

**RESOURCE LIBRARY**

ACTIVITY : 1 HR 50 MINS

## Solar Energy and Diversifying Energy Resources

Students analyze the benefits and drawbacks of solar energy by investigating a real-world conflict between farmers and environmentalists in California and a company that wants to build a solar farm nearby. Students read a case scenario, identify specific benefits and drawbacks of the solar farm in the scenario, and write a position statement.

**GRADES**

6 - 8

**SUBJECTS***English Language Arts***CONTENTS**

1 Video, 4 PDFs, 5 Links

## OVERVIEW

Students analyze the benefits and drawbacks of solar energy by investigating a real-world conflict between farmers and environmentalists in California and a company that wants to build a solar farm nearby. Students read a case scenario, identify specific benefits and drawbacks of the solar farm in the scenario, and write a position statement.

For the complete activity with media resources, visit:

<http://www.nationalgeographic.org/activity/solar-energy-and-diversifying-energy-resources/>

## Program



# DIRECTIONS

## 1. Activate students' prior knowledge by discussing common devices that use solar energy.

Ask students to name some common devices that operate on solar energy, such as solar calculators, highway lighting, and garden lights. Make sure students understand how in these examples solar energy is captured using photovoltaic cells and stored in batteries for later use. Note for students that energy captured from photovoltaic cells is not always stored. In some cases, the photovoltaic cells are directly connected to the power grid. Have students discuss some benefits of using solar energy to power highway lights and some drawbacks. Ask: *What are some factors that have to be considered when choosing to incorporate any energy resource? How would you decide which choices to make?* As the class discusses these factors and decision-making ideas, list some of the student responses on the board. Ask students how solar energy can be scaled up from the examples just discussed to provide some of the electricity for a community. If students don't mention them, introduce both small- and large-scale examples: solar panels on the rooftop of a home or in a backyard; solar farms, which have large photovoltaic panels spread over a large area; and solar thermal plants, which use the sun's energy to heat liquid into steam to turn a turbine.

## 2. Introduce the case scenario A Sunny Conflict in California to students.

Explain that although the sunny Panoche valley in California seems like an ideal place for capturing energy from the sun, a solar farm project there has faced strong opposition from locals. Have students geo-locate the Panoche valley on a wall map of the United States or with Google Earth. Ask geographic questions such as:

- *Where is the Panoche valley located?*
- *Why is this region important?*
- *What characteristics of this region make it suitable for solar energy?*
- *What impact might a large-scale solar project have on the region?*

Distribute and have students independently read the handout Case Scenario: A Sunny Conflict in California. Encourage them to underline or note any drawbacks and/or benefits of the project mentioned in the reading.

### 3. Divide students into small discussion groups.

Distribute the Panoche Valley Solar Farm: Benefits and Drawbacks worksheet and briefly go over the directions with students. Initiate the discussion by asking: *What makes this particular valley in California a good spot for collecting solar energy? What makes it a poor spot for collecting solar energy?* Have students discuss the benefits and drawbacks they found in the case scenario with their group and list them in the chart. Encourage students to provide a specific reference from the text as evidence to back up each item they list. Have each group to share a couple of their responses with the class.

### 4. Have each student read at least one additional piece of information about the Panoche Valley conflict from the web resources provided.

Have students note any additional benefits and drawbacks they find in their reading to the Benefits and Drawbacks worksheet. Ask students to identify the source of the information and determine the bias of the source by asking themselves: Is the source a neutral party, or does the source have a stake in the debate? Project the provided web page from Purdue's Online Writing Lab, which explains how to create web citations. Have students refer to the web page and create a citation at the bottom of the chart for each of the resources they read. Remind students to note the source and the specific text reference in each of their notes on the chart.

### 5. Introduce the concept of a position statement.

Explain that each student will now write one to two sentences stating their position on the solar farm in Panoche Valley and then support that statement with facts from their reading. Display the provided Sample Position Statement. Walk through the page with students, modeling the thought process involved in determining possible positions on a topic, coming up with supporting reasons for those positions, and then crafting a strong position statement. Emphasize that position statements must be arguable; an argument could be made for or against the statement. A statement of known fact is not a position statement. Model a few good and poor examples of position statements for students. Ask students to brainstorm a few positions that could be taken regarding the Panoche Valley solar farm project. Students will likely mention being *for* building the solar farm or being *against* building the solar farm, but they might also mention other positions, such as being in favor of a scaled-down version of the solar farm.

## 6. Have students write a position statement.

Provide students with the Position Statement Rubric and briefly review it together. Give students time to write their initial position statement. Check in with students as they finish their statements. Then have students extend their position statement into a brief paper, citing resources from their readings to support their position. Have students peer review a classmate's position paper using the Position Statement Rubric and revise their position statements based on peer feedback.

