

# energy EXCHANGE

A publication of the National Energy Education Development Project

NOV-DEC 2003

## NEED Energy Education Report Card



During 2002-2003, NEED has been working with an independent evaluation consultant from Lang Consulting Group in Columbus, OH, to conduct a comprehensive evaluation to formally review and improve our program materials and training techniques. The most important focus area was the effectiveness of the NEED curriculum in increasing student knowledge of energy.

To assess gains in students' energy knowledge, changes in opinions about energy, and increases in leadership behavior, **Energy Polls** were developed, with the assistance of our Teacher Advisory Board, on four levels: Primary (K-3), Elementary (Grades 4-5), Intermediate (Grades 6-8), and Secondary (Grades 9-12).

The knowledge sections were further grouped into the four energy content areas emphasized in the NEED curriculum: Science of Energy, Sources of Energy, Electricity, and Conservation/Efficiency. The questions were designed to have varying degrees of difficulty, with some requiring only knowledge and others requiring critical thinking skills.

In August 2002, 350 NEED teachers from 28 states and territories, representing a wide range of grade levels and NEED experience, were asked to participate in a study using these polls. One hundred twenty-eight (128) teachers agreed to participate in the study by administering the appropriate grade-level polls to their students before and after their energy units. The teachers also completed pre and post questionnaires that provided information about their participation in NEED, their schools, energy units and students.

Nine variables were analyzed to determine what factors affect student knowledge: school size, type of community, teacher experience, teacher experience with NEED, type of NEED training, number and focus of NEED materials used, number of students participating in NEED, type of implementation, and length of energy unit.

## Key Findings of the Study

The results of the study showed that NEED students in all grade levels and types of schools significantly increased their knowledge of energy.

The greatest knowledge gains were in the Sources of Energy, an area of key importance in the National Science Content Standards and a focus of many NEED activities and resources. The average pre-score for all students on this section was 37.4 percent; the average post-score was 55.3 percent.

Students showed positive changes in their opinions about energy across all grade levels. The largest positive opinion changes were for primary and secondary grades compared to other grade levels.

Students showed positive change in leadership behaviors after their energy units across all grade levels. Students in the secondary grades showed larger positive change in self-reported leadership behaviors after their energy units than students at the other grade levels.

The energy units varied significantly in length of unit and scope of information covered. The knowledge gains were significantly larger for students whose teachers had more experience using NEED materials and teachers who used more NEED materials in their energy units.

The **Energy Education Report Card** with the poll data and key findings is posted on our website at [www.need.org](http://www.need.org), along with a comprehensive analysis of the data by Lang Consulting Group.

The **Energy Polls** are a recommended assessment tool for all NEED teachers. They are available in the **Blueprint for Success** and on the NEED website at [www.NEED.org/poll](http://www.NEED.org/poll).

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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.*

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# CALENDAR OF EVENTS

For more information, email [info@need.org](mailto:info@need.org) or call 1-800-875-5029

## October – Energy Awareness Month

- 1-4 NEED Presentations - National Ocean Industries Association Fall Meeting - Colorado Springs, CO
- 7, 14, 21, 28 Energy Industry Study Program - Energy Information Administration - Washington, D.C.
- 10-11 Virginia Energy Fair - Richmond, VA
- 14 NEED Workshop - Tulsa, OK
- 16-18 NEED Workshop - Illinois Science Teachers Association Convention
- 20 Kentucky NEED Workshop - Florence, KY
- 21 Kentucky NEED Workshop - Edgewood, KY
- 23 Michigan NEED Workshop - Van Buren, MI
- 24 Solar Schools Ribbon Cutting - Apple River Middle School - Apple River, IL
- 27-28 NEED Sessions - Mississippi Science Teachers Association Convention
- 29-30 NEED Workshops - Maine Public Service Company - Presque Isle, ME
- 30 Kentucky NEED Workshop - Alexandria, KY
- 30-Nov 1 NEED Sessions - NSTA Regional Convention - Minneapolis, MN
- 31 NEED Sessions - CAST 2003 Conference - Houston, TX

