meeting – Middletown, VA
15 Youth Awards Projects due to state offices or NEED Headquarters
15 Illinois Youth Leadership Award applications due to NEED Headquarters
15 ILEED Workshop – St. Jacob, IL
17 Michigan NEED Workshop – Grand Valley State University, MI
26 NEED Workshop – Houston, TX
27 Youth Awards Projects due to NEED Headquarters from state offices

May

2 NEED Youth Awards Review Panel – Washington, DC
6 ILEED Youth Awards Luncheon – Springfield, IL
20 Ohio Energy Project Youth Awards Luncheon – Columbus, OH
22 KentuckyNEED Youth Awards Luncheon – Frankfort, KY

June

10-12 Nebraska NEED Conference – Columbus, NE
20-23 National Youth Awards for Energy Achievement – Hyatt Regency Crystal City, VA

July

13-18 ILEED Camp KEEP (Kids for Energy and Environmental Protection) – Cantrall, IL
21-26 ILEED Camp KEEP (Kids for Energy and Environmental Protection) – Algonquin, IL
12-16 NEED National Energy Conference for Educators – Chicago, IL
19-23 NEED National Energy Conference for Educators – Galveston, TX
21-25 KentuckyNEED Energy Conference for Educators – Western Kentucky Touring Conference
26-30 NEED National Energy Conference for Educators – Denver, CO

TEACHER RESOURCES

Looking for an Internship?
The U.S. Department of Energy Office of Fossil Energy offers the Mickey Leland Energy Fellowship. Through its headquarters and field offices, the Fossil Energy Office offers summer internship opportunities to students to enhance their knowledge and gain hands-on experience. It also encourages them to consider future employment with the federal government upon graduation. For more information about this internship program, go to **www.fossil.energy.gov/education**.

NEED Help with an Energy Education Activity?
The NEED website—**www.need.org**—has several discussion groups for teachers. If you are having difficulty teaching a particular concept or using a NEED activity, go to a discussion group for help from hundreds of experienced NEED teachers.

NEED NEWS

Want Solar Panels?
The Foundation for Environmental Education and the NEED Project, in cooperation with ComEd, the Illinois Department of Commerce and Community Affairs, and the Illinois Clean Energy Community Foundation are looking for a few great schools! The Foundation for Environmental Education plans to install photovoltaic panels (from 2-kilowatt to 50-kilowatt depending on size, space, and available funding) on interested schools in Illinois. Schools interested in receiving panels should contact Glen Kizer at GKizer@columbus.rr.com or Mary Spruill at mspruill@need.org for further information.

Michigan NEED Kids Wow Teachers!
Science leaders from Western Michigan attended the Learning Science in the Real World Seminar at Grand Valley State University in Allendale, Michigan, on February 18, 2003. Representatives from the JASON Project, GLOBE Program, and the NEED Project introduced 30 participating teachers to various methods of involving their students in program-based learning, project-based learning, and inquiry-based science instruction.

The Seminar's highlight for many of the teachers was the opportunity to learn about forms of energy and energy transformations from Shelly Baumann's sixth-grade NEED students. Shelly's students commanded the participants' attention as they taught six Science of Energy stations. Experiencing first-hand the power of students teaching teachers definitely singled out the NEED session from the other programs. Teachers applauded the students following their presentations and asked many questions about how to get their students involved in the NEED program.

High Performance School Buildings Workshop Scheduled for Georgetown, KY, April 30, 2003
In partnership with the Kentucky Division of Energy, the Kentucky NEED Project, the US Department of Energy's Rebuild America/EnergySmart Schools program and Oak Ridge National Laboratory, the Sustainable Buildings Industry Council will conduct a High Performance School Buildings workshop in Georgetown, Kentucky, just outside of Lexington. To request a registration form, contact Karen Reagor at 1-866-736-8941 or email kreagor@need.org.

Nevada
Thanks to the leadership of Lisa Davis at the University of Nevada-Las Vegas, 30 teachers from Las Vegas were energized at the *We NEED Energy* workshop in February. The teachers received NEED materials sponsored by Southwest Gas. For more information on the Nevada program, please contact Lisa Davis at lisa.davis@ccmail.nevada.edu.

EIA Kids Page Shines
The Energy Information Administration's Kids Page is a real winner! EIA recently announced that Kids Page usage has grown over 400% in the past two years and is averaging more than 70,000 user sessions from students and teachers each month. NEED is proud to be part of the EIA Kid's Page project and looks forward to the new and exciting things being added to the site each month! To access kid-friendly energy information, go to **www.eia.doe.gov/kids**.

