ENVIRONMENTAL LITERACY TEACHER GUIDE SERIES

Energy Potential

A Guide for Teaching Energy in Grades 3 to 8

NATIONAL GEOGRAPHIC

5 Energy in Our Human Communities

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Energy enables life on our planet and allows humans to make progress and improve our way of life. But just as energy has moved society forward, the economic and political implications of differential access to energy have brought about negative social unrest around the world. Students may be aware that energy is an environmental issue. They have seen images or heard news about environmental catastrophes like oil spills. Energy, like freshwater, is an excellent context for discussing politics and social unrest caused by human activities.

Energy is an important and complex global and social issue. It may not seem so at the surface. When you flip a switch in your home, the lights come on. The gasoline stations are still filled with gasoline for our cars. Air conditioners run in the summer, and heaters still work in the winter. Life is still happening much as it has been for the last several decades. Yet, a great deal of attention has been given in recent years to the need for a future that relies less on fossil fuels and more on locally available, renewable-energy resources. In fact, students may wonder why people are not simply making the move to new energy resources given all the attention this topic has in the media today.

The present-day energy crisis is about the unequal distribution of oil, electricity, and overall energy resources, as well as the impending depletion of the fossil fuels worldwide. It is also about rising worldwide population, and as a result, increasing use of energy to power consumer-driven lifestyles. As Thomas Friedman describes, we have entered the Energy-Climate Era with the following key issues to tackle: energy supply and demand, petro-dictatorships, climate change, energy poverty, and biodiversity loss (Friedman 2008). This chapter takes a closer look at several of these issues, focusing mostly on social politics around energy use and what your students may or may not understand with respect to this topic.

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Energy in Changing Communities

Our current dependence on fossil fuels can be traced back to the **Industrial Revolution,** which started in Western Europe and the United States in the late 1700s and continued through the late 1800s. Societies in these areas shifted from an agriculture-base to an industrialized one. In traditional agricultural societies, people were responsible for harnessing their own energy. Traditionally, they used renewable resources such as wind and water or by burning plant-based materials such as wood or charcoal. When coal mining advanced and oil was discovered, people were able to use energy more effectively for heat, mechanical power, transportation, and electricity. These fossil fuels supported a newly industrialized society. The industrialized areas became dependent upon fossil fuels, which had widespread and enduring impacts on lifestyles in those nations.

Industrialized cities were associated with wealth or opportunity, so people migrated to cities to make money, often by working in factories. Work opportunities were readily available. Rural life became less attractive to many, and others were forced to move to cities for job opportunities. Until recently, the fossil fuels powering the industries seemed to be an endless and relatively harmless source of energy.

Meanwhile, much of the world lagged decades to centuries behind Western Europe and the United States in terms of industrialization. Some areas, such

CHAPTER OVERVIEW

Since the Industrial Revolution, humans have become dependent upon high-quality energy to power our everyday lives. Obtaining and processing energy sources comes at a cost, as energy resources are not equally distributed around the globe.

People in rural areas of the developing world have little access to energy, even if energy resources are readily available in their countries—a condition known as energy poverty. This is true in developed countries such as the United States as well, as mining towns have some of the highest poverty rates in the nation. Richer countries and communities often pay top dollar for energy resources, taking them away from local people who need them. Energy poverty limits economic opportunities, leads to environmental destruction, and continues the cycle of poverty. This is also an important issue that relates to environmental justice.

The United States is incredibly dependent upon foreign oil, making our nation susceptible to issues of petropolitics, such as oil embargoes, and prompting involvement in the political issues of oil-rich nations. As 21st-century citizens, we must consider the global political issues related to our energy consumption.

as in the Middle East and Africa, were found to be rich in energy and mineral resources such as oil, copper, and zinc. Industrialized nations, which had already been claiming colonies in developing areas, began to extract their natural resources. For the most part, however, even resource-rich developing countries did not begin to industrialize until much later. Resource extraction in both developed and developing nations results in environmental concerns and also in social issues. For example, many countries in Africa deal with violence surrounding the charcoal trade. Now, as the value of fuel rises, social unrest in some of these developing countries has increased. Industrialized nations are starting to question the future of energy—will the cost continue to rise? How accessible will these fuels be in the future?