## November 2003

- 3 NEED session for visiting Japanese Educators - Washington, D.C.
- 4, 18 Energy Industry Study Program - Energy Information Administration - Washington, D.C.
- 5 NEED Workshop in partnership with Alliance to Save Energy - Rochester, NY
- 5-6 Rhode Island Middle School/High School Workshops - Cranston, RI
- 7 NEED Sessions - Kentucky Science Teachers Association Convention
- 10 Mississippi NEED Workshop - Jackson, MS
- 11 Michigan NEED Workshop - Grand Valley State University, MI
- 12 Rhode Island NEED Inservice - Cranston, RI
- 12 Kentucky NEED Workshop - Pippa Passes, KY
- 13 Kentucky NEED Workshop - Whitesburg, KY
- 13 Kentucky NEED Workshop - Hazard, KY
- 13-15 NEED Sessions - NSTA Regional Convention - Kansas City, MO
- 13-14 NEED Sessions for New York City Schools
- 14 Kentucky NEED Workshop - Hazard, KY
- 18 Kentucky NEED Workshop - Owensboro, KY
- 19 Kentucky NEED Workshop - Hopkinsville, KY
- 20 Kentucky NEED Workshop - Paducah, KY
- TBA Illinois NEED Workshops - statewide
- TBA Louisiana NEED Workshop - Orleans Parish, LA
- TBA Louisiana NEED Workshop - La Fourche Parish, LA
- TBA Oklahoma NEED Workshop - Oklahoma City, OK
- TBA Colorado NEED Workshops

## December 2003

- 2, 9, 16 Energy Industry Study Program - Energy Information Administration - Washington, DC
- 3 Kentucky NEED Workshop - Bowling Green, KY
- 4 Kentucky NEED Workshop - Lexington, KY
- 4-6 ILEED Teacher Advisory Board Meeting - Chicago, IL
- 4-7 NEED Sessions - Louisiana Science Teachers Association - New Orleans, LA
- 4-7 NEED Sessions - NSTA Regional Convention - Reno, NV
- 9 Kentucky NEED Workshop - NKU - Covington Campus, KY
- 10 Kentucky NEED Workshop - Ashland, KY
- 11 Kentucky NEED Workshop - Prestonsburg, KY
- TBA Illinois NEED Workshops - statewide



# NEED NEWS



## **Robinwood Lane Elementary – Youngstown, OH**

Robinwood Lane has begun an Adopt A Classroom program! Each member of the Robinwood Lane Energy Rangers is responsible for a particular class throughout the year. To introduce the student leaders to their classes, Jan Zorman, NEED Lead Teacher, took pictures of the Rangers and put them in recycled material frames. As a group, the Rangers plan and organize energy projects, handouts, storybooks, and other activities, and then take them to their adopted classes. The Rangers have a different energy activity each month, along with regular recycling and trash pick-up projects. The teachers think it is just great to have “kids” teaching lessons in their classrooms.

To start the project, many of the Rangers read energy stories to their adopted classes and presented energy activities. For solar energy, they used **Primary Stories and More** and made storybooks for each room, then added plants that use the sun. For Energy Awareness Month, the Rangers made newspapers. The local newspaper donated the blank paper for them to use to teach about energy.

## **Discoveries for Everyone!**

For Energy Awareness Month, October 2003, the U.S. Department of Energy, the U.S. Minerals Management Service, the National Ocean Industries Association and NEED launched year two of Discoveries for Everyone. This coloring poster with teacher guide introduces younger students to many aspects of the offshore oil and gas industry. This year, an additional Offshore Activity Book is available, too! Contact NEED at 800-875-5029 or [info@need.org](mailto:info@need.org) to request class-sets for your school.

## **It May Be November, But Start Thinking Summer!**

NEED's 2004 National Energy Conferences for Educators are scheduled for Hyannis, Massachusetts (July 11-15, 2004), Galveston, Texas (July 17-21, 2004), and Long Beach, California (July 25-29, 2004). Brochures and agendas will be available in December 2003. Registration is \$800.00 and includes lodging and most meals. NEED to energize your classroom? Plan now to attend!

## **New for 2003-2004!**

Have you updated your membership? If not, be sure to call NEED and request the newest NEED curriculum kit. Call 800-875-5029 or email [info@need.org](mailto:info@need.org).

