

RESOURCE LIBRARY
ACTIVITY : 2 HRS

Moving Toward a Modern Grid

Students read a case study about blackouts in California and research grid modernization technology as a solution. Each student assumes the role of a stakeholder, writes a problem summary and research questions from the stakeholder's perspective, and participates in a conference on the subject.

GRADES

9 - 12+

SUBJECTS

English Language Arts, Geography, Human Geography

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4 PDFs, 6 Links

OVERVIEW

Students read a case study about blackouts in California and research grid modernization technology as a solution. Each student assumes the role of a stakeholder, writes a problem summary and research questions from the stakeholder's perspective, and participates in a conference on the subject.

For the complete activity with media resources, visit:

<http://www.nationalgeographic.org/activity/moving-toward-modern-grid/>

Program



DIRECTIONS

1. Activate students' prior knowledge with a brief discussion about energy.

Ask students to describe ways they are using energy right now, and focus their attention on electricity use. Ask: *How do we maintain a constant supply of electricity to homes and businesses? What energy resources are used by electric companies to generate electricity? What happens if we do not maintain a constant supply of energy?* Divide students into small groups and invite them to share their experiences of times when they have lost access to electricity. Invite each group to share one or two stories with the whole class.

2. Introduce the idea of grid modernization.

Discuss with students ways that electric utility companies maintain our supply of electricity. Make sure students realize that power plants decrease the amount of electricity they produce during times when demand is low and increase the amount of electricity they produce during peak demand times. Introduce the vocabulary term grid modernization and have students share what they know about it. Explain that grid modernization includes technologies such as smart meters that allow for frequent readings of and reactions to electrical use. Explain that grid modernization is sometimes referred to as the “smart grid.”

3. Introduce the California Blackouts case study to students.

Explain that students will read a case study describing problems with the electric grid in California that resulted in blackouts. They will then take on the role of a stakeholder and identify questions they would need to investigate before deciding whether modernizing the electric grid should be a major focus for solving the problems that led to the blackouts. Distribute a copy of the handout Case Study: California Blackouts to each student. Have them independently read the case study and underline or note important points as they read.

4. Discuss the California Blackouts case study with students.

Ask students to describe some of the causes of blackouts in California according to the case study they read. Ask: *How did the causes of the blackouts in the early 2000s differ from the 2011 blackout? How were they similar? How did the blackouts affect the stakeholders mentioned in the case study? Which stakeholders were affected most negatively? Why?*

5. Divide students into small research groups.

Divide students into small groups and assign each group a stakeholder from the case study to represent. Distribute the worksheets California Grid Modernization: Problem Scenario, Grid Modernization: Research Notes, and Stakeholder Analysis Rubric to students. Read the problem scenario with students and make sure they understand what they are supposed to do. Review the Stakeholder Analysis Rubric and make sure students understand the expectations for the project. Use the provided website to have all students read the American Public Media: Marketplace Tech story “Why We Need to Build a Smart Grid—Fast” to gain basic background information about grid modernization. Have students brainstorm some initial questions their stakeholders might have about grid modernization and use those as the beginning basis for research. Provide students with the following list of aspects of grid modernization to consider as they research: the basic mechanics of how grid modernization would change the electric grid, how grid modernization can increase the reliability of the grid, how grid modernization can increase efficiency, how grid modernization aids in conserving energy resources, and costs and social changes of grid modernization. Have students research grid modernization using the provided websites and take notes on the Research Notes worksheet. Students can also use the provided websites for additional information on the California blackouts if needed. Stress that the goal here is not for students to become experts on the subject, but rather to develop an understanding of questions and concerns their stakeholders might have.

6. Have each group write a problem summary and identify five important questions.

Model writing a brief problem summary of the incident described in the story of Goldilocks and the Three Bears from the bears’ perspective. Have the class collaboratively write a problem summary of the same incident from the perspective of Goldilocks. (Feel free to use a different story for this exercise, but be sure it contains characters with different perspectives and that your students are familiar with the story.) Briefly discuss how personal experiences and situations can alter your perspective on a problem. Have students use information from

their research to write a brief problem summary from their stakeholder's perspective. Have them review the questions about grid modernization from their initial brainstorming session, as well as questions that came up as they researched. Ask students to combine any questions that are similar or closely connected. Then have them eliminate any questions they feel are not important. Finally, have them select five questions that they believe would be most important to their stakeholder. They should revise the final questions as needed.

