CURRENT ENERGY AFFAIR

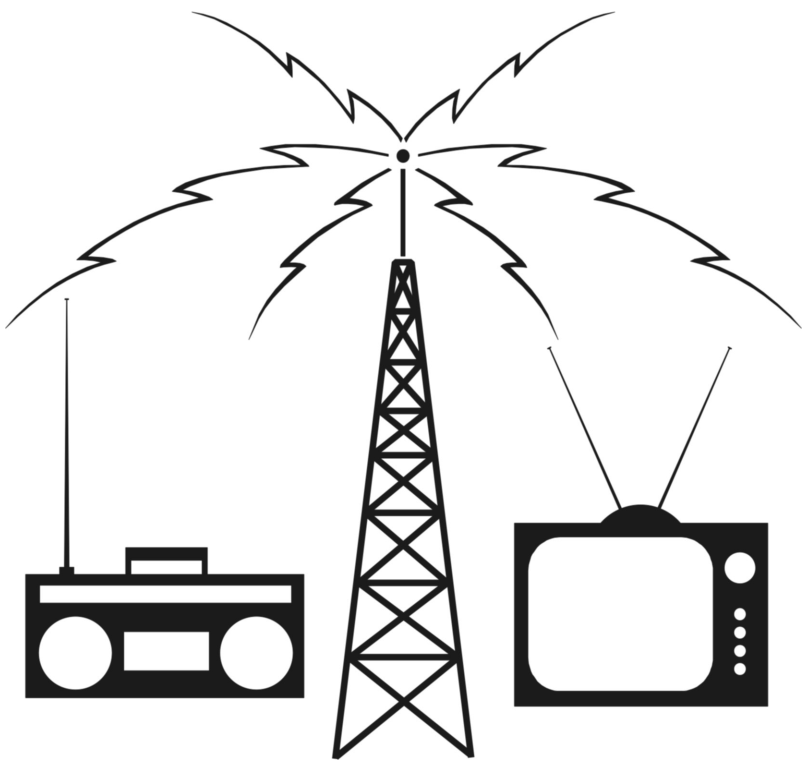
Student reporters use this activity to create a television show about electricity.

GRADE LEVEL

7–12

SUBJECT AREAS

Science
Social Studies
Language Arts
Technology



NEED 2009-2010

Putting Energy into Education

NEED Project PO Box 10101 Manassas, VA 20108 1-800-875-5029 www.NEED.org

Teacher Advisory Board

Teacher Advisory Board Vision Statement

NEED Mission Statement

The mission of the NEED Project is to promote an energy conscious and educated society by creating effective networks of students, educators, business, government and community leaders to design and deliver objective, multi-sided energy education programs.

In support of NEED, the national Teacher Advisory Board (TAB) is dedicated to developing and promoting standards-based energy curriculum and training.

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NEED
Putting Energy into Education

Correlations to National Science Standards

(Bolded standards are emphasized in the unit.)

INTERMEDIATE STANDARDS

3. Natural Hazards

b. Human activities can induce hazards through resource acquisition, urban growth, land-use decisions, and waste disposal.

c. Hazards can present personal and societal challenges because misidentifying the change or incorrectly estimating the rate and scale of change may result in either too little attention and significant human costs or too much cost for unneeded preventive measures.

4. Risks and Benefits

b. Students should understand the risks associated with natural hazards, chemical hazards, biological hazards, social hazards, and personal hazards.

c. Students can use a systematic approach to thinking critically about risks and benefits.

d. Important personal and social decisions are made based on perceptions of benefits and risks.

5. Science and Technology in Society

a. Science influences society through its knowledge and world view. The effect of science on society is neither entirely beneficial nor entirely detrimental.

b. Societal challenges often inspire questions for scientific research, and societal priorities often influence research priorities.

c. Technology influences society through its products and processes. Technological changes are often accompanied by social, political, and economic changes that can be beneficial or detrimental to individuals and to society. Social needs, attitudes, and values influence the direction of technological development.

d. Science and technology have contributed enormously to economic growth and productivity among societies and groups within societies.

e. Science cannot answer all questions and technology cannot solve all human problems or meet all human needs. Students should appreciate what science and technology can reasonably contribute to society and what they cannot do. For example, new technologies often will decrease some risks and increase others.

SECONDARY STANDARDS

3. Natural Resources

a. Human populations use resources in the environment to maintain and improve their existence.

b. The earth does not have infinite resources; increasing human consumption places severe stress on the natural processes that renew some resources, and depletes those resources that cannot be renewed.

c. Humans use many natural systems as resources. Natural systems have the capacity to reuse waste but that capacity is limited. Natural systems can change to an extent that exceeds the limits of organisms to adapt naturally or humans to adapt technologically.

4. Environmental Quality

c. Many factors influence environmental quality. Factors that students might investigate include population growth, resource use, population distribution, overconsumption, the capacity of technology to solve problems, poverty, the role of economic, political, and religious views, and different ways humans view the earth.

5. Natural and Human-induced Hazards

b. Human activities can enhance potential for hazards. Acquisition of resources, urban growth, and waste disposal can accelerate rates of natural change.

d. Natural and human-induced hazards present the need for humans to assess potential danger and risk. Many changes in the environment designed by humans bring benefits to society, as well as cause risks. Students should understand the costs and trade-offs of various hazards—ranging from those with minor risk to a few people to major catastrophes with major risk to many people.

6. Science and Technology in Local, National, and Global Challenges

b. Understanding basic concepts and principles of science and technology should precede active debate about the economics, policies, politics, and ethics of various science and technology related challenges. However, understanding science alone will not resolve local, national, and global challenges.

Teacher Guide

TO INTRODUCE STUDENTS TO ELECTRIC POWER GENERATION, DISTRIBUTION, MANAGEMENT, AND HISTORY.

BACKGROUND

This activity is modeled after a television news broadcast with student-correspondents reporting on seven major areas of electric power generation. Using NEED's **Secondary Electricity Factsheet** and the **Current Energy Affair** lead stories, students develop presentations on seven areas of electric power generation.

CONCEPTS

- Electricity is a secondary source of energy that is easily transported. It is an effective energy carrier.
- Three types of power plants produce most of the electricity we use.
- Electric power is very reliable—99 percent in the United States.
- Watts, kilowatts, and megawatts are all measures of electric power.
- Demand-side management affects the quantity and timing of electricity demand.
- Energy Guide Labels help consumers buy efficient home appliances.
- Many factors affect the cost of electricity.
- The nation's electricity comes mostly from large electric utility companies and also from some small independent power producers.
- The use of energy efficiency technologies and energy conservation techniques can significantly reduce electricity consumption.

TIME

Two to three 45-minute class periods

MATERIALS

- One **Current Energy Affair** lead story for each student
- One **Secondary Electricity Factsheet** for each student (found in **Secondary Energy Infobook** and on NEED's website at www.need.org)
- One **Current Energy Affair Questions** for each student
- Sample scripts for **Optional Activity** included in this booklet

PROCEDURE

Step One—Preparation

- Familiarize yourself with the activity and the information in the **Secondary Electricity Factsheet**. Make copies of the factsheet, the **Current Energy Affair Questions**, and the seven lead stories so that each student in the group has a copy.
- Decide who will be in each of the seven groups. If your students are not used to working in groups, you may want to give them guidelines for group work.