Interestingly, students may not recognize that rural or agriculture areas, especially in developing nations, do not have access to energy as most Americans do today. They may believe those communities do not want or need energy. Yet, many of those communities struggle to survive because they do not have the necessary energy resources they require. Imagine life without energy to pump water into our homes. Imagine not having electricity or gas to cook food or boil water. While communities in developing nations appear to need little energy when compared to U.S. lifestyles, even some of the most basic energy needs are still not met.

Teaching Tip

Ask your students to share what they know about the energy needs of industrialized versus developing nations. Create one class list of all the things than a U.S. family needs energy to do. Then, ask students to brainstorm a list of things a family in rural Africa might need energy to do. This family might farm and/or raise livestock. Compare both lists.

Then, share the following data with students:

According to the World Bank, America uses more than 7,000 kg of oil per person, per year. Compare this to countries such as the Sudan (about 350 per capita), Nigeria (about 750 per capita), or Tanzania (about 450 per capita). Ask your students the following questions:

- What do you think about the difference of oil use in America and African nations?
- How would your life be different if we used much less energy?
- What if everyone on earth consumed as much energy as Americans?

Running Out of Control—And Just Running Out

The inexpensive and widespread access to fossil fuels for industrialized nations has resulted in extremely heavy use of Earth's finite resources. According to the World Bank, the United States uses more than ten times the energy per capita than many African nations. Over time the American way of life has shifted to a new standard of living the relies heavily on energy even for the most conscientious of consumers. Some consumers feel entitled to this level of energy use even when they urged by power companies to conserve energy. People around the world are looking to this lifestyle as one of prosperity and success as opposed to overuse or unsustainable use of resources. Consider discussing with students: What would we do if all people around the world had the same lifestyle as Americans or other industrialized countries? How would our power companies manage the demand for fossil fuel energy? How long before we would run out?

As different businesses flourished around the world, they began to need services or products from other countries around the world. Aided by international treaties that allowed for free trade of goods and services between nations, a trend started that changed the world forever—a trend we now know as **globalization.** Globalization describes the way regional or local economies and cultures become more integrated into a global community. Globalization made it clear that access to goods, wealth, and comfort was achieved only with access to energy. Today, many of the poorest parts of the world do not have access to oil, coal, or other means to produce electricity, which in turn limits their access to food and clean water sources. Friedman describes this situation as **energy poverty** (2008). Unlike energy-poor nations, countries with access to oil have great power to change the economic and political agenda of nations around the globe. Friedman uses the terms **petropolitics** and **petrodictatorships** to capture the idea that fossil fuels are inextricably linked to the way politics work today. Let us take a closer look at both energy poverty and petropolitics.

Energy Poverty: Is Energy a Right?

One glimpse of satellite imagery of our planet at night shows the world's uneven distribution of energy, or more

The Earth at Night shows clear distinction between the energy haves and the energy have-nots. View more images at NASA: http://visibleearth.nasa.gov/view_detail.php?id=1438.

specifically, electricity. Show your students an image of Earth at night and see what conclusions they can make about haves and have-nots when it comes to energy. They should notice that vast areas are completely dark, where others are shining brightly. If we carefully observe, Africa is one of the darkest areas on the globe, and other dark areas are found in Asia and South America. It could be argued that the darker areas could be undeveloped and pristine natural areas, but sadly, that is not necessarily the case. In fact, many poor, rural communities depend upon unsustainable sources of biomass for their energy. Do your students know where some of these rural communities are located in the world?