7. Hold a stakeholder conference.

Gather students for a conference of all the stakeholders. Read the problem scenario again and invite each stakeholder group to present their problem summary and the questions they have about grid modernization, along with their reasons for selecting these questions. Following each stakeholder group's presentation, allow other students to ask the group questions. Keep a master list on the board of the questions presented by each of the stakeholders. When all stakeholders have presented, allow time for an open discussion among all stakeholders. Discuss the stakeholders' problem summaries. Ask: *What are some similarities among stakeholders' perspectives on the problem? What are some differences? Do you think there is enough common ground among stakeholders for them to agree on further actions?*

8. Categorize and prioritize stakeholder questions.

Return to the master list of questions and read through them as a class. Have students sort the questions into categories of their choosing; for example, economic questions, social questions, or technical questions. Next, have students combine questions that are similar and eliminate questions that they agree are not high priority. Finally, have them reprioritize the remaining questions to create an action list for further research. Discuss the criteria students used to prioritize the list. Ask:

- *Does this list reflect all stakeholders' concerns? Why or why not?*
- *Are some stakeholders more adversely affected by problems with the electric grid? If so, should those stakeholders have a bigger voice in the decision-making process? Why or why not?*
- *How can this process be applied to decisions you have to make?*

Modification

For auditory learners, provide headphones for students to listen to the American Public Media: Marketplace story instead of reading it.

Modification

If students pose a research question in Step 5 that they cannot answer as they begin to research in Step 6, have them highlight the question.

Tip

In Step 5, check in with students early in the research phase to make sure they are using solid research questions.

Tip

In Step 6, remind students to think from the perspective of their stakeholder when developing questions. For example, would their stakeholder likely care more about costs, public opinion, or the specifics of how technology would be integrated?

Informal Assessment

Use the provided Stakeholder Analysis Rubric to assess students' problem summaries and performance in the stakeholder conference.

Extending the Learning

- Have students research blackouts and brownouts in other U.S. cities and list the major causes of each. Ask students to analyze any patterns they see.
- Invite a representative from your local electric company to answer students' questions—either in person or virtually—about grid modernization in their local area.

OBJECTIVES

Subjects & Disciplines

- English Language Arts
 - **Geography**
 - Human Geography

Learning Objectives

Students will:

- research the causes behind blackouts and brownouts in southern California and the integration of grid modernization technology as part of a solution to the problem
- identify and prioritize questions specific stakeholders would need to have answered before making a decision on the issue of grid modernization

Teaching Approach

- Learning-for-use

Teaching Methods

- Cooperative learning
- Discussions
- Research
- Role playing

Skills Summary

This activity targets the following skills:

- 21st Century Student Outcomes
 - Information, Media, and Technology Skills
 - Information Literacy
 - Learning and Innovation Skills
 - Communication and Collaboration
 - Critical Thinking and Problem Solving
- Critical Thinking Skills
 - Evaluating
- Geographic Skills
 - Asking Geographic Questions
- Science and Engineering Practices

- Asking questions (for science) and defining problems (for engineering)
- Obtaining, evaluating, and communicating information

National Standards, Principles, and Practices

ENERGY LITERACY ESSENTIAL PRINCIPLES AND FUNDAMENTAL CONCEPTS

- **Fundamental Concept 6.6:**

Behavior and design affect the amount of energy used by human society.

- **Fundamental Concept 7.6:**

Some populations are more vulnerable to impacts of energy choices than others.

IRA/NCTE STANDARDS FOR THE ENGLISH LANGUAGE ARTS

- **Standard 7:**

Students conduct research on issues and interests by generating ideas and questions, and by posing problems. They gather, evaluate, and synthesize data from a variety of sources (e.g., print and nonprint texts, artifacts, people) to communicate their discoveries in ways that suit their purpose and audience.