Step Two—Introduce unit to the class

- Introduce the activity to the class. Explain that the students will be working in small groups and give them guidelines for working together.

- Give this explanation of the activity to the class:

  You have all probably seen television shows in which investigative reporters go behind-the-scenes to uncover information about various feature stories. In this activity, you will be the investigative reporters assigned to uncover stories about electricity. Electric power generation has been divided into seven areas, and background information and story leads have been written for each of these areas. Your job is to develop a news story to teach your audience about one area of electricity.

- Put students into groups and distribute the lead stories, factsheets, and Current Energy Affair Questions.

- ***Note: If you are using the optional activity, explain to the students that their assignment is to make presentations, using the scripts.***

Step Three—Monitor group work

- Once students are in their groups, have them read through the sections of the factsheet listed at the top of their lead story and compile a list of important facts. Emphasize that their list must answer the questions that correspond to their lead story. Have the students read their lead story and decide how to incorporate their list of facts into the story. Students should develop their story and rehearse their presentations.

Step Four—Student presentations

- Now it's time for the group presentations. Students need to have their **Current Energy Affair Questions** with them so they can answer the remaining questions as the presentations proceed. You can use the following lead to introduce the students' presentations:

  What's the first thing that comes to your mind when someone mentions your local electric power company? Well, if that image in your mind is not a positive one, you haven't been reading all the information you get in your monthly utility bill. Electric utilities are promoting a unique new partnership among the makers, buyers, and users of electrical power—a sort of Utilities & Us approach to electricity. To bring you up-to-date, Current Energy Affair presents an in-depth profile on the new relationship between electric utilities and their customers. Featured all this week are stories on what's up with our utilities.

- After the presentations, students should hand in their completed **Current Energy Affair Questions**. You may go over the answers in class if time remains.

Step Five–Grading and Evaluation

You can use the grading outline below, or design your own.

- Script—25 points
- Presentation—40 points
- Group work—10 points
- **Current Energy Affair Questions** (answers for the other groups)—25 points

Alternate Procedure

Divide students into seven groups, distribute the sample scripts, and have the groups learn their scripts to make presentations to the class instead of creating their own scripts, while the other students answer the **Current Energy Affair Questions** during the presentations.

Technology Connection

Have the students create PowerPoint presentations about their assigned topics.

Story Leads

String of Pearls—The History of Electricity

Factsheet Section: History of Electricity.

Let's turn our electric clocks back to 1905, to Thomas Edison's time. Edison had the simple idea of lighting the world with electric lamps. He had already invented the first light bulb. In 1882, Edison had designed an electric power system—using Direct Current—to provide power to 85 customers in New York City. His Pearl Street Station was the first electric power plant in the world. Thirteen years later, in 1895, George Westinghouse opened a power plant in Niagara Falls, using Alternating Current. This power plant was able to transmit electricity all the way to Buffalo, nearly 25 miles away. What might Ben Franklin, Alessandro Volta, and Michael Faraday have to say?

Electrolympics: Generation, Transmission & Distribution

Factsheet Sections: Making Electricity; Moving Electricity from Power Plants to Homes; Energy Sources Used to Make Electricity; Measuring Electricity; Economics of Electricity.

Olympics athletes have their own events, but they also work together as a team to win as a country. It is the same in the Electrolympics. Today, we will be interviewing athletes who work together to make sure that your lights go on when you flip that switch. We'll be talking to the fuel jumpers who get the water really steamed up, the athletes in the steam medley who run the course from boiler to turbine to condenser and back Let's hear what the volt vaulters have to say about boosting the team's morale and the long distance runners who carry the torch over high-voltage lines. Our last interviews will be with the sprinters who carry the baton to neighborhood sub-stations and those who run the obstacle course through the wiring in our homes.

Electricity—The Dependable Force

Factsheet Section: Power to the People.

Isn't it annoying to have to reset all the clocks in your house when there has been a power outage? Can you imagine how you would feel if the electric power went out several times a week? Or several times a day? In many places around the world, electric outages are everyday occurrences. In the U.S., however, the electric power systems are more than 99 percent reliable, providing electricity without interruption. Having a reliable electric power system is important if homes, businesses, and industry are to operate efficiently and effectively—at two o'clock in the morning in the winter or two o'clock in afternoon on a hot summer day. To find out why they are so reliable, I am going to speak with several electric generators—base-load and peak-load. We'll find out what their work schedules are like, who uses their electricity, and how they work with other generators to provide electricity.

The Negawatt Diet—Demand-Side Management

Factsheet Sections: Demand-Side Management; Appliance Efficiency.

America has gone on a diet. If we aren't cutting calories, we're cutting fat. The latest diet craze is the negawatt diet. This diet requires us to cut down on the electricity we use and also change our meal times. To understand why this diet is necessary, just look at the profile of our electrical demand. You'll see a definite mid-day bulge. Today, we will interview an electric junkie who has decided to make sensible changes in his diet. He has learned that he doesn't have to change his lifestyle to save energy. We will also interview the manager of Chez Lean Restaurant, which has all the latest energy efficient appliances. Our last guest will be a marathon runner who will tell us how he keeps in shape by running steadily over long periods, with no bursts of peak energy.

Crime Watch—Investigating the Nation's Energy Losses

Factsheet Section: Economics of Electricity.

Theft is always in the news. Usually cash, jewelry, or cars are stolen. Our news team has just uncovered the loss of quadrillions of units of energy. The disappearance of energy is happening at all of the nation's power plants. And what's more shocking—it's been going on for more than 100 years. Where does the loss take place and who is responsible? What can we do to prevent further losses? Our investigative news team brings us this exclusive interview with the detectives assigned to the case.

Changing Electrotraffic Patterns—IPPs and Cogenerators

Factsheet Sections: Independent Producers; Power to the People; Making Electricity; Future Electricity Demand.

Thomas Edison's first power plant opened in 1882 and succeeded so well that others soon built their own systems to sell electricity. Over the next 50 years, the number of small power companies grew. They soon saw the economic value of merging their systems into single utilities. These utilities built giant power plants—mostly coal-fired, nuclear, or hydro plants—and began providing power to large geographical areas. As people began to demand more electricity, more power plants were built. Our WNRG traffic reporter spent time monitoring peak hour electrotraffic. Since 1975, however, he/she has noticed some definite changes in the electrotraffic patterns. Many independent power plants and cogenerating plants have sprung up in the utility's service area. The traffic from these plants is not flowing to consumers, but to the utility. In some places, consumers are generating their own power. Let's take a tour of these facilities to find out what's happening.

Time Tunnel to Tomorrow—The Future of Electric Power

Factsheet Section: Future Electricity Demand; Research and Development.