The concept of energy poverty might be difficult to understand for American students who have grown accustomed to access to electricity on demand. Even given our energy-rich status in America, we still find energy poverty in areas with low household income (Power 2010). For the most part, though, industrialized countries such as the United States have had the benefit of energy access and have developed infrastructure to deliver that energy to their citizens. In developing countries the situation is different. Households in the slums and rural areas of developing nations are, in most cases, not connected to the grid. If they are connected, it is highly probable they would experience rolling blackouts or outages caused by insufficient generation of energy or inadequate infrastructure. In these countries, power plants can be insufficient to fulfill energy demands. This is also true in some regions in developed countries.

The most important thing to understand about energy poverty is that it limits economic growth and "perpetuates social inequality" (Friedman 2008). People living in poverty can become even poorer without access to clean water, health care, and connections to the rest of the world that allow them to learn at the same pace as those in industrialized societies. Education, health, industry, and agriculture problems will not be solved as long as a region or a country is energy poor. These are some of the energy issues that define the present situation in energy poor areas:

- Countries in Africa, especially in rural areas, depend on charcoal, which causes deforestation and spurs violence due to the illegal charcoal trade. Trees are cut down and the wood is buried and burned underground. Burning the wood without access to oxygen forms charcoal, which is a valuable commodity.
- Natural resources obtained for the generation of energy are exported rather than used for domestic purposes.
- Schools, hospitals, and small businesses do not have the advantage of regular power supply and tend to face power outages that obstruct basic services for the population.
- Poor communities not only have limited access to energy, but also may be on the receiving end of pollution. This is a matter of environmental justice. The public health in these areas may suffer from both water or air pollution, even in developed areas of the United States.

Energy poverty is common among many nations and many communities within Africa. Corruption, lack of management, and endless wars can cause or exacerbate unequal access to energy sources. In addition to all this, Africa is fossil-fuel poor relative to other regions around the world. There are not enough fossil fuels to generate energy for the entire continent, and the oil and coal they have are controlled by elite, wealthy businesses. African countries cannot compete financially for fossil fuel resources when they are bidding against wealthier countries.

It is a complex scenario with no simple solutions. Many of these communities are learning to meet their energy needs by bypassing fossil fuels altogether and using renewable energies, such as solar, wind, and hydropower. While these countries are energy poor by U.S. standards, they are some of the best examples of countries going green!

Energy also flows across borders in complex ways. For example, the United States receives much of its natural gas through pipelines from Canada and Mexico. Interestingly, the United States also exports natural gas to Mexico. Moving energy across borders brings into question whether citizens are aware of imports and exports of energy and whether energy-poverty countries have the same voice compared to citizens in the energy-hungry countries. Encourage your students to consider the idea of energy poverty, and how it plays out both in the United States and across the globe.

Pictures of Practice

Energy Across Borders

Students may not realize where their energy is obtained—from the cars they ride in on their way to school to the electricity that powers their televisions and computers. Yet, much of the energy resources we use everyday may come from places far away. Like many resource issues, energy resources can create problems between two countries. When energy is extracted in one country to sell to another country, the benefit may not be equally distributed to the people of both countries. Relatively poor countries may sell their energy resources to wealthier countries to bring in revenue. The citizens of the poor countries may not have a say in how this exchange happens, while the citizens in the wealthier countries are likely unaware of the inequity that may occur. This phenomenon is also true within the United States. For example, West Virginia is one of the most energy-rich areas of the nation, yet the state's residents are among the poorest in the nation.

Students: Grades 4 and 5

Location: San Diego, California (a coastal community)

Goal of Video: The purpose of watching this video is to hear students discuss buying natural gas from Mexico.

Classroom Context

Ms. Howard addresses energy concepts with her elementary students across several grade levels. Ms. Howard pulls out cards and images of several resources we get from Earth and uses a globe she has modified for the activity. As she pulls out each resource, students discuss what the resource is, and whether there are drawbacks to our use of the resource. When Ms. Howard pulls out the natural-gas resource card, she introduces the controversy over natural gas from Mexico and probes one student's—Ezequiel—ideas about the issue.