Massachusetts
Students from the Massachusetts Institute of Technology's Alpha Chi Sigma chapter conducted its annual Science Splash (physics and chemistry) for local junior and senior high school students in Boston in December. NEED student leader Ali Jiwani introduced NEED to the program two years ago. The event showcased the NEED Science of Energy kit and other activities as hands-on ways to learn more about physics, chemistry and energy. For more information on the Splash, contact Ali Jiwani at alij@MIT.EDU.

North Carolina
School decision-makers from western North Carolina attended the NC-NEED EnergySmart Schools conference on March 11, 2003, to learn more about integrating energy efficiency and conservation activities into their school construction, renovation, and expansion plans. The U.S. Department of Energy's Rebuild America program provided technical resources for the conference and several NEED partners provided presentations to showcase their success and assist other school districts in creating active energy efficiency programs in schools. A teacher workshop was conducted on March 13, 2003, to train local teachers to implement NEED programs in their classrooms. Special thanks to the Western North Carolina Green Building Council and the North Carolina State Energy Office for their support of the workshops.

Indiana
Students in Nancy Lillie and Jean Schmeltzer's classes at North Dearborn Elementary wrote NEED to tell us more about their Science of Energy and ElectroWorks activities. One student, Alisha, wrote the following, "I learned three things using ElectroWorks: I learned what magnetism is and how it works. Learning how magnetism makes electricity was fun. The next thing I learned was which objects make static electricity and which ones don't. I enjoyed this lab because I learned something new about energy. The last thing I learned was that with circuits you can make electrons move. I liked this lab because I could hook up circuits to move electricity in different ways. I enjoyed the labs and I think you should try them out – you will learn something new!" Many thanks to North Dearborn for letting us know how their NEED activities went!

PRIMARY ACTIVITY: How Many Years to Disappear?

Directions: Use this as an introduction to a unit on recycling/solid waste disposal. Students will be surprised at how long it takes for most trash/litter to disappear. *(Answers are at bottom of page.)*

How Many Years To Disappear?

If you throw these things in a ditch, mark how many years you think they'll be there.

OBJECT	0 - 1 year	1 - 100 years	100 - 500 years	500 - 1,000 years	1,000 - 1,000,000 years
Disposable Diaper					
Cotton Sock					
Styrofoam Cup					
Glass Bottle					
Leather Belt					
Wooden Block					
Banana Peel					
Paper Box					
Plastic Bottle					
Aluminum Can					

Answers: Diaper: 500-600 years, Cotton Sock: 5-6 months, Styrofoam Cup: 1 million years or more, Glass Bottle: 1 million years or more, Leather Belt: 40-50 years, Wooden Block: 10-20 years, Banana Peel: 3-4 weeks, Paper Box: 1-2 months, Plastic Bottle: 1 million years or more, Aluminum Can: 200-500 years.

ELEMENTARY ARTICLE: Will Your First Car Run On Ethanol?

Today, most people in the United States drive cars that run on gasoline. By the time you're ready to buy your first car, you will have lots of choices. You will be able to choose from cars that run on electricity, natural gas, ethanol, propane, or a mixture of fuels.

Ethanol

Ethanol is a clear, colorless alcohol fuel made by fermenting the sugars found in grains such as corn and wheat, as well as potato skins, rice, and yard clippings. There are several ways to make ethanol from biomass. The most commonly used processes today use yeast to ferment the sugars and starch in the biomass. Many cars in Brazil operate on ethanol made from sugar cane.

A new process uses enzymes to break down woody fibers, making it possible to produce ethanol from trees, grasses, and crop wastes. Trees and grasses require less energy than grain crops, which must be replanted every year. Scientists have developed fast-growing trees that can be harvested in ten years or less. Many grasses can produce two harvests a year for many years. Soon, you may find yourself driving by huge farms that are not producing food or animal feed, but feedstock for ethanol.

History of Ethanol

Ethanol is not a new fuel. In 1908, Henry Ford designed his Model T to run on a mixture of gasoline and alcohol, calling it the fuel of the future. In 1919, when Prohibition began, ethanol was banned because it was considered a liquor. It could only be sold when it was mixed with petroleum. With the end of Prohibition in 1933, interest in the use of ethanol increased.