## **American Coal Foundation Launches New Website**

The American Coal Foundation recently launched its new and much improved website to provide excellent resources for students and teachers about coal, coal mining, and electricity generation. The new site [www.teachcoal.org](http://www.teachcoal.org) has a variety of materials to help teach about coal, including free coal samples.

## **NEED – It's Not Just for Teachers and Students**

Expanding its partnership with the U.S. Department of Energy's Energy Information Administration, NEED and EIA launched the Energy Industry Study Program in the spring. The ten-week lecture and field trip series introduces EIA staff to many aspects of the energy industry. The fall session is well underway and participants have the opportunity to interact with many NEED partners in the energy industry while touring nuclear power stations, photovoltaic manufacturers, hydro facilities and more!

## **Many Thanks!**

NEED programs were presented at the Illinois Science Teachers Association Annual Convention, the Convention for the Advancement of Science Teaching in Texas, and the Mississippi Science Teachers Association Convention, with the help of NEED Leaders Bob Thompson and Doris Tomas, and Kentucky Coordinator Karen Reagor. These sessions introduced teachers to NEED and encouraged them to teach energy in the classroom. Sessions for other state associations are planned throughout the fall. If you are attending an NSTA Regional Convention in Minneapolis, Kansas City, or Reno this fall, visit the NEED sessions at these events.

## **New NEED Student Arrives!**

Congratulations to NEED Teacher Advisory Board member Constance Beatty and her husband Steve on the birth of Grace Elizabeth Beatty on October 16, 2003. Grace is the sister of NEED Student Leader Lauren Beatty!

## **Mark Your Calendar for Youth Awards!**

The 24<sup>th</sup> Annual Youth Awards for Energy Achievement is scheduled for June 25-28, 2004, at the Hyatt Regency Crystal City, VA.

## **Tennessee Leads the Way**

Tennessee has launched its Energy Smart Leaders program to involve Lead Teachers who work to educate students about energy efficiency in the classroom and community. The Leaders receive stipends to host energy workshops and act as resources for local schools. Congratulations to Tim Hicks, Kay Lange, and Debbie Schafer for being selected as the first Energy Smart Leaders!

## **Energy Star**

Energy Star is a government-backed program that helps schools, businesses and individuals protect the environment through superior energy efficiency. Last year alone, Americans, with the help of Energy Star, saved enough energy to power 15 million homes and avoid greenhouse gas emissions equivalent to those from 14 million cars - while saving \$7 billion. The Energy Star website provides lots of information and resources for teachers and students at [www.energystar.gov](http://www.energystar.gov).

# PRIMARY **ACTIVITY: Spin the Saltine!**

**Concepts:** The chemical energy in food can be converted into motion.

The linear (straight) motion of air can be changed into a rotational (spinning) motion.

Windmills convert wind - the motion of air - into electricity.

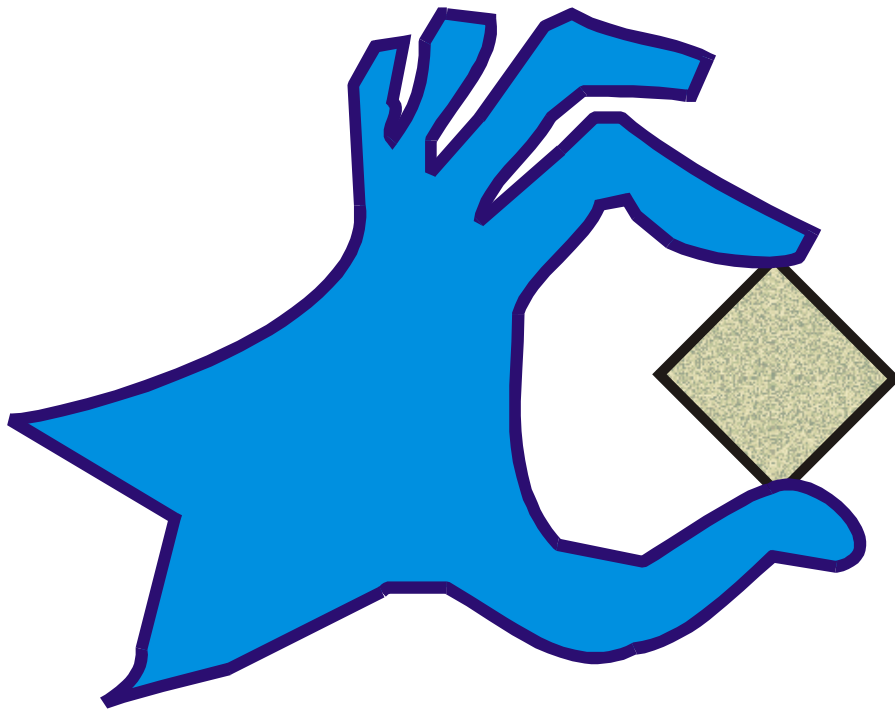
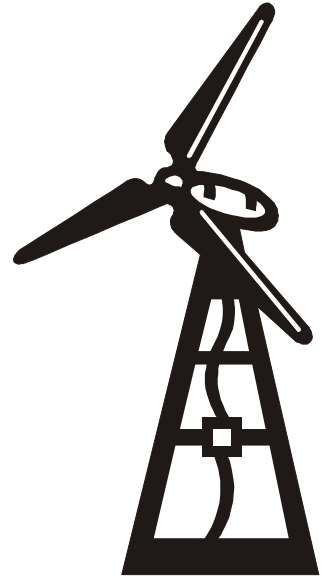
**Materials:** Box of saltine crackers (enough for each student)