NATIONAL COUNCIL FOR SOCIAL STUDIES CURRICULUM STANDARDS

- **Theme 7:**

Production, Distribution, and Consumption

NATIONAL GEOGRAPHY STANDARDS

- **Standard 16:**

The changes that occur in the meaning, use, distribution, and importance of resources

NATIONAL SCIENCE EDUCATION STANDARDS

- **(9-12) Standard F-3:**

Natural resources

- **(9-12) Standard F-6:**

Science and technology in local, national, and global challenges

COMMON CORE STATE STANDARDS FOR ENGLISH LANGUAGE ARTS & LITERACY

- Writing Standards 6-12:

Research to Build and Present Knowledge, W.9-10.7

- Writing Standards 6-12:

Research to Build and Present Knowledge, W.11-12.7

Preparation

What You'll Need

MATERIALS YOU PROVIDE

- Pencils
- Headphones (optional)

REQUIRED TECHNOLOGY

- Internet Access: Required
- Tech Setup: 1 computer per learner, Speakers

PHYSICAL SPACE

- Classroom

SETUP

For the conference, arrange all the chairs facing a podium or desk.

GROUPING

- Large-group instruction

OTHER NOTES

Conduct the activity in two sessions. Complete Steps 1 through 6 in the first session, and hold the stakeholder conference in the second session.

BACKGROUND & VOCABULARY

Background Information

The basic technology behind the United States' electric grid has remained largely unchanged for over a century. During this time, the amount of energy traveling along the grid has increased exponentially. In most parts of the country, workers must manually address fluctuations in electricity supply and demand moment-to-moment to prevent surges, blackouts, and brownouts. Today, many experts are suggesting modernizing our electric grid to make data flow more instantaneous and to increase the accuracy and specificity of information. A fully modernized grid would also allow electric companies to briefly cycle off individual appliances, such as hot water heaters or air conditioners, in consumers' homes during peak times to help the system run more efficiently and prevent blackouts. Modernizing the electric grid includes using best practices in the design and control of distribution systems and enhancing the communication among agencies operating along the grid. A complete upgrade of the electrical system is an expensive endeavor, involving laying new lines, replacing meters, and even upgrading appliances. However, a modernized grid would ultimately help the electric grid run more efficiently, saving energy and money.

Prior Knowledge

["[Energy Literacy Principle 1](http://energy.gov/eere/education/energy-literacy-essential-principles-and-fundamental-concepts-energy-education): Energy is a physical quantity that follows precise natural laws.", "[Energy Literacy Principle 2](http://energy.gov/eere/education/energy-literacy-essential-principles-and-fundamental-concepts-energy-education): Physical processes on Earth are the result of energy flow through the Earth system.", "[Energy Literacy Principle 3](http://energy.gov/eere/education/energy-literacy-essential-principles-and-fundamental-concepts-energy-education): Biological processes depend on energy flow through the Earth system."]

Recommended Prior Activities

- None

Vocabulary

Term	Part of Speech	Definition
blackout	<i>noun</i>	period during which electrical energy is unavailable due to system failure.
case study	<i>noun</i>	form of problem-based learning, where the teacher presents a situation that needs a resolution. The learner is given details about the situation, often in a historical context. The stakeholders are introduced. Objectives and challenges are outlined. This is followed by specific examples and data, which the learner then uses to analyze the situation, determine what happened, and make recommendations.
demand	<i>noun</i>	quantity of a product that consumers are willing to buy at a particular price.
electrical grid	<i>noun</i>	network of cables or other devices through which electricity is delivered to consumers. Also called a power grid.
electrical system	<i>noun</i>	groups of electrical components connected to carry out some operation.
electricity	<i>noun</i>	set of physical phenomena associated with the presence and flow of electric charge.
energy	<i>noun</i>	capacity to do work.
energy resource	<i>noun</i>	source of energy found in nature that has not been subject to any human-induced energy transfers or transformations; for example, oil, coal, gas, wind, or sunlight.
energy source	<i>noun</i>	location in which the energy resource (oil, coal, gas, wind, etc.) is converted into electrical energy.
grid modernization	<i>noun</i>	improving an electricity grid system by using digital technologies to monitor and control electricity flow, coordinate between electricity producers and users, maximize efficiency and reliability, and minimize cost.
peak demand	<i>noun</i>	time period during which demand for electricity is at its highest.
problem scenario	<i>noun</i>	hypothetical challenge that requires critical thinking and decision-making to solve.
problem summary	<i>noun</i>	comprehensive and brief description of a challenge.
stakeholder	<i>noun</i>	person or organization that has an interest or investment in a place, situation, or company.

For Further Exploration

Maps

- [National Geographic Maps: Energy Realities](#)

Websites

- [U.S. Department of Energy: Energy.gov—The Smart Grid: An Introduction](#)
- [U.S. Department of Energy: Energy.gov—Smart Grid](#)

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