Ethanol as a Transportation Fuel

Today, more than fifty ethanol plants, mostly in the Midwest, produce over a billion gallons of ethanol a year. Gasoline containing ten percent ethanol—E10—is used in many urban areas that fail to meet clean air standards. Since ethanol contains oxygen, mixing it with gasoline reduces carbon monoxide emissions up to 25 percent. E10 is not considered an alternative fuel, but a replacement fuel.

There is also E85, a fuel that is 85 percent ethanol and 15 percent gasoline, used mainly in the Midwest and South. Vehicles are not converted to run on E85, they are specially manufactured as flexible fuel vehicles (FFV), designed to use any combination of ethanol and gasoline. There are about 50,000 trucks and vehicles using this fuel, provided by 145 ethanol stations. Forty percent of these are private vehicles; the rest are fleet vehicles. The cost of E85 is about the same as mid-grade gasoline.

The fueling process for E85 is the same as for gasoline. The range of vehicles using ethanol is about 15 percent less. Acceleration, weight capacity, and cruise speed are the same as for gasoline-powered cars. Maintenance is also similar.

Ethanol is made from crops that absorb carbon dioxide and give off oxygen. This carbon cycle maintains the balance of carbon dioxide in the atmosphere when using ethanol as a fuel. As new technologies for producing ethanol from all parts of plants and trees becomes economical, the use of ethanol will increase and more fueling stations will become available. Your first car could very well run on ethanol.

INTERMEDIATE/SECONDARY ARTICLE: Measuring Electricity

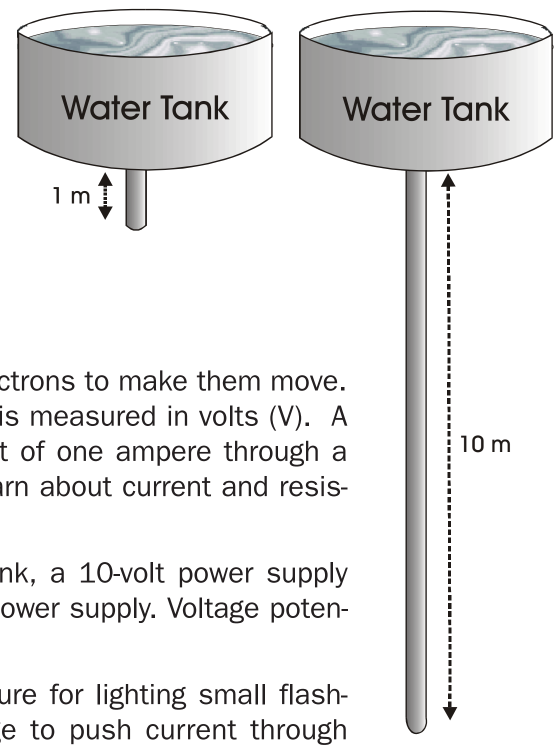
We use electricity for hundreds of tasks every day. It makes our lives productive and enjoyable, yet it remains a mysterious force to most of us. Understanding electricity and how it is measured is confusing because we cannot see it. We are familiar with terms such as watt, volt, and amp, but most of us do not have a clear understanding of these terms. We buy a 60-watt lightbulb, a tool that requires 120 volts, or a vacuum cleaner that uses 8.8 amps, and don't really think about what those measurements mean. We are confident that when we plug them in, they will work.

It is important to understand electricity, because we rely on it for so many things. Electricity is the flow of electrons. Using the flow of water as an analogy can make concepts of electricity easier to understand. The flow of electrons in a circuit is similar to water running through a hose.

If you could look into a hose at a given point, you would see that a certain amount of water passes that point each second. The amount of water depends on how much pressure is being applied—how hard the water is being pushed. It also depends on the diameter of the hose. The more forceful the pressure and the larger the diameter of the hose, the more water passes each second. The flow of electrons through a wire depends on the electrical pressure pushing the electrons and on the cross-sectional area of the wire.

Voltage

The pressure that pushes electrons in an electrical circuit is called voltage. Using the water analogy, if a tank of water were suspended one meter above the ground with a one-centimeter pipe coming out of the bottom, the water pressure would be similar to the force of a shower. If the same water tank were suspended 10 meters above the ground, the force of the water would be much greater, possibly enough to hurt you. (If you jumped from a one-meter diving board, the force when you hit the water would not be too great. If you jumped from a 10-meter board, the force would be much greater.)