Video Analysis

Ms. Howard pulls out the natural-gas resource card and introduces the controversy of getting natural gas from Mexico. Ms. Howard says that San Diego is piping in natural gas from Mexico and asks her students what they think about the issue. Interestingly, this is not a one-sided issue. While Americans import natural gas from Mexico, Mexico also imports natural gas from the United States. Canada is also a major importer and exporter of natural gas in North America. Thousands of natural gas pipelines run across the borders between countries, especially between Canada and the United States (see more information at http://www.eia.doe.gov/pub/oil_gas/natural_gas/analysis_publications/ngpipeline/impex.html). However, Ms. Howard brings up an interesting question about whether Mexican citizens and U.S. citizens voted on sharing natural gas resources across borders. One student—Ezequiel—says that they made a border between Mexico and the United States for a reason. Ms. Howard, Ezequiel, and the class also discuss why Mexico might sell natural gas to the United States in order to get money.

Reflect

What issues would you teach about social inequalities of energy?

Buying energy resources from other countries, whether it's Mexico, Canada, or overseas, can be a confusing topic for students. However, as the world becomes more globalized, our citizens will need to be more aware of energy flowing across borders, global or local, and the effects on people on both sides. How would you introduce this topic to your students? What concepts would you focus on, and why?

Case Study

The Charcoal Trade and Social Unrest

Charcoal has played a major role in energy history and has been a mainstay in African culture. Charcoal is essential to cooking or heating in many countries in Africa. For thousands of years, biomass, such as wood and charcoal, has been the most essential source of energy for rural communities. These sources of energy allowed for heating, lighting, and cooking, as well as other nonessential activities important to the development of the local cultures (e.g., firing of ceramics and metalworking). Today, charcoal is produced by cutting down trees and bushes, and placing the pieces into a pit in the ground. The wood is then lit and buried with sediment, depriving the fire of oxygen. The resulting material is charcoal.

Several countries in Africa that have been heavily militarized are dealing with armies that control the protected national-park areas and also control the illegal charcoal trade. Such is the case in the Democratic Republic of the Congo, where dense forests in protected parks are rapidly disappearing to fulfill the growing demand for charcoal. Since civil war officially ended in 2003, profits from charcoal and firewood have increased. Farmers would rather cut down trees for the production of charcoal than wait for two years to harvest food. This is turning many forested regions of the country into deserts (Lovgren 2007).

The majority of the population have to rely upon charcoal for cooking and heating, so the illegal trade of charcoal is a lucrative business, especially for military personnel who are sent to patrol the forested areas and do not receive pay for their work. This illegal trading, in turn, creates unsafe communities. Park rangers cannot perform their jobs because anyone acting against the illegal charcoal trade is physically threatened or thrown into jail.

Wildlife has been impacted as well because conflict over charcoal occurs in forested, mountain areas where gorillas and other endangered species reside. Park rangers, charged with enforcing park regulations and protecting wildlife, often risk their own lives trying to safeguard gorillas. For example, at least 150 rangers from the Congolese national wildlife service have been murdered in the last decade (Raffaele 2007). Seemingly endless human conflict in the eastern Congo region makes it hard to pay attention to preservation of forests and wildlife. While Americans and others around the world want to protect gorillas and other imperiled species, **refugees** fleeing conflict are more concerned with meeting their daily needs for food, water, and shelter. The people need energy for cooking and boiling water—energy that charcoal can supply. Unfortunately, the very same groups that forced entire communities out of their homes in the first place also control charcoal trading. Profits from the trade go back into fueling the war (McConnell 2009).

Two other detrimental outcomes from this system are air pollution and depletion of natural resources. The production and use of charcoal generates air pollution, and more people are becoming ill and dying as a result of poor indoor-air quality. Women and children are the most affected by poor air quality in the homes, which is now one of the leading causes of death in Africa, after malnutrition, AIDS, and water pollution.

Most people participating in the charcoal trade are likely unaware of the environmental consequences of such a system. Such communities are likely open to alternative sources of energy—sources of energy that are reliable and reduce dependence on the corrupt charcoal-trade system. The solutions for these communities must look toward renewable, portable, and inexpensive energy for all people.