## 7. Have students share and discuss their position papers.

Have students publish their revised position papers and allow time for each student to read at least two other position papers. Revisit the guiding question by discussing the benefits and drawbacks of solar energy. Ask:

- *What are some benefits and drawbacks of solar energy that you discovered as you learned about the situation in Panoche Valley?*
- *Do you think deciding whether or not to build a solar farm is a simple or complex decision? Why?*
- *Do you think the decision would be any more or less complex in a different location? Why?*
- *If the solar farm is built in Panoche Valley, will it supply all the electricity for the region?*
- *Could the solar farm still be a valuable asset even if it does not supply all the electricity the region needs? Why or why not?*
- *Why is it important to diversify the energy sources a region relies on for electricity?*

## TipTeacher Tip

Because of the nature of the assignment, students might read some opinionated pieces about the project. Take the opportunity to encourage students to evaluate the bias of a source. Ask: *Who is the author of this piece? Why is the author writing it? What outcome in the situation would most benefit the author? Does the author have actual data to support what he or she is claiming?*

# TipTeacher Tip

If possible, demonstrate how energy from the sun can power a device by showing students solar-powered garden lights, solar calculators, or a small photovoltaic panel connected to a motor.

## Modification

Offer guided reading support for English language learners or struggling students. Prepare them for the readings by first watching a video version of an ABC News report titled "[Solar power plan under fire in Panoche Valley.](#)"

## Modification

To support visual and auditory learners, watch a video version of an ABC News report titled "[Solar power plan under fire in Panoche Valley.](#)"

## Informal Assessment

Review students' completed Panoche Valley Solar Farm: Benefits and Drawbacks worksheets to assess their understanding of the concept. Look for the inclusion of both positives and negatives about solar energy. Check to be sure students have listed the items in the correct column and that the source for each item is noted.

Use the provided Position Statement Rubric to assess students' written position statements. Allow students to revise their statements based on feedback from the rubric.

## Extending the Learning

Have students research an additional renewable energy resource and a fossil fuel. Have them create a 3-circle Venn diagram comparing the benefits and drawbacks of all three energy resources.

## OBJECTIVES

# Subjects & Disciplines

- English Language Arts

# Learning Objectives

Students will:

- identify and evaluate benefits and drawbacks of using solar farms as a renewable energy resource
- formulate and write a position statement about the use of solar energy and support the statement with evidence
- evaluate and cite information sources

# Teaching Approach

- Learning-for-use

# Teaching Methods

- Cooperative learning
- Discussions
- Information organization
- Reading
- Writing

# 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
  - Analyzing Geographic Information
- Science and Engineering Practices
  - Engaging in argument from evidence
  - Obtaining, evaluating, and communicating information

# National Standards, Principles, and Practices

## ENERGY LITERACY ESSENTIAL PRINCIPLES AND FUNDAMENTAL CONCEPTS

- Fundamental Concept 4.1:

Humans transfer and transform energy from the environment into forms useful for human endeavors.

- Fundamental Concept 4.7:

Different sources of energy and the different ways energy can be transformed, transported, and stored each have different benefits and drawbacks.

## 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.

- Standard 8:

Students use a variety of technological and informational resources (e.g., libraries, databases, computer networks, video) to gather and synthesize information and to create and communicate knowledge.

## NATIONAL COUNCIL FOR SOCIAL STUDIES CURRICULUM STANDARDS

- Theme 8:

## NATIONAL SCIENCE EDUCATION STANDARDS

- **(5-8) Standard B-3:**

Transfer of energy

- **(5-8) Standard C-4:**

Populations and ecosystems

- **(5-8) Standard F-2:**

Populations, resources, and environments

## COMMON CORE STATE STANDARDS FOR ENGLISH LANGUAGE ARTS & LITERACY

- **Writing Standards 6-12:**

Production and Distribution of Writing, W.8.4

- **Writing Standards 6-12:**

Production and Distribution of Writing, W.7.5

- **Writing Standards 6-12:**

Production and Distribution of Writing, W.6.4

- **Writing Standards 6-12:**

Production and Distribution of Writing, W.6.5

- **Writing Standards 6-12:**

Production and Distribution of Writing, W.7.4

- **Writing Standards 6-12:**

Text Types and Purposes, W.7.1

- **Writing Standards 6-12:**

Text Types and Purposes, W.8.1

- **Writing Standards 6-12:**

Text Types and Purposes, W.6.1

- **Writing Standards 6-12:**

Production and Distribution of Writing, W.8.5

### Preparation

### What You'll Need

### MATERIALS YOU PROVIDE

- Paper
- Pencils
- Wall map of the United States

## REQUIRED TECHNOLOGY

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

## PHYSICAL SPACE

- Classroom

## GROUPING

- Large-group instruction

## OTHER NOTES

In preparation for this activity, ask students to watch the video clip "Solar Power" with the following questions in mind:

- Describe how California is using solar energy to meet its energy needs.
- What's the difference between a photovoltaic cell and a solar panel?
- What does the narrator mean when he says "rain or shine, they can always supply the power Los Angeles expects"?
- What are the hidden costs of any energy technology?