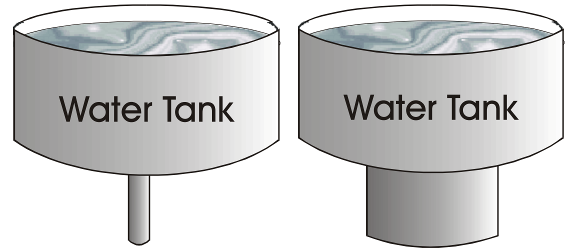
Voltage (V) is a measure of pressure, or electromotive force, applied to electrons to make them move. It is a measure of the strength of the electric current in a circuit. Voltage is measured in volts (V). A volt is the amount of electromotive force (emf) needed to push a current of one ampere through a resistance of one ohm. This definition will make more sense after you learn about current and resistance.

Just as the 10-meter tank applies greater pressure than the 1-meter tank, a 10-volt power supply (such as a battery) would apply greater electromotive force than a 1-volt power supply. Voltage potential is the electrical term that is analogous to water pressure.

AA batteries are 1.5-volt; they apply a small amount of voltage or pressure for lighting small flashlight bulbs. A car usually has a 12-volt battery—it applies more voltage to push current through circuits to operate the radio or defroster. The standard voltage of wall outlets is 120 volts—a potentially dangerous amount of voltage. An electric clothes dryer is usually wired at 240 volts—a very dangerous amount of voltage.

Current

The flow of electrons can be compared to the flow of molecules of water. The water current is the number of molecules flowing past a fixed point; electrical current is the number of electrons flowing past a fixed point. Electrical current is defined as electrons flowing between two points having a difference in voltage potential. Current is measured in amperes or amps (A). One ampere is 6.25×10^{18} electrons per second passing through a circuit.

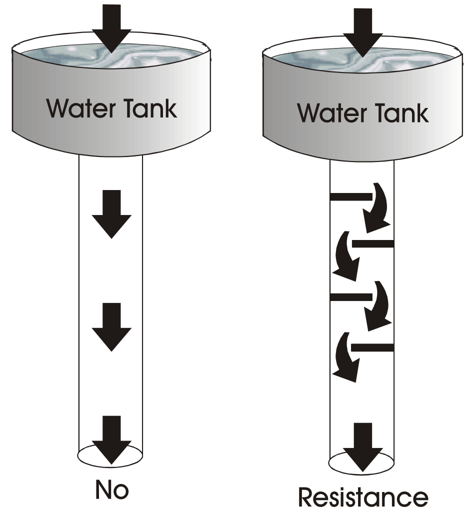


With water, as the diameter of the pipe increases, so does the amount of water that can flow through it. With electricity, a conducting wire is the pipe. As the cross-sectional area of the wire increases, so does the amount of electric current (number of electrons) that can flow through it.

Resistance

Resistance is a property that slows the flow of electrons—the current. Using the water analogy, resistance is an impediment to water flow. It could be a smaller pipe or fins on the inside of a pipe. In electrical terms, the resistance of a conducting wire is dependent on the metal used to make the wire, and the diameter of the wire. Copper, aluminum, and silver—common metals used in conducting wires—all have different resistance properties. Resistance is a characteristic property of a conducting material.

Resistance is measured in units called ohms (Ω). There are electrical devices, called resistors, designed with specific resistance that can be placed in circuits to reduce or control the flow of the current. Every electrical appliance contributes resistance to a circuit, as well. Any appliance or device placed within a circuit to do work is called a load. The lightbulb in a flashlight is a load. A television plugged into a wall outlet is a load. Every load introduces resistance in a circuit.



Ohm's Law

George Ohm, a German physicist, made an important discovery about electricity in the early 19th century. He found that in many materials, especially metals, the current that flows through a material is proportional to the voltage across the material. In the substances he tested, he found that if he doubled the voltage (V), the current (A) also doubled. If he reduced the voltage by half, the current dropped by half. The resistance (Ω) of the material remained the same whether the voltage and current increased or decreased. This relationship is called Ohm's Law, and can be written in three simple formulas. If you know any two of the measurements, you can calculate the third using these formulas:

voltage (volts) = current (amperes) x resistance (ohms) or $V = A \times \Omega$

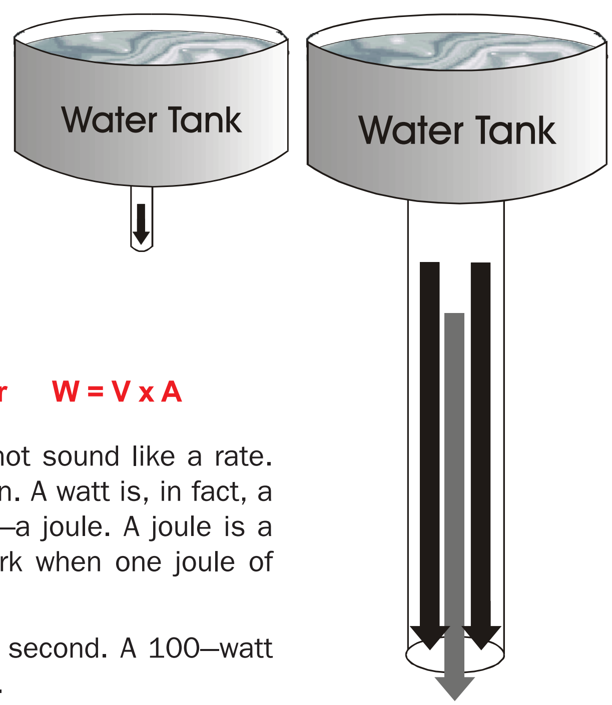
current (amperes) = voltage (volts) / resistance (ohms) or $A = V / \Omega$

resistance (ohms) = voltage (volts) / current (amperes) or $\Omega = V / A$

Electrical Power

Power is a measure of the rate of doing work or the rate at which energy is converted. Electrical power is the rate at which electricity is produced or consumed. Using the water analogy, electric power is the combination of the water pressure (voltage) and the rate of flow (current) that results in the ability to do work.

A large pipe carries more water (current) than a small pipe. Water at a height of 10 meters has much greater force (voltage potential) than water at a height of one meter. The power of water flowing through a 1-centimeter pipe from a height of one meter is much less than water through a 10-centimeter pipe from a height of 10 meters.



Electrical power is defined as the amount of electric current flowing due to an applied voltage. It is the amount of electricity required to start a device or operate a load for one second. Electrical power is measured in watts (W). The formula for power that quantifies this relationship is:

power (watts) = voltage (volts) x current (amperes) or $W = V \times A$

Measuring electrical power can be confusing because a watt does not sound like a rate. Usually we think of rates as ratios—miles per hour or miles per gallon. A watt is, in fact, a ratio; you must learn about another measurement to understand it—a joule. A joule is a measurement of work performed. One watt is the rate of doing work when one joule of energy is used in one second (1 watt = 1 joule/second).

A 50–watt lightbulb uses electrical power at a rate of 50 joules per second. A 100–watt lightbulb uses electrical power at the rate of 100 joules per second.

Short Circuits

Star Power for the Future

Fusion is the energy source of the stars—an energy produced by fusing hydrogen atoms into helium under tremendous heat and pressure. Today, we can break apart atoms through the process of fission to produce energy and long-lived radioactive waste. Tomorrow, we may be able to produce energy through fusion with very small amounts of short-lived radioactivity.

The basic fuels of fusion—deuterium (a heavy form of hydrogen) and lithium—are abundant on earth. About four gallons of seawater contain enough deuterium to produce the same amount of energy as two tons of coal. The challenge is to find a way to heat the fuels to 100 million degrees Celsius, at which point they become plasma, then sustain and control that temperature so that the energy produced can be converted to electricity.

The Department of Energy's Fusion Energy Sciences Advisory Committee thinks that fusion could be a possibility in the next 35 years. There have already been many breakthroughs in fusion research. Thirty years ago, researchers reached a milestone by producing one-tenth of a watt of power for one-hundredth of a second. Today, they can produce 10 million watts for about a second. For more information on fusion research, go to **www.ofes.fusion.doe.gov**.

Burying Greenhouse Gases—Carbon Sequestration in Briny Reservoirs

Deep beneath much of the United States lie rock formations containing water much too salty to drink. These brine-filled reservoirs are now being considered as possible storage sites for greenhouse gases emitted from power plants. Theoretically, these reservoirs could hold all of the carbon dioxide emitted from the nation's coal-fired power plants for the next 100 years.

The Department of Energy has approved a research team headed by American Electric Power (AEP) and Battelle to begin studying potential sites in the Ohio River Valley where carbon dioxide—a greenhouse gas emitted when coal and other fuels are burned—might one day be injected in reservoirs deep underground, where it would remain safely and permanently trapped. AEP has volunteered its Mountaineer Plant in New Haven, WV, as the test site for studying the process.

If the technique proves feasible, it could offer a way for many electric and industrial plants to reduce emissions that contribute to global climate change. The AEP project will be important because it will be located in an area with a large concentration of fossil fuel power plants. For more information on carbon sequestration, go to **www.fossil.energy.gov**.

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