In the Classroom

Energy Use in the Americas

In this activity, students will discuss energy consumption in North, Central, and South America. They will also use technology to research leading countries of energy consumption and then graph, map, and analyze the information.

Materials

- Pen/pencil
- Computer lab/Internet access
- Energy Consumption chart/worksheet
- Map of the Americas (North, Central, and South America)

Country Name	Total Population	Energy Consumption (kg of oil equivalent per capita)
Canada		
United States		
Mexico		
Brazil		
Chile		
Columbia		

Directions

1. Distribute and discuss components of the Energy Consumption chart/worksheet.
2. Have students circle the two countries they anticipate will have the highest energy consumption.
3. Allow students to access the Internet, and guide students to the following website to find information for completing the Energy Consumption chart/worksheet.

   a. Source: http://www.google.com/publicdata/directory

   b. World Development Indicators → World View → Total Population

   c. World Development Indicators → Environment → Energy Use (kg of oil equivalent per capita)
4. Have students fill in their charts and compare their answers to a neighbor in order to verify that they have recorded the correct information.
5. Prompt students to graph all columns as they find information for each country. NOTE: This will be done automatically on the screen for each data set. Students may print the screen or sketch each onto the back of the worksheet page.
6. Once everyone has finished, ask students to rank the countries in order of overall consumption (#1—highest, #5—lowest) and label each on a map of the Americas.

Discuss

1. What are the two highest energy-consuming countries in the Americas? Were your initial predictions correct?
2. What do you notice when you compare each country's population size to its consumption? What about its population size compared to its area size (using a map)?
3. Are there any patterns you recognize in the chart, graph, or map data?
4. If countries in Africa and Asia were included, how would their numbers compare to your findings?

Case Study

Peak Oil

The amount of crude oil extracted from our planet has been rising for the past 150 years. This rise in extraction can't continue forever, simply because oil is a nonrenewable resource, meaning Earth holds a fixed quantity of oil.

If people continue burning oil, eventually the store will be depleted. It will not run out suddenly, in the same manner as a car that is driven until its gas tank runs dry and then sputters to a stop. Instead, most experts expect the world's oil extraction would gradually rise over many decades, reach a peak, and then gradually decline over many more decades. The pinnacle, the point of "peak oil," would mark a crucial turning point—the dividing line from an era when the world had more and more oil over time, to an era when it has to get by with less and less all the time.

U.S. Peak in Crude Oil

Crude oil extraction in the United States has followed this pattern of a rise, peak, and decline. The first U.S. oil well was drilled in Pennsylvania in 1859, and this country soon became the world's biggest oil producer, a title it held for more than a century. A graph of the whole history appears like a mountain, with the maximum rate of oil extraction—nearly 10 million barrels a day—in 1970.

Since the 1970 peak, more than 600,000 new oil wells have been drilled in the United States, but crude-oil extraction has declined decade after decade. This is partly because most new wells are reaching smaller or more remote oil fields. In 2010, the United States extracted about 5.5 million barrels a day, a little more than half as much as at the 1970 peak (EIA statistics).

World Peak in Crude Oil

The world appears to have reached the peak of crude-oil production in 2006 (International Energy Agency 2010). Since that date, crude-oil production has been flat, neither rising nor falling. Meanwhile, the price of oil quintupled from 2000 to 2008, reaching an all-time high of nearly $150 a barrel. Since then, prices have remained high, averaging about $100 a barrel in 2011.

New Sources of Liquid Fuels

Since passing the U.S. production peak in 1970, some giant oil fields have been discovered and tapped—such as in Prudhoe Bay, Alaska. Also, development of technologies, such as ultra-deepwater drilling, has allowed oil companies to gain access to "extreme oil"—deposits that had appeared before to be too difficult or too expensive to tap (Strahan 2009). Examples of ultra-deepwater drilling in the Gulf of Mexico include the floating production platform Perdido, which operates in 8,000 feet of water, and the Deepwater Horizon drilling rig that had reached a drilling depth of 13,000 feet into the seabed when the Macondo well blew out, causing an explosion and the eventual sinking of the 58,000-ton mobile rig.

