

# Grades 9-12: Points to ponder

A few observations to encourage your students to engage in discussions

## Overview

Before teaching any of these lessons, read them thoroughly to assure you understand how the activities and worksheets are integral to the overall learning process. You may choose to revise these lessons to address topical needs relevant to your students. Naturally, an enthusiastic teaching style will better engage your students. Be sure to print out all of the activity sheets in advance of any course. References to worksheets appear in **bold**. Narratives appear in *italic*. The lessons presented here are designed specifically for students in grades 9-12 and will appear more “lecture heavy” than other courses also being made available to instructors. Additional lessons are available for college students, as well as for adults. Any of those lessons also could be taught to students in grades 9-12. Plus, the auxiliary PDF files may be used to support your lessons. These PDF files include a glossary of renewable energy terms and the history and role of energy in civilization. Finally, look for Web addresses that will provide much more information.

## LESSON 1

### Essential or Convenience?

#### *Essential uses of energy include:*

- Planting, harvesting, processing, transporting and storing food
- Health care services
- Heating our homes
- Powering heavy industries such as manufacturing and small businesses that provide goods and services to consumers.
- National security, law enforcement, and emergency response

#### *Non-essential uses of energy include:*

- Many forms of entertainment and recreation, such as concerts, water skiing, and stock car racing
- Running one’s air conditioning and the gas fireplace at the same time
- Sunday drives
- Leaving on lights, televisions, and heat in rooms that are unoccupied
- Wasting food by letting it spoil or throwing away good food at the end of a meal

### Energy Crisis Learning Curve

- Develop renewable sources of energy to diversify the sources while increasing the options should once source “dry up.”
- Adopt federal policies to encourage conservation of energy usage: these policies include higher fuel economy standards for cars and trucks, and increasing use of insulation to reduce heating and cooling costs of buildings.
- Change the culture that grew up with cheap, available energy to one that sees energy as a limited resource
- Introduce the concept that all energy has an environmental and economic impact both in America and worldwide.

## Did we learn anything as a nation?

### *What did we learn?*

- How to better design and build homes to use less energy.
- How to use computer-controlled fuel injection, aerodynamics, and overdrive transmissions to increase highway fuel economy.
- How to reduce electricity demands by using fluorescent lights and low-energy appliances.

### *What did we not learn?*

- New cars and light trucks are began gaining back weight, size, and horsepower (consumers paid the “gas guzzler” penalty).
- The U.S. continued to use more energy than it could produce, resulting in up to two-thirds of our oil having to be imported from overseas in some years.
- We incorporated more conveniences into “essentials” of everyday life: examples include multiple televisions in every home and all-wheel drive vehicles which seldom if ever left dry pavement.
- Hundreds of thousands of individual commuters daily driving to and from work rather than using car pools or public transportation.
- We were slow in adoption of renewable fuels and did not provide adequate funding to develop renewable sources of energy.

## Do The Math

The numbers simple double each year. In Year 12 all the available coal is gone. This exercise will illustrate how ever-expanding use of a resource can quickly consume it. What will happen in Year 13? Ask your students if in Year 8 people voluntarily agree to use less. Would it affect their quality of life? Their productively? How might they stretch their supply? Could there be problems with people who chose to use even more coal instead of less? What if the government mandated conservation? Would this be more fair as a way to share the impact evenly?

## Think For Yourself

Are the solutions to preparing for another energy crisis being offered by the students practical? Will they run into political, environmental or economic opposition? As you ask the students if each group’s findings are Fact or Fiction, question them as to what lead them to make their choice. Is is possible more research could convert a Feeling to a Fact? When asking the students if they Agree or they would Argue, ask them if they be vocal in agreement or willing to voice an opposing point of view with their friends, family, or in a public meeting.

## LESSON 2

### It’s In The Cards

Done correctly, this activity will engage all students during the discussions. Expect some to agree with each group’s findings and others to disagree. Assess whether each group and each student’s response is based on fact or feeling. Consider asking variations of the following questions to keep the discussion lively and thoughtful. Is it easy for one person to decide what is right for his or her own life? Is it more difficult to reach agreement as a community? A country? Globally? If our parents make their livings because the work for a coal mining company, does that affect our thought process? What if a coal company moves next door to where we live and begins mining. Would that also affect our attitudes?

## LESSON 3

### Discussion Checklist

Answers to these questions will vary greatly depending on the type of tour you arrange. Your role is to serve as a facilitator, encouraging students to both ask and answer questions as a group.

### Renewable Energy Is Hardly Trivial

If you find you have extra time, please use the **Renewable Energy is Hardly Trivial** quiz and offer it to your students.

Renewable Energy can come from:

E. All of the above: The answer here should be obvious

Which statement is true:

C. Humans have been using wind and water to generate renewable power for hundreds of years

Coal remains in use because:

D. Both A & B

Gasoline became the leading fuel for automobiles because:

B. It has a high energy content per gallon meaning more power and longer range between refueling

The Moon can be a source of renewable energy because:

B. Its gravity causes tidal surges which can power generators along coastal areas

America suffered an energy crisis in the 1970s because:

B. Oil exporting nations in the Middle East cut back production

The benefits of renewable energy include:

E. All of the above

Ethanol is commonly made from:

C. Field corn

Hybrid cars are powered by:

A. A combination of electricity and a gas engine

Fossil fuels are:

B. A significant source of air pollution

Before fossil fuels were widely used, people used these sources of energy:

E. Wind and water

## **Consider making these comments as appropriate to encourage further comments from your students**

What will be the shock to U.S. economy if a transition from fossil fuels to renewable energy is sudden and unplanned due to serious disruptions in supply? Examples of these disruptions could be war in the Middle East, a major refinery fire in the U.S., or a natural disaster such as an earthquake that affects pipelines and thus supply.