**Directions:** Provide each student with an unbroken saltine cracker. Make sure the corners of the crackers are sharp. Demonstrate how to hold diagonal corners of a cracker gently between your thumb and index finger, as shown in the picture below. Blow on the outside corner and the saltine will spin like a turbine.

Direct the students to hold their crackers very gently and blow on the outside corner. It might take the students a few attempts to master the technique.

Explain to the students that they are converting the energy in the food they have eaten into motion energy - the movement of air. The energy in the moving air is spinning the cracker. Direct the students to blow very lightly, then harder and harder to see what happens.

Explain that windmills work on the same principle. The blades of a windmill convert moving air, called wind, into a spinning motion that spins a turbine. The turbine spins a magnet inside a coil of wire to produce electricity.



**Blow On  
Corner**

# ELEMENTARY ARTICLE: What's A Short Circuit?

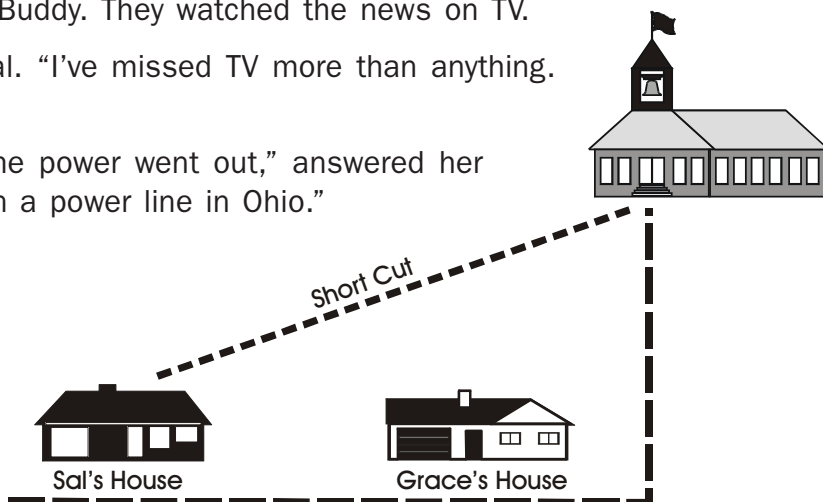
Sal sat on the couch with her mother, patting Buddy. They watched the news on TV.

"I'm so glad the power is back on," sighed Sal. "I've missed TV more than anything. Can we change the channel?"

"In a minute, Sal. They're talking about why the power went out," answered her mother. "They think there was a short circuit in a power line in Ohio."

"What's a short circuit?" asked Sal.

"A short circuit is electricity taking a shorter path because a wire is broken. It's like when you take the short cut through the field to school. You get to school faster, but you don't get to walk with Grace, because you don't go by her house."



"Short circuits are the reason we make sure Buddy doesn't chew on the electric cords. When a lamp is plugged in, it is connected to an electric circuit through the outlet. Electricity runs from the outlet to the lamp and back to the outlet through two wires in the cord. The two wires don't touch each other. They are separated by an insulated covering. The electrons flow to the lamp through one wire in the cord, through the light bulb, and back to the outlet through the other wire in the cord."