In the meantime, the oil producers are boosting the amount of gasoline and diesel from sources besides normal crude oil. For example, the United States may be able to increase its extraction of oil a bit in the coming decade, primarily by using a technique known as hydrofracturing, or fracking, according to the U.S. Energy Information Administration. This process uses water to move petroleum deposits into more extractable areas. Fracking is controversial due to concerns over contamination of local water supplies. Fuel companies could also produce more liquid fuels by turning coal into liquids or by mining a black rock known as kerogen (more commonly known as tar sands) that can be cooked to make it release oil (EIA 2011). However, these unconventional technologies may have more environmental impacts than extraction of regular crude oil and have been more expensive to use to this point.

The production of all kinds of liquid fuels may also reach a peak in the next half-century, with the most pessimistic predictors saying it could come by 2020 (Hirsch 2007). One of the most optimistic forecasts is from oil historian Daniel Yergin, who foresees a peak around 2050 (Yergin 2011). Petroleum in all its forms is a nonrenewable resource and, therefore, won't be around forever.

Petropolitics: Oil and Politics Don't Mix!

Have you ever heard the phrase, "independence from foreign oil?" This phrase has been used ubiquitously among politicians in the United States. What does it mean to depend upon foreign oil, and why do we need to become independent? Unfortunately, Earth's oil deposits are not equally distributed around the globe, and therefore, relatively few nations hold the major sources of oil for all the others. Given the high demand for this resource, rich oil deposits and weak political stability in some countries have caused petrodictatorships to develop—dictatorships that control much of the world's oil so that many countries are affected.

Petro is another word for *oil,* so when added as a prefix to words such as *dictatorship* or *politics,* these words take on new meanings. *Petropolitics* describes the political arena around global oil distribution. *Petrodictatorships* describes countries with leaders who control not only the rights of their own citizens, but also exert great influence upon countries around the world through the oil industry.

Experts agree that petroleum is reaching its peak, or the maximum production rate of its supply. Once the peak has passed, the rate of production enters decline. This is hard for economies such as the United States that depend upon oil for their growth, but also for developing countries that rely upon oil for meeting their basic needs. Gas prices increasing and policies allowing for offshore drilling are signs of the times we are living. We always need more oil and are in constant search of it in places previously off limits, such as the Arctic National Wildlife Refuge (ANWR). Citizens are discovering that the true price of our oil addiction is not necessarily paid at the pump.

Thomas Friedman (2006) describes an interesting relationship between the price of oil and the pace of freedom. He calls this the first law of petropolitics—that in countries rich with oil resources, the freedom of local people diminishes as prices for crude oil rises. Leaders in these countries become more confident and more controlling when the world depends upon them to supply crude oil. The law also works in the opposite direction. If oil prices drop, then leaders in oil-rich nations lose their stability (or control) and become more vulnerable to opposition and outside voices.

One interesting dimension of petropolitics happens when a powerful nation, such as the United States, which is dependent upon foreign oil, interferes in the affairs of oil-rich nations. Nations with high energy usage mostly interfere to secure a continuous flow of oil. The oil-rich countries are then under constant scrutiny and pressure from the energy-hungry countries. Experts call this the **resource curse,** also known as the paradox of plenty (Auty 1993). This paradox describes scenarios in which nations and regions with abundant natural resources tend to develop at a slower pace with less economic growth than nations and regions with fewer natural resources.

Teaching Tip

The concept of petropolitics is complex and can be a difficult subject for younger students. Petropolitics considers different aspects of society and life. Teaching such a topic may require a multidisciplinary approach that combines what students already have learned in geography, history, science, and civics. One of the most important aspects of petropolitics that students should understand is that energy is a commodity traded on the world market. Consider using small objects, such as tokens or candy, to show how energy could be unequally divided among "buyers" depending on the one doing the selling. Energy may also be unequally divided depending upon how much each buyer is willing pay. Such an activity may help students understand why countries don't simply "share" their resources with each other equally.