The final segment of Current Energy Affair is the Time Tunnel to Tomorrow feature. What will our lives be like in the future when it comes to energy? Will we have enough power? Where we will get it? How much more or less will we need? What energy sources will generate it? And what technologies may revolutionize the electric power industry? To find the answers to these questions, let's go to the year 2020 via our Time Tunnel to Tomorrow screen. We'll speak to power company engineers to discuss the technologies they are using and what the future will bring.

Current Energy Affair Questions

A String of Pearls—The History of Electricity

1. What contribution did Ben Franklin make to the understanding of electricity?
2. What contribution did Alessandro Volta make to the practical use of electricity?
3. What contribution did Michael Faraday make to the practical use of electricity?
4. Explain how Thomas Edison took electricity from the laboratory to people's homes.
5. Explain why George Westinghouse's use of AC current was more practical than Edison's use of DC power.

The Electrolympics—Generation, Transmission and Distribution

1. Why is electricity called a secondary source of energy?
2. What are the nation's top sources of energy for the generation of electricity?
3. How does high pressure steam or falling water produce electricity?
4. How is the electricity transported from the power plant to the customer?
5. What do transformers do?

Electricity—The Dependable Force

1. What would it be like to live in an area where the power system is 75 percent reliable?
2. Why do electric companies have 15 to 20 percent more generating capacity than they need?
3. What might increase the reliability of a power system?
4. Why do power companies use certain power plants almost 24 hours a day, while others only operate several hours each afternoon?
5. How do power pools increase the reliability of a power system?

The Negawatt Diet—Demand-Side Management

1. What is peak demand, and when is it during a 24-hour period?
2. Why is it important to reduce the amount of electricity used during peak demand periods?
3. How are electric utility companies encouraging people and industry to use energy more efficiently or during non-peak periods of the day?
4. How have past efficiency measures reduced the amount of electricity the nation uses today?
5. What is the payback period of an appliance?

Crime Watch—Investigating the Nation's Energy Losses

1. How many units of electrical energy would 200 units of coal produce in a power plant?
2. Most of the energy lost at a thermal power plant is in what form?
3. How much energy is used just to operate a power plant?
4. How much energy is lost transporting electricity from the power plant to you?
5. How does your body compare to a power plant in terms of energy efficiency?

Changing Electrotraffic Patterns—IPPs and Cogenerators

1. How do independent power producers differ from large electric utilities?
2. What primary sources of energy do independent power producers use to generate their electricity?
3. How much of the nation's electricity is presently generated by independent power producers?
4. Why is cogeneration an effective way to get more energy usage out of a single fuel?
5. What are the benefits to manufacturers that generate their own electricity?

Time Tunnel to Tomorrow—The Future of Electric Power

1. What technologies do consumers use today to conserve electricity?
2. What energy sources will be used to produce electricity in the future?
3. How much electricity is it estimated that the nation will need in 20 years?
4. How might superconductors affect the amount of electricity we will need in the future?
5. What inventions or new technologies might help us use less electricity in the next 20 years?

String of Pearls—The History of Electricity

CAST:

THELMA AND LOUISE: INVESTIGATIVE REPORTERS

THOMAS EDISON: INVENTOR OF DIRECT CURRENT POWER PLANT

GEORGE WESTINGHOUSE: DEVELOPER OF FIRST ALTERNATING CURRENT POWER PLANT

BENNIE FRANKLIN: DESCENDANT OF BEN FRANKLIN

ALEXIS VOLTA III: DESCENDANT OF ALESSANDRO VOLTA

MIKE FARADAY: DESCENDANT OF MICHAEL FARADAY

ANCHORPERSON

ANCHOR:
Tonight's "Flash From the Past" segment will take you to a City Council meeting in New York City in 1905, where an interesting hearing is in progress.

THELMA:
Thank you, *Anchorperson*. Louise and I are at a City Council meeting to decide the future of New York's electrification program—whether to use Thomas Edison's Direct Current technology or George Westinghouse's Alternating Current to electrify the city. Many experts are here to testify to the history and the future of electricity, and we will talk to some of them.

LOUISE:
That's right, Thelma. With me now is Thomas Edison, inventor of the phonograph, movie camera, and, of course, the light bulb.

EDISON:
And, of course, Miss Thelma, one must not forget that I invented the electric power generating and transmission system. Twenty-three years ago, in 1882, I opened my Pearl Street Station and began supplying electricity to 85 customers right here in New York City. And at a reasonable cost, I might add—only $5 per kilowatt-hour.

LOUISE:
An incredible accomplishment. (Pause.) Mr. Westinghouse, do you have anything to add?

WESTINGHOUSE:
I have no dispute with Mr. Edison over who developed those technologies. The issue here is the superiority of my alternating current over Mr. Edison's direct current system.

THELMA:
Excuse me, Mr. Westinghouse. Can we get back to you in one moment? With me right now is Bennie Franklin, great, great grandson of Ben Franklin. Can you tell the viewers a little bit about your famous ancestor's role in the history of electricity?

FRANKLIN:
I certainly can. I am a bit of an expert on family history. In 1752, my great, great grandfather was exploring the properties of electricity. In his experiments, he established that lightning was definitely a form of static electricity, but decided that it could not be controlled in any way to be of value.

EDISON:
He discovered that static electricity is not usable like my direct current.

VOLTA:
May I interrupt for a moment?

LOUISE:
This is Alex Volta, descendant of Alessandro Volta.

VOLTA:
It was my great grandfather who first produced direct current more than 100 years ago, back in 1800. That is when he invented the electric cell.

LOUISE:
An electric cell is a battery, isn't it?

VOLTA:
Let me explain. He discovered that if you make a sandwich of paper soaked in salt water between pieces of copper and zinc, an electric current flowed. As for the battery, when a group of electric cells are connected together, you have a battery of cells. Just like a row of cannons is called a battery.

LOUISE:
And what importance is this to the issue today?

VOLTA:
The electric cell gave experimenters and inventors a convenient and reliable source of electricity. You can even power lightbulbs with electric cells.

THELMA:
Mr. Edison, if batteries can power lightbulbs, why does New York need any distribution system at all? Why can't everyone just use batteries?

EDISON:
Power systems are designed to deliver reliable and dependable power all the time, conveniently. Batteries must be replaced or recharged frequently.

THELMA:
What about the contribution of Michael Faraday? His son just testified at the hearing that he was the one who laid the real foundation of the electric power system you developed.

FARADAY:
That's right. My father was the first to realize the relationship between electricity and magnetism. He found that if you pass a coil of wire through a magnetic field, electrons flow through the wire.

LOUISE:
So without your father's efforts, generators and motors wouldn't exist?

FARADAY:
Exactly. It was my father's devices that Mr. Edison used in his first power station at Pearl Street. He simply enlarged the dynamos and conductors to deliver the power.

LOUISE:
Would you say that there are disadvantages to using this direct current system to supply power to New York?

FARADAY:
Well, I must admit there are. The main problem with direct current is that the voltage can't be varied, so long distance transmission is impossible.

THELMA:
Mr. Edison, what do you have to say to that?