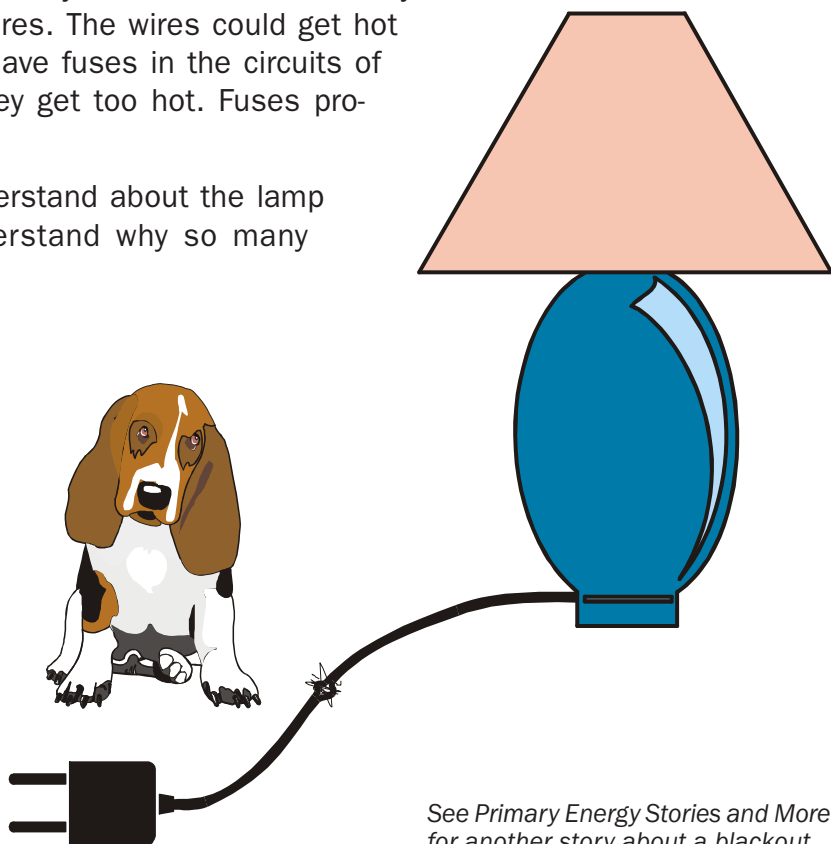
"If Buddy chews on the cord, he can break the insulation covering the wires. The wire going to the lamp could touch the wire going back to the outlet. The electrons would flow from one wire to the other through this shorter path, the short circuit. No electrons would flow to the lamp."

"The short circuit could make the wires get very hot because so many electrons are flowing so quickly through the wires. The wires could get hot enough to cause a fire. To keep us safe, we have fuses in the circuits of our house. Fuses shut down the circuits if they get too hot. Fuses protect our house from electrical fires."

Sal looked at Buddy and the lamp. "Ok, I understand about the lamp and the short circuits. But I still don't understand why so many people lost power for so long."

Her mom answered, "Lots of power lines are connected to each other in the United States and Canada. One of the big lines had a short circuit. The electricity flowed through the other power lines. Some of these became too hot and also short-circuited. Just like in our house, these big circuits shut down if they are getting too hot. A lot of power plants shut their lines down so they would not burn. It took a long time to make sure all the short circuits were fixed and get everything working again."

Sal smiled and said, "I'm glad the power's back on. Can I watch my show now?"



*See Primary Energy Stories and More for another story about a blackout.*



# INTERMEDIATE/SECONDARY ARTICLE: The Blackout of 2003

On August 14, 2003, much of the Northeast United States and parts of Canada suddenly lost electrical power. Many cities were without electricity for several days. Subways came to a stop and people on the top floors of high-rise buildings had to walk down many flights of stairs when the elevators came to a halt. The lives of many people changed dramatically until the power was restored. The real question on everyone's mind was, "What happened?"

