

## ENERGY GRID

### Smart Grids: Examining Ways of Using Technology to Reduce Household Energy Consumption

#### Overview

What are the pressures on our electric grid today? From what sources do they originate? How is Smart Grid technology being implemented to relieve these pressures? And, how can it be brought into households? Support your STEM and Science curriculum with this video that demonstrates the use and impact of Smart Grid technology at an avocado processing plant in California. Then, use the accompanying lesson plan to engage students in the examining their household energy consumptions and proposing innovative solutions for implementing smart grid technologies to reduce residential energy use.

#### Materials

- Smart Grid Solutions video
- Reproducible: Trading Energy

#### Featured Vocabulary

***demand response system*** – in electricity grids, a networked communication system whereby consumers reduce energy consumption in response to supply conditions, such as peak usage times or market prices.

***smart grid*** - delivers, monitors, and manages supply of electricity from suppliers to consumers using digital technology with two-way communications to control appliances

***utility*** – a service such as electricity, gas, water, or telecommunications, provided and managed by a public supplier

## Background

A complex network of power plants and millions of miles of transmission and distribution lines, the electric grid is a vast network for delivering electricity from suppliers to consumers. Although the technology that delivers electricity has hardly changed over the past 100 years, the stresses on the grid have multiplied due to increased population and the increase of gadgets.

The following statistics from the Alliance to Save Energy paint a compelling portrait of the pressures on our electric grid:

- Power outages already cost the U.S. more than \$100 billion each year.
- In just two decades, it is projected that U.S. energy consumption will increase by almost 40 percent – an amount equivalent to the energy used today in California, Texas, New York, Ohio, Pennsylvania, and Illinois.
- Many idle electronics – TVs, VCRs, DVD and CD players, cordless phones, microwaves – cost consumers over \$3 billion annually. Even when switched off, they use 5% of our domestic energy to keep display clocks lit and memory chips and remote controls working.
- American households typically spend more than \$200 annually on air conditioning. Households in some regions of the South can easily spend twice that much. Over an air conditioner's lifetime, only one-fourth of the total cost is for the purchase of the air conditioning unit. The greater cost – three-fourths – is for the energy to run the air conditioner

In the face of these pressures comes the “Smart Grid” technology, which adds intelligence and communication to the existing grid system. By using computer-based remote control and automation, smart grid technology enables consumers and utility companies to monitor energy usage, figure out why it's so high, and work together to make systems more efficient. In a world where the cost of electricity goes up based on the demand for it, the smart grid provides a win-win situation where utility companies provide incentives (including lower bills) to consumers to not use energy and are able to save energy in the process.

## Warm Up

Ask students to guesstimate the percentage of residential energy costs in the US every year for the categories identified in this pie graph

<http://hes.lbl.gov/public/consumer/images/energy-costs.jpg> which depicts residential energy costs in the US every year. Then, share the actual breakdown and ask students: What are your observations about home energy use? How can savings be achieved? What are the rooms for improvement?

Use this dialogue to introduce the concept of the smart grid to students. You might wish to share the following resources which make the concept accessible and relevant to a young audience:

- A lively video from eGFI <http://students.egfi-k12.org/video-green-revolution-smart-grid/> which introduces the SmartGrid concept to a student audience
- A news story which <http://www.youtube.com/watch?v=z5TtCAqUMUw> highlights a smartgrid pilot project in South Korea focused on households

### Discussion Questions

Have students watch the video while taking notes on the following. Afterwards, use the following questions to assess comprehension and prompt discussion:

- Why is there so much pressure on the electric grid right now?
- How can smart grid technology relieve this pressure? Why is it a win-win situation?
- Draw a graph depicting the relationship between electricity costs and demand. Why is this relationship important?
- How is technology essential to energy conservation?

### Activity

Have students figure out their own household energy consumption using Home Energy Saver <http://hes.lbl.gov/consumer/>, an online tool that helps users determine the energy consumption of a home and find ways to reduce it. Engage students in a classroom discussion on household energy consumption. The site recommends energy-saving upgrades that are appropriate to the home and make sense for the home's climate and local energy prices. Alternatively, you could have students play online games such as Energy Hog <http://www.energyhog.org/childrens.htm> and Hog and Seek <http://www.hogandseek.org/intro.html>. Both have been developed by the Alliance to Save Energy and the AdCouncil. They introduce children to different sources of energy and students score points by "busting household energy hogs" to save energy. )

Then, based on their Home Energy Saver findings or their game learning about their own energy habits, invite students to develop and present concepts for the usage of Smart-Grids in private households. For example, many appliances could be switched on only during off-peak times (i.e. laundry could be done at night instead of during the day).

They can use the reproducible [Smart Homes](#), [Smart Grid](#) to guide their brainstorming. Ask: What kinds of solutions would create win-win solutions for utility companies and consumers? How can technology be used to conserve energy? What kinds of applications would you develop?

### **Going Further**

The concept of gamification <http://www.ecomagination.com/game-on-getting-smarter-about-the-smart-grid> – solving problems by communicating data in a game-structured format, one that engages our natural affinities for competition and play—has been applied to home utility bills by the company Opower [www.opower.com](http://www.opower.com). Their utility bills read more like report cards which grade energy efficiency as average, good, or great than as dry data about “total kilowatt-hours” and provide easy-to-use energy-saving tips that can improve your “score.”

Have students compare their electricity bills with the innovative, game-based utility bills <http://opower.com/what-is-opower/reports/> created by OPower. How would they “rewrite” their own utility bills? What categories would they add? What information would they modify? Invite them to create their own game-based report cards based on their Home Energy Saver reports.

### **Resources**

**Smart Grid** <http://energy.gov/oe/technology-development/smart-grid>  
Department of Energy Smart Grid primer

**Ecolmagination** <http://www.ecomagination.com/tags/smart-grid>  
GE features on the Smart Grid

**Energized Learning** <http://energizedlearning.lbl.gov/EnergizedLearning.html>  
Middle school lesson plans focusing on energy, its use, and its complex interrelationships

**Energy Education and Workforce Development**  
<http://www1.eere.energy.gov/education/lessonplans/default.aspx>  
Creative lesson plans, labs, projects and other activities for grades K-12 on energy-related topics from the Department of Energy

**US Energy Information**  
<http://www.eia.gov/kids/index.cfm>

## **Standards**

### **Engineering Education**

- 4. Knows applications of electrical skills and theories
- 5. Understands energy and power types, sources, and conversions

### **Science**

- 12. Understands the nature of scientific inquiry
- 13. Understands the scientific enterprise

### **Technology**

- 6. Understands the nature and uses of different forms of technology

AMERICA  
REVEALED