EDISON:
I don't see that as a problem, Miss Thelma. My vision is to build small, local power plants for each neighborhood. They will provide jobs in the neighborhood and people will feel involved in the power system. It has worked fine at my Pearl Street Station.

THELMA:
So in a large city like Chicago, or here in New York, you would need...

WESTINGHOUSE:
Let me answer that. You would need to build dozens of coal-burning power plants—dozens. The city would be covered with coal dust. With my alternating current system, I can vary the voltage and transmit electricity long distances. I proved this ten years ago, in 1895, when my Niagara Falls plant began sending electricity over high voltage power lines to Buffalo, more than 25 miles away.

LOUISE:
So high voltage transmission is the advantage of your alternating current system?

WESTINGHOUSE:
That's right. One giant power plant built miles away from the city could provide all the power the city needs. And the people wouldn't have to see the plant, smell the smoke, or be constantly cleaning soot off everything. Their neighborhoods would be clean. We must always be open to new technologies.

LOUISE:
That seems to be a powerful argument, Mr. Westinghouse.

THELMA:
Tomorrow we will report on the decision of the City Council and the impact it might have on the future of electric power distribution all over the country. This is Thelma and Louise reporting live from New York. Now back to *Anchorperson* at our studio in *Hometown*.

The Electrolympics—
Generation, Transmission & Distribution

CAST:

SPORTSCASTER JIM MAKILOWATT: INTERVIEWER

CAPTAIN COAL: FUEL JUMPER

DISTILLED WATER: STEAM MEDLEY RUNNER

GENERATOR (G) ELECTRON: VOLT VAULTER

TRANSMISSION (T) ELECTRON: MARATHON RUNNER

DISTRIBUTION (D) ELECTRON: 15,000 METER RUNNER

HOUSE (H) ELECTRON: STEEPLECHASER

JIM:
I am here today at the Electrolympics to talk to the key players in the generation, transmission, and distribution of electricity. These tireless participants have been bringing all of us the benefits of alternating current since the first successful delivery of electricity from Niagara Falls to the distant city of Buffalo, New York, in 1895. Here comes the Captain of the Electric Team, Coal. Excuse me, Captain, could I ask you a few questions for our audience out there?

COAL:
Sure, Jim. Shoot.

JIM:
First of all, why do you and your energetic team work so hard to make electricity?

COAL:
Our audience demands it, Jim. Consumers want electricity to simplify their lives. Take air conditioning, for example. The daily demand for air conditioning in this country alone makes enough cold air to freeze 16 trillion ice cubes. That's enough to provide every American with 5,000 trays of ice cubes every day.

JIM:
And what part do you play in making all that ice?

COAL:
I provide the fire. To make electricity, I superheat water into steam to turn the turbines. Burning natural gas or oil, or splitting uranium atoms, produces heat, too.

JIM:
So you're the one that starts electrons on the way to our homes?

COAL:
Well, Jim, electrons don't actually travel from the power plants to your homes. Electrons actually travel in a series of closed loops, each loop passing their energy on to the next loop, sort of like a relay race.

JIM:
Tell our viewers about all the events here at the Electrolympics.

COAL:
Well, there are the turbine games and the generator games. I'm in the turbine games.

JIM:
Is that sort of like the summer and winter Olympics?

COAL:
Very similar, Jim. My event is called the Fuel Jump. In all thermal power plants, the fuel is used to heat pure, distilled water in a boiler. I enter the bottom of a boiler 20 stories high and catch fire. As I burn, I give off an incredible amount of heat to the water in the boiler. Then, exhausted after so much effort, I am sent through scrubbers to be cleaned of carbon dioxide, sulfur dioxide and ash, and exit through the smoke stack. I only run one event.

JIM:
So you pass your baton of heat to the water. What does the water do with it?

COAL:
Let me get some of my teammates over here to explain it to you. Jim, I'd like you to meet Distilled Water.

WATER:
Hi, Jim. Let me tell you what I do with that heat after Coal passes it to me. I run a hot and fast race from the bottom of the boiler to the top, picking up heat as I go. By the time I reach the top, I'm all steamed up and race down huge pipes like a hurricane into the turbine. There I pass my energy on to the turbine blades, which spin like giant windmills.

JIM:
I guess you're exhausted then, just like the Coal?

WATER:
Oh, no. I've got to start the race again. But first I have to be cooled down into water again. I get pumped through some cool water and head back to the boiler to start the race again.

JIM:
Those are the turbine games. What can you tell me about the other events?

WATER:
Those are all run by different electrons. Here comes one of the generator electrons now. Let me get him/her to tell you about the generator games.

G ELECTRON:
Hey, Jim. I hear you want me to tell you about my travels. My event is the Volt Vault, which begins in the wires wrapped around the generator called the stator. The turbine spins a large magnet called a rotor and that magnetic field sends me coursing through the stator. At high amperage and low voltage, I race through the wires to the power plant transformers, driven by that amazing alternating current. In the transformer, I pass on my low voltage current, then I race back to the stator to start all over again. The transformer changes my current into high voltage current and passes it on to Transmission Electrons, all in a series of closed loops.

JIM:
I see. So what event does the Transmission Electron do? Is he a vaulter, too?

T ELECTRON:
No, Jim. I'm no jumper; I'm a long distance runner. I run a marathon across those high steel towers you see along highways. I run at high voltage all the way to a neighborhood sub-station where I pass my energy on to a step-down transformer, and head back to the power plant. That transformer takes my energy, which I carried at about 340,000 volts, and drops it down to about 12,000 volts before it passes it on to the distribution lines.

JIM:
Wow! Those transformers can do a lot with alternating current. Here comes Distribution Electron now. Let's see what kind of event he runs. Hey! D.E., talk to me!

D ELECTRON:
I'm a short distance runner, Jim. I pick up the current at the transformer in the sub-station and run over those lines you see in your neighborhood.

JIM:
Oh, so you're the one that brings electricity into our houses?

D ELECTRON:
No, not me—that's the one over there, the House Electron. My loop stops at that little tub-like transformer on the pole outside your house. I pass my energy on there and head back to the sub-station for another load.

H ELECTRON:
That's where I come in. The transformer on the street drops the voltage to 120 or 240 volts, then I pick it up and run the obstacle course of wires in your house. I keep running all around your house as long as power is given to me at the pole. I never go away from home.

JIM:
How long do these events take?

T ELECTRON:
Less than one second. We all run at the speed of light.

JIM:
You all deserve a medal.

H ELECTRON:
We don't need any medals. In fact, we owe our efficiency to two *metals*—copper and aluminum. They conduct us with speed and safety. Lightweight aluminum moves us over high power lines and copper transports us inside.

JIM:
Well, folks. You've just heard an incredible story of a race run at 186,000 miles per second. Run every day of the year so that you have power at the flick of a switch. With that, I now switch you back to our studio, thanks to the marvel of electricity.