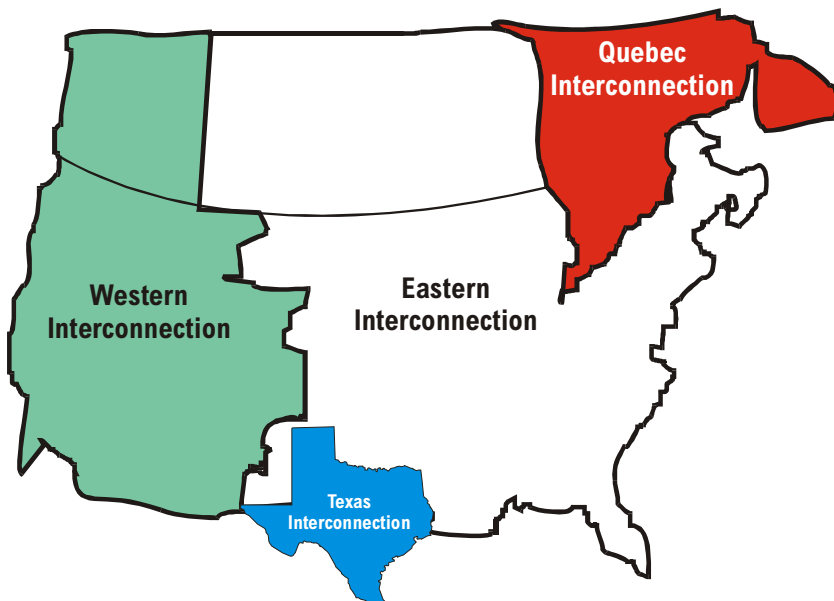
The North American Electric Reliability Council thinks the power blackout originated from transmission lines in Ohio that short-circuited, causing facilities all along the grid to shut down. Investigators believe that an overheated transmission line sagged into a tree outside of Cleveland at 3:32 p.m. on August 14th and short-circuited. The failure of that transmission line put enormous strain on the other lines in Ohio. Soon a utility company that serves southern Ohio sealed itself off because its lines were close to burning up from the additional load. This created a barrier on the grid between the southern part of Ohio and the northern part.



The Cleveland area, in the north, began drawing huge amounts of power from Michigan and Ontario, knocking out more lines and shutting down more power plants, pushing the crisis to the borders of New York. The New York power system, acting to protect itself, sealed its borders with Canada, which created a different problem. It has no place to quickly send its surplus power and overloaded its own system. A widespread shutdown then occurred. In a moment of unexpected darkness, terms like "power grid" and "transmission lines" were all over the news, but many people still aren't sure exactly what they mean.

**Power grid: A geographical section of transmission lines.** The United States has three power grids – the Western Interconnection, the Eastern Interconnection and the Texas Interconnection. Canada also has three – the Western, Eastern, and Quebec grid, which includes Atlantic Canada. The border between the Eastern and Western grids lies between Alberta and Saskatchewan. The Eastern and Western grids are connected in some areas by direct-current lines, but are largely independent of each other.

**Transmission lines: Cables that carry electricity.** The tall electrical towers throughout the country hold large power lines that transmit high voltage electricity over long distances. Transmission lines can also be buried underground.



**Electricity: The flow of electrons through conducting wire.** The electricity flowing over the grid is a function of voltage and current. Combining high voltage and low current generates the same amount of power as combining low voltage and high current. Current produces heat, which can cause wear to transmission lines. Because heat damages the wires over time, power is transmitted with high voltage and low current. While this prolongs the life of transmission cables, the current still degrades the lines over time.

Electricity is one of the world's most valuable commodities and the market to sell it is crowded. The problem is, while there has been enormous investment in electricity generation, there has been relatively little attention paid to the maintenance and expansion of the lines used to transport electricity. The result is too much electricity traveling over too few or inadequate transmission lines.

## The Blackout of 2003 *continued*

**Cross-border connections: Transmission lines that cross the borders of countries.** When parts of Canada's electricity grid were connected with the U.S. grid, the intention was to open a new market for surplus electricity and to establish a source of backup power. The shared system allows generators to operate more efficiently, because they can continue to generate electricity when local demand is low. With open markets and shared transmission lines, power can be sold across hundreds of miles.

Since the transmission lines are shared, however, there is little incentive for companies to invest heavily in their upkeep. It's simply not a profitable venture, so it isn't done and breakdown is the result. Many of the lines in the North American system were built decades ago.