Iranians show their love of soccer as they play among the oil fields. The Middle East is one of the world's regions rich with oil deposits.

Case Study

The 1973 Oil Embargo

Several times in the last 50 years, some petroleum-rich countries have implemented oil embargoes against western nations to express discontent about specific western actions and policies. On June 6, 1967, one day after the beginning of the Six-Day War, several Middle Eastern countries limited their oil shipments to deter any countries from supporting Israel militarily. The 1967 Oil E**mbargo** lasted three months, but the United States did not see much change in oil availability because the embargoing countries were not consistent.

However, a few years later, a real energy crisis occurred during the more successful Oil Embargo of 1973. In this case, the members of the Organization of Arab Petroleum Exporting Countries (OAPEC) proclaimed an embargo when the United States decided to assist the Israeli military during the Yom Kippur War. This time embargoing countries held strong on their threat. The 1973 embargo had great impacts in the United States until it ended six months later in March 1974.

Even though countries that supported Israel were the targets, repercussions were felt globally. Prices of oil soared, and many nations struggled financially to keep up with the increases. The price of oil actually quadrupled at one point during the crisis. The world was watching and waiting for a global recession that seemed imminent (U.S. Office of the Historian 2010).

Luckily, many industrialized nations had stockpiled oil for such a situation, but prices of oil increased dramatically in the United States during the embargo. The retail price of a gallon of gasoline almost doubled. The U.S. government imposed several strategies for controlling gasoline sales: Congress passed a national speed limit of 55 miles per hour because fuel consumption in automobiles increases rapidly at higher speeds. Many stations did not sell gasoline on Saturday nights or Sundays, which created long lines the rest of the week. Many stations went out of business or did not sell gasoline at all. Lines at the pump were common. In order to control the lines at the pump, the government had drivers with license plates that ended in even numbers buy fuel on even days of the month. Drivers with license plates that ended with odd numbers bought fuel on odd days. Many American consumers lashed out in anger by rioting or going on strike because of the fuel costs and fuel rations.

World leaders engage in talks over oil controversies in the 1970s.

Although U.S. policy makers' focus on the issue abated as oil prices dropped, the fallout of the oil embargo was more attention to fuel conservation and domestic energy production. For example, the oil embargo prompted immediate attention to alternative energy sources such as wind or solar. Campaigns around the country focused on educating citizens on energy conservation. We are still struggling with the issue of energy consumption today.

Read more at The U.S. Office of the Historian: http://history.state.gov/milestones/1969-1976/OPEC.

Invisible Communities: The Coal People

"Whenever we scoop a teaspoon of baking powder, drive down a street, shine a flashlight, or brush our teeth, we are using one of several thousand by-products generated by the coal economy. We are all inextricably bound to these coal-mining communities and yet we all know so little about them".

Melanie Light (2006), Author of Coal Hollow: Photographs and Oral Histories

A young coal mining boy with a coal-streaked face smiles outside a Pennsylvania mine.

While energy can be transported thousands of miles to its point of use, that transport begins at a place where residents are intimately tied to energy extraction, refinement, and transport. Whether oil in South Louisiana, natural gas in Alaska, or coal in West Virginia, energy extraction has a profound impact upon communities. This section focuses on coal, which is but one example of how communities can be intimately tied to energy—for better or for worse.

Coal use has dated back to ancient China, Greece, Rome, Britain, and the Aztecs. These civilizations used coal for different activities, ranging from metal work and heat to ornamentation. As mentioned before, the Industrial Revolution triggered a need to obtain larger amounts of coal, and the development of more effective ways to do so. This led to the development of communities around the coal mines, where job opportunities were abundant and workers were in great demand. Years ago these communities were filled with people willing to labor for enough money, or food, to survive. Even today, these communities struggle with poverty and health issues. Because technology has replaced the need for manual labor, fewer jobs are available. Nonetheless, these communities still survive because of the increased energy demand around the globe. A peek into these communities is a great way to learn about the people behind the energy we use every day.