Electricity—The Dependable Force

CAST:

CATHY CAPACITY: REPORTER

BETTY BASE-LOAD: ELECTRICTOWN CITIZEN

RHONDA RELIABLE: ELECTRICTOWN CITIZEN

PETER PEAK-LOAD: ELECTRICTOWN CITIZEN

BARNEY BASE-LOAD: ELECTRICTOWN CITIZEN

CATHY:
Hello. This is Cathy Capacity reporting from Electrictown. Today I'll be interviewing some of the biggest electric generators in this *Upfront and Personal* segment. One thing I've learned is that we can count on these guests to show up—reliability is their strong point. In fact, my first guest today is Rhonda Reliable to speak to this exact point. Hello, Rhonda.

RHONDA:
Cathy, I almost always show up when I say I will. A 100 percent reliable power system would always be there for you to use—no matter what happened. In most areas of the United States, power systems are 99.9 percent reliable. If a power system were 90 percent reliable, your power would be cut off one hour out of ten, and that would be really inconvenient. Even the occasional outages that everyone experiences because of storms and other problems can really cause inconveniences in peoples' lives.

CATHY:
Why is our power system so reliable?

RHONDA:
Most electric companies have 15 to 20 percent more generating capacity than they need from their power plants. If there is a problem at one power plant, there is still enough power to supply their customers.

CATHY:
What happens when customers demand more electricity?

RHONDA:
Well, to maintain reliability, electric systems must increase their capacity by building new plants or reducing the amount of electricity people use. Reliability depends on having that reserve capacity.

CATHY:
I see, Rhonda. Thanks for being on my show today. (Pause) Rumor has it my next two guests are constantly working, electrifying the nation day and night. It's my pleasure to introduce Barney and Betty Base-load. Thank you for taking time from your heavy work schedule to appear with me today.

BARNEY:
It's true, Cathy. We do work day and night, and we're proud of it. We provide the nation with the least expensive way to generate electricity. Power companies call on us to produce those megawatts 24 hours a day. We try to save them and their customers money.

CATHY:
Betty, would you describe your typical workday?

BETTY:
Well, we usually work 24 hours a day, making all the electricity we can. We do sometimes take a vacation to get a new turbine, generator, or other new equipment. We schedule vacations way in advance so that other generators are ready to take up the load.

CATHY:
What happens if you get really sick or break down?

BARNEY:
If a problem suddenly occurs, another power system will cover for us. In the electric business, this sharing is called a power pool. When one system needs help, other systems send their reserve power over transmission lines to help each other. Of course, members of the power pool charge each other for the electricity they provide at a rate they've all agreed on.

CATHY:
I know you two generate a lot of kilowatt-hours each year. Can you explain to our audience exactly what a kilowatt-hour is?

BARNEY:
Well, a watt is a measure of the power an appliance needs to operate—like a 100-watt lightbulb or a 1,500-watt hair dryer. A kilowatt is just 1,000 watts. A kilowatt-hour is the amount of electricity that is used. Maybe an example will help. Lighting ten 100-watt bulbs for one hour or five 100-watt bulbs for two hours uses one kilowatt-hour of electricity. Running a 1,500-watt hair dryer for 20 minutes uses one-half of a kilowatt-hour of electricity. One kilowatt-hour of electricity costs about nine cents. The electric meter on your house measures the number of kilowatt-hours of electricity you use each month.

CATHY:
Where do you get all that energy?

BETTY
Our two major fuels are coal and uranium. These fuels are cheap and provide a lot of heat to make the high-pressure steam we need to turn our turbines. We also use other sources, such as hydropower, to help meet the nation's base-load demand.

CATHY:
Ever think about retiring?

BARNEY:
We'll never retire, Cathy, though we will retire some stations when they get too old and expensive to operate. We'll replace them with plants that use the newest technologies to generate electricity cheaply and cleanly.

CATHY:
Thank you, Betty and Barney. I know you have to get back to work. (Pause.) My next guest has just the opposite reputation in Electrictown. Peter Peak-load works just a few hours a day, and he's being asked to work even less. Peter, what's the real story?

PETER:
It's true, Cathy, I work as little as possible. I'm like a field goal kicker on a football team. They play only a few minutes of every game, but if you have a reliable kicker, you can win a lot of games.

CATHY:
So you're a specialist in the power generation game?

PETER:
That's right. I'm paid to be there when they need me, on a moment's notice. I don't need any start-up time like those big base-load systems. When I'm needed, usually between the hours of 12 noon and 6:00 p.m., I can start right up. I can stop quickly when I'm no longer needed. I'm just there to add that extra power when it's needed.

CATHY:
And what sources of energy do you use to get those quick starts?

PETER:
Using hydropower, I can get a quick start with the water stored in reservoirs. I can also use natural gas turbines that are like big jet engines—I can start generating power at the flip of a switch.

CATHY:
What about the cost?

PETER:
Well, I cost more per kilowatt-hour to operate than my base-load friends because I don't operate all the time. Sometimes my fuel costs more, too. I might not work a lot, Cathy, but I'm always ready to go when I'm needed, day or night.

CATHY:
I hear power companies are always trying to cut back your hours?

PETER:
That's true, because I do cost the company more whenever they have to use me. The companies are encouraging businesses and households to use electricity during non-peak hours. If some electricity use can be shifted to non-peak hours, my base-load friends can handle it, and more power stations won't have to be built.

CATHY:
Thank you, Peter. It's good to know you're the Minuteman of electric power generation, ready to go whenever you're needed. (Pause.) And that's our story for today, folks, I'll be back next week with a really *shocking* story.

The Negawatt Diet—Demand-Side Management

CAST:

WILLARD WATT: INTERVIEWER

CONNIE KILOWATT: INTERVIEWER

MARY MEGAWATT: INTERVIEWER

RICHARD TRIMMINS: RECOVERING ENERGY WASTER

JEAN SMART: ENERGY FAT TRIMMER

MONTEL CLARK: MARATHON RUNNER

WILLARD:
This is Willard Watt reporting to you from the control center of today's typical electric junkie—the American kitchen. With me today is Richard Trimmins, a reformed electric junkie, who has agreed to tell America his story. Richard, how did you first get hooked on electricity?

RICHARD:
It started when I was just a kid, Willard. My parents wanted me to have a better lifestyle than they had. They got me everything I wanted. First, it was my own radio. Next came the color TV. It never stopped. Just look around. What do you see?

WILLARD:
Just the usual, Richard—refrigerator, freezer, TV, lights, air conditioner. It looks like the normal kitchen to me.

RICHARD:
That's right. It is, and all at the touch of a button. You're looking at a junkie who had a 50 kilowatt-hour a day habit. By my teens, I was not only using essential appliances, but I'd begun to dabble in those convenient extras like food processors and video games.

WILLARD:
So, watt-wise, you were hooked?

RICHARD:
Yes. I knew I had to cut back, but I didn't know how. How could I conserve in a country where seven percent of the electricity is used just to keep food cold?

WILLARD:
You just can't kick a habit like that cold turkey.

RICHARD:
Cold turkey, never! I just got a new microwave to warm up my turkey.