In the years since the transmission lines were built, they have been used to transport more electricity over longer distances, adding more stress to the system. The lines degrade under the extra heat and eventually burn. The electricity is then shunted to another line and, if that cable can't sustain the extra load, it breaks too. That's what led to a 1996 blackout that included areas of Alberta and British Columbia, and ranged all the way to Baja, California. And it's apparently what happened to the lines in Ohio on August 14<sup>th</sup> to cause the major blackout in the Northeast.

Researchers at Cambridge Energy Research Associates pointed out an additional problem—communication. The system for communication among the organizations that operate the power grid is inadequate. Problems can erupt within the grid in seconds and expand very quickly. A communication system needs to be able to respond just as quickly. In many areas, the only method of communication is over phone lines. Most people agree, however, that quicker communication would not have prevented the August 14th blackout.

Chances are the blackout isn't the last incident. The U.S. Department of Energy estimates that American generating capacity will increase more than 20 percent by 2010. Transmission line capacity in that same period is expected to increase only four per cent. Suggestions to improve the capacity and reliability of the grid include:

- Make an investment in new infrastructure. We need to build more lines that can carry more electricity. This will take huge amounts of money and a long time.
- Integrate the regional power networks more efficiently in terms of infrastructure and communication.
- Mandate electric reliability standards and procedures.
- Add new silicon switches. The switches would allow transmission lines to be operated like toll roads. This would place some power generating facilities in strategically better positions than others, and some energy companies could suffer.
- Install flow cell batteries. Flow cell batteries store up energy when supply exceeds demand and dole it out when demand exceeds supply. They are very expensive. A battery to store 24 hours of power for a small community would cost twice as much as a new power line. It would also be the size of a low-rise building.
- Install computer programs to isolate outages. Computers could anticipate the cascade effect and trip circuit breakers to isolate and minimize the problem. Massive blackouts would not occur because the program would trip all switches surrounding a circuit breakage. These computer models are still in the testing stages. Once perfected, they will be quite useful in combination with silicon switches.

*Summarized from articles and testimony by CBS News Online and Cambridge Energy Research Associates*

# Short Circuits

## The Hindenburg Myth

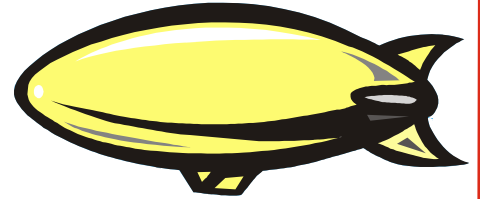
The Hindenburg tragedy is considered by some to be the most notorious example of a hydrogen fuel safety failure. A recent study by former NASA scientist Addison Bain indicates that, in fact, the hydrogen fuel was not the culprit and suggests that the accident has unfairly branded hydrogen as an unsafe fuel.

The Hindenburg was a zeppelin, a rigid airship with a long, cylindrical body supported by internal gas cells. Named after German president Paul von Hindenburg, it was the largest airship ever built, stretching more than 800 feet from bow to stern. Inside the ship, large bags filled with hydrogen gas provided lift and catwalks allowed crew members to move about the ship. A gondola underneath carried the passengers, who enjoyed the finest staterooms and luxurious dining.

In the 1930s, airships like the Hindenburg were expected to be the future of air travel. With a maximum speed of more than 80 miles per hour, they cut trans-Atlantic crossings by about two-thirds.

When the Hindenburg left Frankfurt, Germany, for America on May 3, 1937, there were 97 people aboard. It had already made several trips to Brazil and several more to North America, carrying a total of more than 2,600 passengers. The ship encountered a storm upon arrival in Lakehurst, New Jersey, on May 6th. A crowd had gathered to watch the landing when, suddenly, the ship burst into flames, killing 35 passengers. After an investigation, the hydrogen fuel was blamed for the explosion.

Addison Bain, however, after nine years of research, has concluded that the accident was most likely caused by the paint covering the surface of the airship, not the hydrogen fuel. He believes the chemical and electrical properties of the paint on the outer shell, in connection with the meteorological conditions on May 6th, were the real culprits in the explosion.



For more information, go to the National Hydrogen Association website, [www.hydrogenus.com](http://www.hydrogenus.com).

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