In France more than 75 percent of electricity comes from nuclear power. France has a national policy to be energy independent. Because of this, France has low-cost electricity that it exports to other European nations. It is the world's largest exporter of electricity. And, France has electrically powered passenger trains whose average start to stop speeds are in excess of 170 mph. This too is because France has developed a modern and efficient electrical infrastructure.

Nuclear power in the U.S. generates nearly 20 percent of all electricity. All of these operating plants were built before 1974. Opposition to nuclear power by some groups has been intense, effectively reducing public support for future plants. Safety concerns have been heightened due to serious nuclear disasters at Three Mile Island in the U.S. in 1979, Chernobyl in Russia in 1986, and Fukushima in Japan in 2011. Concerns have been expressed about the disposal of radioactive nuclear fuel, and of the ability of nations to use nuclear power plants to generate the material needed to build nuclear bombs.

The U.S. alone has a vast supply of coal, especially low-sulfur content coal in Northeastern Wyoming and Southeastern Montana. Some types of coal mining cause significant environmental damage. Some forms of coal release hazardous or harmful emissions when burned. Yet coal is an affordable and reliable source of energy. It is transported to power plants within the U.S. and is exported to other nations. Coal causes relatively little environmental damage in the event of spills in transit. In some situations, power plants are built next to coal mines to greatly minimize delivery costs. Ten years ago coal fired power plants produced half of all U.S. electricity. That has dropped to 40 percent, mostly replaced by natural gas that has become much less expensive. Natural gas also has the benefit of producing lower amounts of undesirable emissions.

Coal and crude oil fuel the world. High energy content, worldwide availability, and extensive mining, refining, and delivery systems assure these fuels a dominate place across the globe. When it comes to transportation, as in planes, trains, trucks, and automobiles, petroleum products have no equal. Gas, diesel fuel and jet fuel move people and products. Farming and food production depend on crude oil. That said, crude oil makes a big mess when it spills. Offshore oil wells have exploded (BP in the Gulf of Mexico, 2010), gas pipelines have ruptured and burned in residential neighborhoods (Mounds View, Minn., 1986), huge oil tankers have broken open at sea and caused huge environmental disasters (Exxon Valdez near Alaska, 1989), and oil wells have been set afire by terrorists and as a result of war (the Persian Gulf War, Kuwait, 1991).

Gasoline as a car fuel has a built in advantage based on historical market dominance. The oil companies grew hand in hand with auto manufacturers and highway building efforts. Gas was the only choice really offered to motorists. Gas provides a lot of power for its volume and weight. It works well in the type of engines used in cars, trucks, many airplanes, small boats and lawnmowers. With some 150,000 gas stations nationwide, this fuel is incredibly convenient and completely entrenched in the American way of life.

Renewable forms of energy such as water and wind have been in use for hundreds of years. Biofuels have been around since the beginning of the automotive and aviation industries. Scaling up all of these industries to offset fossil fuels is challenging for technical reasons, and because of opposition by industries and individuals who have something to lose. And because of the Not In My Back Yard (NIMBY) attitude. If one community welcomes a wind farm, but the next one down the road objects to having the transmission lines cross the area, who wins and who loses, especially when you consider the regional impact beyond either community. Money has a way of silencing critics.

Not sharing in the wealth has a way of creating critics.

Although the energy industry is extremely complex, there is overall agreement by professional that affordable and available fossil fuels will run out and that these fuels cause significant environmental damage that has been accumulating for centuries. The question is how to balance convenience against true costs. The U.S. military spends billions of dollars every year to maintain safe passage of oil tankers in and out of the Middle East. Terrorism, wars, and embargoes that cripple the world economy are directly linked to the production of oil. Mountain top mining of coal in the eastern United States has caused environmental and economic damage to communities.

Some people believe wind turbines compromise the landscape. Consider that rural areas also have power lines, larger electric transmission lines, grain elevators, water towers, processing plants and smokestacks that also "litter" the horizon. We tend to be blind to what we grew up with but sharply focus on what represents something new. Naysayers are common in our society. It is easy for people to be critical of anything, far more difficult for them to offer viable alternatives or solutions. People will take sides on an issue without necessarily giving consideration to the opposite point of view, or listening with an open mind to professionals who are well versed on technical matters. You have both a right and responsibility to research these topics, ask tough questions of the people and companies and agencies involved, and to have a voice in your energy future.

—Grades 9-12 Sources: Cornell University, Bloomberg News, U.S. Energy Information Administration, U.S. Department of Energy, U.S. Department of the Interior, Bureau of Reclamation, North Dakota State University, Iowa State University; howstuffworks.com, Scientific American, Pennsylvania State University; The New York Times; National Wind Watch, American Wind Energy Association; Growth Energy, Solar Energy Industries Association, Smithsonian Magazine, Poudre Valley Rural Electric Cooperative, U.S. Department of Labor.