WILLARD:
So what did you do?

RICHARD:
I knew I couldn't do it alone, so I went to my local utility for help. They showed me so many ways I could cut back on my electrical demands without changing my lifestyle. They taught me that I didn't need to give up anything; I just needed to change my behavior. I cut kilowatts and never missed them.

WILLARD:
Give us some examples, Richard.

RICHARD:
Simple things, like deciding what I wanted *before* I opened the refrigerator door. I redesigned my kitchen and installed ENERGY STAR® appliances. I stopped using my shower as a steam bath—short showers save hot water. And I started thinking about my lights. I put low-wattage bulbs in closets and use compact fluorescents wherever I can. No more using the TV as a nightlight.

WILLARD:
I see, basically using the right appliance for the job.

RICHARD:
I don't heat or cool my whole house at night any more, either. I put an extra blanket on my bed in heating seasons and set back my thermostat to 60 degrees. In cooling seasons, I set the thermostat at 80 degrees and turn on my ceiling fans. I installed a programmable thermostat, too.

WILLARD:
My utility bill had a suggestion last month to use my drapes as insulation—open them on cold, sunny days for warmth and close them at night to keep in the heat. What advice do you have for those Kilofatties out there?

RICHARD:
It's simple, Willard. Energy management, not just conservation.

WILLARD:
Thanks, Richard. I know your story should help a lot of electric junkies out there still hooked on watts. Now, we take you to Connie Kilowatt, who is live at the newest restaurant in town, Chez Lean. To you, Connie.

CONNIE:
Thank you, Willard. I'm here at Chez Lean, a restaurant that caters to customers who want to curb their appetites for electricity. With me today is Jean Smart, head of the electricity management team. I see that everything on your menu is trimmed of fat—is that the secret of your success, Jean?

JEAN:
The key is that I trim the fat for my customers. Sometimes it's hard for people to change their behaviors on their own, but technical fixes are easier to accept.

CONNIE:
What do you mean by technical fixes, Jean?

JEAN:
I mean making appliances more efficient—like developing air conditioners that use less energy to cool a room, rather than using less air conditioning.

CONNIE:
I see. The engineers trim the energy fat, and we save energy without giving up comfort.

JEAN:
That's right. Today's freezers, for example, are 80 percent more efficient that the freezers 20 years ago, and air conditioners are 50 percent more efficient.

CONNIE:
But aren't those new appliances more expensive?

JEAN:
I just bought a new refrigerator for the restaurant, Connie. I compared the energy labels on several models before I made my choice. The one I bought had a higher purchase price than most of them, but over time it will be less expensive because I'll save so much on energy to run it. New efficient appliances are easy technical fixes we can all choose in our effort to trim watts from our menu.

CONNIE:
Thank you, Jean, for your great suggestions. We switch you now to Mary Megawatt with Montel Clark, who has just raced against the clock to win the New York Marathon.

MARY:
Thanks, Connie. Montel, how does it feel to have won the marathon in record time?

MONTEL:
Mary, in my quest to stay young, I try to be as efficient as possible and conserve my energy for the sprints and long-stretches when I need it the most. I've beaten the clock with DSM.

MARY:
DSM? Does that stand for Dandy Speedy Montel?

MONTEL:
No, Mary. Demand Side Management. Demand side management means lowering my energy use by controlling the time of day that I use electricity. I used to be like other electric junkies, using power during peak demand times—you know, that real fat time between noon and 6:00 p.m.

MARY:
That's when most of the electricity is needed, right?

MONTEL:
Right. And that's when utilities charge the most for the electricity because they have to pay more for the fuels they use to produce that peak power. So, I try to use as little electricity as possible during those peak hours. I wash all my clothes and dishes at night, and I put my hot water heater on a timer to operate only in the evening. My programmable thermostat is set to raise or lower the temperature according to the season and the times of the day when I am at home.

MARY:
It sounds like you've learned a lot from marathon running. You've learned to spread your energy use over a long stretch of time, instead of following the pack. Let's go back to our studio.

Crime Watch
Investigating the Nation's Energy Losses

CAST:

ENTROPY BROWN: INTERVIEWER

COLUMBO: CHIEF INVESTIGATOR ON THE CASE

DETECTIVES 1, 2, AND 3: (CREATE YOUR OWN NAMES)

BROWN:
Good evening. This is Entropy Brown, reporting to you from the downtown headquarters of the team investigating the alleged theft at the nation's electric power plants. This hand-picked investigating team is headed by none other than the world-renowned Detective Columbo, who is with me now. Detective Columbo, do you have any suspects in the case, and do you expect to make any arrests soon?

COLUMBO:
Well, Ms. Brown, it's still early in the investigation. At this time, we haven't really determined who or what is responsible for the reported losses. As a matter of fact, the team and I are still trying to determine whether any Laws of Thermodynamics have been violated at all in the power plants' conversion of fossil fuels and uranium into electricity.

BROWN:
You mean it's possible that a crime has not been committed?

COLUMBO:
Precisely. If no laws have been broken, then there is no crime.

DETECTIVE 1:
Furthermore, there must be a victim. In this case, we haven't determined if there is a victim. No complaint has been filed.

BROWN:
Well, Detective Columbo, if you need a complaint, I'll file one. There are documented losses at every power plant in the country, sir. Every day, at every thermal power plant, for every 100 units of energy consumed, only 35 units of energy are produced. That is a loss of 65 units of energy. I'm sure that I, as a consumer, am paying for those losses.

DETECTIVE 2:
Well, let's take a look at the alleged crime, Ms. Brown. Tell me, what exactly is it that goes into these power plants?

BROWN:
Well, several fuels. Mostly, coal. Then there are the nuclear plants that use uranium and the hydro plants that use falling water. Some plants burn natural gas or petroleum.

COLUMBO:
And what do all these energy sources do for you?

BROWN:
They heat my home and office, keep my food cold, give me light, and run my appliances—my dryer, blender, things like that.

DETECTIVE 1:
Why don't you use these energy sources directly?

BROWN:
Well, they're not convenient for me to use myself. I'd never be able to take uranium ore and use it to run my hair dryer.

DETECTIVE 2:
You're right about that. Until Edison invented the electric power system, most energy consumers were dependent on nearby rivers for their power.

DETECTIVE 3:
Electric power distribution gives us the freedom to live wherever we want and not have to be bothered with the problems of using those fuels directly.

BROWN:
But what does all this have to do with the losses at the power plants?

COLUMBO:
That's a good question. You see, the power plants are forced to obey the Laws of Thermodynamics. Whenever energy resources are converted to electricity, there is a loss of usable energy. Most of the energy lost at thermal power plants is in the form of heat. Some of the heat is absorbed by the equipment, some is lost to the atmosphere.

DETECTIVE 1:
And energy is lost turning the turbines. Friction produces heat and sound.

DETECTIVE 2:
Energy is lost in the generator, too, as the magnet is rotated inside the coil.