## BACKGROUND & VOCABULARY

### Background Information

Citing dwindling resources and mounting environmental concerns, United States government and industry are trying a variety of ways to reduce the nation's reliance on fossil fuels. One way to decrease this reliance is to increase the use of renewable energy resources. According to U.S. Energy Information Administration reports, the use of renewable energy resources to produce electricity in the United States increased by 24.73% between the first nine months of 2010 and the first nine months of 2011. By September 2011, renewable energy resources,

including solar, wind, water, geothermal, and biomass, accounted for 12.73% of net electrical generation in the U.S. As large-scale renewable energy grows, so too do environmental concerns and other conflicts. Animal conservationists are concerned about the impact of large wind farms on birds, hydroelectric dams on fish, and solar farms on land animals. Critics also describe uncomfortably loud sounds from large wind farms near residential areas and point out that large-scale solar and wind farms can have a negative impact on views and property values. Companies and government interests struggle to determine the best locations for renewable energy plants. Their goal is to achieve the biggest environmental and societal gains with the smallest impacts on the environment and quality of life. The cost of any energy technology includes more than setting up and running the technology. It's important to make sure students understand there are hidden costs to any energy technologies, including impacts on the environment. For example, coal, gas, and hydroelectric power may cost less per kilowatt hour than solar photovoltaic or geothermal; however, they include environmental impacts that are not accounted for in consumers' monthly bills.

Energy from the sun is an inexhaustible resource that creates little to no pollution. The sun is indirectly responsible for most of the energy resources we use. In addition to supplying energy long ago to the plants that later became coal and oil, the sun supplies energy to living plants today that can be harvested and burned as biomass. There is enough energy in the sunlight that falls on Earth in twenty days to equal that in all known fossil fuel reserves. However, current methods of collecting solar energy and converting it to electricity can capture and store only a small amount of the available energy from the sun at any given time. Large-scale solar energy projects operate in one of two ways. Solar thermal concentrating systems use parabolic troughs or dishes to concentrate the sun's light on liquid, thereby heating the liquid. Steam from this super-heated liquid is used to turn a turbine, much like steam from burning coal is used in a typical coal-fired power plant. Photovoltaic systems use combinations of semi-conducting materials with special characteristics that convert energy from the sun into electricity. The Panoche Valley solar farm would use photovoltaic panels to turn photons from sunlight into electricity.

## Prior Knowledge

[<a href="http://energy.gov/eere/education/energy-literacy-essential-principles-and-fundamental-concepts-energy-education">Energy Literacy Principle 1</a>: Energy is a physical quantity that follows precise natural laws."<a href="http://energy.gov/eere/education/energy-literacy-essential-principles-and-

fundamental-concepts-energy-education\>Energy Literacy Principle 2</a>: Physical processes on Earth are the result of energy flow through the Earth system.","<a href=\"http://energy.gov/eere/education/energy-literacy-essential-principles-and-fundamental-concepts-energy-education\">Energy Literacy Principle 3</a>: Biological processes depend on energy flow through the Earth system."]

## Recommended Prior Activities

- None

## Vocabulary

Term	Part of Speech	Definition
<b>bias</b>	<i>noun</i>	writing that shows strong feeling for or against something or someone or that favors one side too much. It presents just one point of view or one side of an argument.
<b>case scenario</b>	<i>noun</i>	imagined or actual set of events used to illustrate a problem or situation.
<b>citation</b>	<i>noun</i>	quote or reference a source in support of a fact.
<b>diversify</b>	<i>verb</i>	to select a variety of options.
<b>electricity</b>	<i>noun</i>	set of physical phenomena associated with the presence and flow of electric charge.
<b>energy resource</b>	<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.
<b>energy source</b>	<i>noun</i>	location in which the energy resource (oil, coal, gas, wind, etc.) is converted into electrical energy.
<b>fossil fuel</b>	<i>noun</i>	coal, oil, or natural gas. Fossil fuels formed from the remains of ancient plants and animals.
<b>non-renewable energy</b>	<i>noun</i>	energy resources that are exhaustible relative to the human life span, such as gas, coal, or petroleum.
<b>photovoltaic</b>	<i>adjective</i>	able to convert solar radiation to electrical energy.
<b>position statement</b>	<i>noun</i>	a thesis describing one side of an arguable viewpoint and supported by facts.
<b>power grid</b>	<i>noun</i>	network of cables or other devices through which electricity is delivered to consumers. Also called an electrical grid.

<b>Term</b>	<b>Part of Speech</b>	<b>Definition</b>
<b>region</b>	<i>noun</i>	any area on Earth with one or more common characteristics. Regions are the basic units of geography.
<b>renewable energy</b>	<i>noun</i>	energy obtained from sources that are virtually inexhaustible and replenish naturally over small time scales relative to the human life span.
<b>solar energy</b>	<i>noun</i>	radiation from the sun.
<b>solar farm</b>	<i>noun</i>	large-scale array of solar panels designed to capture solar energy and convert it into electricity.
<b>solar power</b>	<i>noun</i>	rate of producing, transferring, or using solar energy.

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## For Further Exploration

### Articles & Profiles

- [Solar Action Alliance: California Solar Energy—An Impressive Solar Panel Track Record](#)

### Maps

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

### Websites

- [National Geographic Environment: Solar Energy](#)
- [Energy.gov: Solar](#)
- [U.S. EIA: Energy Kids—Solar Basics](#)

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