DETECTIVE 3:
It takes a lot of energy to produce the steam to turn those turbines. But, all the energy in the steam isn't transferred to the turbines. After the steam has done its job, it's still steam—it still has a lot of heat energy in it. It has to be cooled and turned into water again before it can be piped back to the boiler. Some of that heat can be recovered, but a lot is lost.

COLUMBO:
That's what happens to the 65 percent of energy lost.

DETECTIVE 1:
Two percent of the electricity produced is used to run the equipment at the power plant.

DETECTIVE 2:
And another ten percent is lost as the electricity is sent over the transmission lines.

COLUMBO:
That's the trade-off we have to accept for convenience.

BROWN:
So, what you're saying is energy is lost because power plants are obeying the law, not because there has been a crime. But isn't wasting energy a crime?

COLUMBO:
But is energy being wasted? That's the real question here, isn't it? Tell me this, Ms. Brown, what uses would we have for these fuels if we didn't use them to make electricity? How would we use the energy stored in uranium and coal, especially? Think of it this way—aren't we salvaging the energy trapped in these fuels by using them to make electricity?

BROWN:
Mr. Columbo, I never thought of it that way. Salvaged energy rather than lost energy.

COLUMBO:
And consider this—before electricity, most energy use was crude, dirty, and often dangerous. The electricity we receive today is a finely-tuned, pure energy that can run the most complicated computers and lasers. What would we do without it?

BROWN:
But what about the simple arithmetic of 100 units in, 35 units out?

DETECTIVE 1:
Well, power plants are becoming more efficient all the time. Edison's first power plant only produced two units of power for every 100 units consumed.

DETECTIVE 2:
And what about you, Ms. Brown? Your body produces only about five units of energy for every 100 units you consume.

BROWN:
You mean I waste more energy than those power plants I'm complaining about?

DETECTIVE 3:
This sounds serious. I think we'd better take you downtown.

BROWN:
(Yelling as she is led off by the detectives.) But wait!! Wasn't I just obeying the Laws of Thermodynamics?

Changing Electrotraffic Patterns IPPs and Cogenerators

CAST:

MISS UTILITY: UTILITY COMPANY OWNER

IPP: INDEPENDENT POWER PRODUCER

JILL MILL: COGENERATOR

TRAFFIC REPORTER

ANCHORPERSON

ANCHOR:
Good afternoon, viewers. Today our traffic reporter will be presenting a special rush hour segment on the changing electrotraffic patterns he's been seeing. We will take you to several new traffic hubs that are causing these changes in the electrotraffic flow. Let's go now to our reporter in the sky.

REPORTER:
You're in the air with the WNRG electrotraffic watch. This job used to be easy. During this peak afternoon rush hour, the traffic was easy to monitor. All of the electrotraffic flowed from one big power plant out to the consumers all over the service area. All I had to do was check on the occasional power outage caused by a storm or accident, or I'd report on a brownout when soaring temperatures caused a surge in demand that the utility couldn't meet.

In the last few years, though, my job has gotten a lot more complicated. I have to monitor electrotraffic flowing from lots of small generating plants to the utility, as well. I've just landed on the roof of our utility's executive offices to speak to Miss Utility about this.

MISS UTILITY:
Welcome.

REPORTER:
Tell me, Miss Utility. Why is the electrotraffic so complicated these days?

MISS UTILITY:
There are several reasons. First of all, there has been a big increase in the demand for electricity. People need more electricity than our power plant can produce. We could have built a new plant, but we are required to buy electricity from other sources first, if it's available. So that's what we're doing. We buy electricity from several cogenerating plants and independent power producers.

REPORTER:
Well, you must be happy that you don't have to build an expensive new plant.

MISS UTILITY:
Yes, you know most of the electricity produced today is from coal and nuclear power plants. The requirement is designed to encourage the use of natural gas, new technologies, and renewable energy sources.

REPORTER:
Thank you for your time, Miss Utility. I'm on my way to interview one of the cogenerating plants that supplies you with power. (Pause.) Right now, folks, we're heading for the Rapping Paper Mill. What in the world is a paper mill doing generating electricity? Let's find out. Here comes Jill Mill now. Could you please explain to the viewers what a paper mill is doing in the electricity business?

JILL MILL:
It's not such a strange thing when you think about it. Our paper mill operates 24 hours a day turning pulp into paper. It takes an enormous amount of heat to make the paper. We realized we could use that heat to generate electricity.

REPORTER:
How do you do that?

JILL MILL:
We burn coal in our furnace to heat water into steam. The steam turns a turbine to generate electricity. Then the steam is used in the mill to manufacture paper. The electricity we make powers all the machinery at the plant, and we sell the rest to Miss Utility. It's a great system. We're using the same fuel twice—to make paper and electricity. We don't have to pay for the power we need. And we can sell the surplus and make a little extra money.

REPORTER:
I see. The system really works for you. Are there many cogenerating plants out there?

JILL MILL:
Quite a few. Cogeneration plants produce almost five percent of the electricity in the country right now. There are also independent power producers—IPPs we call them in the business—that produce only electricity to sell to utilities. Together, we produce about 30 percent of the nation's electricity.

REPORTER:
That's where I'm heading right now—to that new power plant over by the river. Thanks for your time. (Pause.) Well, viewers, this is turning out to be a fascinating tour today. This new plant we're approaching right now will give us another view of electric power generation. I see the plant manager coming out to meet us. Hello, IPP.

IPP:
Hello, there. Welcome to our state-of-the-art plant.

REPORTER:
Tell our viewers about your plant, IPP.

IPP:
This plant is a natural gas-fired plant with all the newest technology to reduce pollution. We burn natural gas—the cleanest burning fossil fuel—to produce electricity. The natural gas super-heats water into steam to turn turbines, just like a coal-fired plant.

REPORTER:
And you sell your electricity to Miss Utility?

IPP:
Yes, we do. They're glad to get it.

REPORTER:
Are there a lot of plants like yours in operation?

IPP:
More all the time. Right now, plants like this one produce about 25 percent of the electricity in the country. In the future, independent power producers will produce more and more of our electricity.

REPORTER:
Why is that?

IPP:
Most of our plants are fueled by clean-burning natural gas, renewable energy sources, or waste fuel. We can provide electricity when it's needed, reducing the need for huge new base-load plants.

We aren't the only ones producing power. There are lots of homeowners and schools that generate electricity by installing solar panels on their roofs. In some places, companies are installing microturbines and fuel cells for distributed generation.

REPORTER:
Thank you, IPP. It's been a pleasure talking with you. (Pause.) Well, viewers, there you have it. The reason the electrotraffic pattern is so complex now is that there is a lot of power flowing in to Miss Utility from many places, especially during that peak afternoon rush hour. Back to the station.

ANCHOR:
Thank you for that exclusive electrotraffic report. It sounds to me like your job will only get more complex in the future. Good luck trying to keep up with all that electrotraffic.

Time Tunnel to Tomorrow—The Future of Electric Power

CAST:

CANDY ROONEY: REPORTER

FRAN FUSION: SCIENTIST

FRED FOSSIL FUEL: POWER PLANT EMPLOYEE

SUE SUPERCONDUCTOR: SCIENTIST

NORMA NUCLEAR: POWER PLANT EMPLOYEE

RICK RENEWABLE: RENEWABLE ENERGY SPECIALIST

ANCHORPERSON

ANCHOR:
This evening, our Time Tunnel to Tomorrow will bring you the story of how electricity might be produced in the future. Let's go now to Candy Rooney in the year 2020 with a special report.

ROONEY:
Thank you, *Anchor*. I'm sitting in the living room of my new house—a house that I've just had built with all the latest energy-saving technologies. The temperature is controlled by a sophisticated computer system. Every room has sensors and monitors to control the temperature.

ANCHOR:
How does that help you save energy, Candy?

ROONEY:
I've programmed the computer to let it know the times of day that I usually use each room. For example, my bedroom—I'm usually only in there from 11:00 at night until 7:00 the next morning. So, my computer only heats my bedroom during those times—and it lowers the heat to the rest of the house. Of course, if I change my plans and want to sleep late, I can over-ride the computer at the touch of a button.

ANCHOR:
Is there anything else you've done in the house?

ROONEY:
Lot's of things. I've added extra insulation to the ceilings and walls and, of course, I sited the house with lots of windows on its southern exposure to take advantage of the passive solar energy. I've installed ENERGY STAR® appliances, I'm using compact fluorescents for lighting, and I'm using many other energy-saving strategies.

ANCHOR:
Sounds great, Candy. Who are your guests today?

ROONEY:
My first guest on this remote broadcast will be Fred Fossil Fuel, talking with me from the King Coal Power Plant. Fred, can you hear me?

FRED:
Loud and clear, Candy. What can I do for you today?

ROONEY:
Back in the old days, fossil fuels, especially coal, produced most of the electricity in the nation. What is your role in electricity production today—in the year 2020?

FRED:
Well, Candy, there have been some changes, but coal is still king. We are the nation's most abundant energy source and produce more electricity than any other fuel. New technologies have allowed us to burn coal cleaner and more efficiently, but with the nation demanding one-third more electricity than it did 20 years ago, all the energy sources are very important.

ROONEY:
Are the other fossil fuels a part of the picture?

FRED:
They sure are. Natural gas is the cleanest-burning fossil fuel and many peak-demand plants are still using natural gas because the plants can be put into production and taken out on such short notice. But no new plants are likely to be built, because natural gas is in such short supply—there's only about a 30-year supply left at current prices.

FRED:
Oil is still used occasionally to produce electricity, but it isn't a major player and propane never has been used for that purpose.

ROONEY:
I'm going now to Norma Nuclear. What about uranium, Norma?

NORMA:
Nuclear power plants are making a comeback, because nuclear power is clean and cheap, and the new technologies for building power plants have made them safe and reliable, though long-term storage of radioactive waste is still a concern.

ROONEY:
Thanks for your help, Norma. I'm switching my remote monitors to West Coast Power to speak with Rick Renewable about the role that renewable energy sources are playing in electricity production in 2020. Come in, Rick!

RICK:
Thank you, Candy. Renewable energy sources are producing more electricity for the country each year. Hydro plants still produce more power than any other renewable, but incentives and advanced technologies are making solar power more economical every day. We've also seen an increase in the number of waste-to-energy plants, geothermal plants, and wind farms. The use of renewable sources to produce electricity will continue to grow, especially solar power. Hydrogen fuel cells are entering the market in ever increasing numbers, too, in conjunction with renewables.

ROONEY:
So you see a major increase in the use of solar power as technology increases the efficiency of using the sun's energy?

RICK:
That's right, Candy. Solar thermal power plants and photovoltaic cells certainly have a bright future.

ROONEY:
Thank you, Rick. I'm going to speak with Fran Fusion momentarily to hear about the newest technology for producing electricity—nuclear fusion. Fran, are you there?

FUSION:
Yes, I am.

ROONEY:
Fran, can you tell our viewers exactly what nuclear fusion is and how it produces electricity?

FUSION:
I sure can. Nuclear fusion in this case is combining the nuclei (or core) of four atoms of hydrogen to produce one atom of helium. In the process, enormous amounts of energy are also produced. It takes incredibly high temperatures to fuse the nuclei—270 million degrees Fahrenheit. We have developed the technology to reach those temperatures and have produced electricity from the energy released. But the technology is still in the experimental stage. It still takes much more energy to fuse the nuclei than is produced by the fusion.

ROONEY:
What are the benefits of nuclear fusion over other energy sources? In other words, why are we working so hard to develop this technology?

FUSION:
The possibilities are endless, Candy. For one thing, there is an almost endless supply of hydrogen in the atmosphere, free for the taking. And fusion would produce no pollution. I predict that in the next 20 to 40 years, fusion will be the major source of electricity nationwide.

ROONEY:
Let's go now to Sue Superconductor to explore the role of superconducting materials. Tell me, what role are superconductors playing?

SUE:
Well, superconductors don't generate electricity—they are important because they can transmit electricity with almost no loss of energy. New ceramic materials are able to transmit electricity when they are super-cooled to -270 degrees Fahrenheit with liquid nitrogen. This technology is beginning to be used in many different capacities, and its potential is enormous. Much less electricity will need to be produced if there is no loss during transmission.

ROONEY:
It sounds like new technologies will make for a bright tomorrow. Back to you, *Anchor*.

CURRENT ENERGY AFFAIR

Evaluation Form

State: ___________ **Grade Level:** ___________ **Number of Students:** __________

1.	Did you conduct the entire activity?	Yes	No
2.	Were the instructions clear and easy to follow?	Yes	No
3.	Did the activity meet your academic objectives?	Yes	No
4.	Was the activity age appropriate?	Yes	No
5.	Were the allotted times sufficient to conduct the activity?	Yes	No
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7.	Was the preparation required acceptable for the activity?	Yes	No
8.	Were the students interested and motivated?	Yes	No
9.	Was the energy knowledge content age appropriate?	Yes	No
10.	Would you use the activity again?	Yes	No

How would you rate the activity overall (excellent, good, fair, poor)?

How would your students rate the activity overall (excellent, good, fair, poor)?

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Sentech, Inc.
Shell
Snohomish County Public Utility District–WA
Society of Petroleum Engineers
David Sorenson
Southern Company
Southern LNG
Southwest Gas
Spring Branch Independent School District–TX
Tennessee Department of Economic and Community Development–Energy Division
Toyota
TransOptions, Inc.
TXU Energy
United Technologies
University of Nevada–Las Vegas, NV
United Illuminating Company
U.S. Environmental Protection Agency
U.S. Department of Energy
U.S. Department of Energy–Hydrogen, Fuel Cells and Infrastructure Technologies
U.S. Department of Energy – Wind for Schools
Virgin Islands Energy Office
Virginia Department of Mines, Minerals and Energy
Virginia Department of Education
Virginia General Assembly
Wake County Public Schools–NC
Washington and Lee University
Western Kentucky Science Alliance
W. Plack Carr Company
Yates Petroleum