As the Industrial Revolution movement advanced in England, so did the extraction techniques used for coal mining. Coal-mining towns sprouted around the industry. Over the years, coal-mining communities suffered from instability because the industry was under pressure by competing resources, such as oil and natural gas, and because some coal mines were depleted. Miners and their families moved to new mines to work, accepted low salaries, or were forced into unemployment. Like in all industries, business ebbs and flows, although high poverty rates are not uncommon in mining towns.

Coal Mining Communities in the United States. In the United States, coal became the preferred fuel in cities, replacing wood by the early 1850s. There was also great demand for coal to be used in railway locomotives and steam engines, along with demand from the steel industry. In the late 19th century, thousands of European immigrants and African Americans migrated to southern West Virginia to work in coal mines owned by big companies, which also owned the tools and the equipment. Miners were required to lease the equipment and tools from the company. A miner's pay also took into account deductions for housing and purchases from company stores. Some coal companies forced miners to purchase from company-owned stores exclusively.

Economic depression following the American Civil War caused mine owners to continue to seek less expensive labor. These positions were filled mostly by immigrants from English, Scottish, Irish, and German ancestry. By the 1870s, immigration from Poland and Lithuania grew steadily, but by the early 20th century, many coal miners were immigrants of Slovak, Ukrainian, Russian, and Serbian decent. Needless to say, American coal mines created diverse communities of new immigrants from all over the world.

Energy Extraction Is Risky Business. Extraction of natural resources, including oil, minerals, and

coal, can be dangerous. There have been several instances of accidents in coal mines. In West Virginia alone, several accidents have hit these communities hard. In December 1907, the worst mine disaster in U.S. history occurred in Monongah, West Virginia, where an explosion killed 362 miners. In fact, between the years of 1907 and 1913, the three worst mining accidents in U.S. history occurred, killing almost 900 miners combined across the three sites (USMRA 2010a).

Three decades later, 91 miners were killed by an explosion in Bartley, West Virginia, in 1940. Farmington, West Virginia, saw its own share of tragedy when in 1968 a night crew was buried underground after an explosion. Twenty-one miners were able to escape, but 78 miners died, including 19 whose bodies were never recovered (USMRA 2010b).

The incessant battle about mine safety between the coal industry, the United Mine Workers, and the government has lasted for more than a century. Like in most industries, legislation is spurred by accidents. The Upper Big Branch Mine disaster of April 2010 is considered the worst in the United States since 1970. The explosion left 29 out of 31 miners buried 1,000 feet underground at Massey Energy's Upper Big Branch coal mine in Montcoal, West Virginia.

Most often miners do not survive these accidents; however, some amazing survival stories exist. Your students may have heard some of these inspiring stories of survival. In 2006 one miner survived the Sago Mine explosion in West Virginia after being trapped for a couple of days. Thirty-three Chilean miners were trapped more than 2,000 feet underground for 69 days in 2010. All of the miners were rescued.

Satiating Our Need for Coal. Coal continues to be the number one source of energy to produce electricity in the United States. Coal mining reached an all-time high in 2008, existing in 26 states across the country. In 2006, more than 80,000 people were employed in coal mining in the United States. The average age of coal miners is 48 years. There are now 54 coal mines in this country, and the average per capita income in these communities is lower than the nationwide average. For example, in 2000, communities averaged a per capita income of $16,246—25 percent lower than the U.S. average of $21,587 (Sourcewatch 2010).

Coal mining communities represent a struggling sector of our society and are charged with a risky job—often under poor conditions—that allows the rest of us to enjoy electricity every day of our lives. As nations move to cleaner renewable sources of energy, such as solar and wind, these communities will have to adapt, migrate, and find a place in the new era of green-collar jobs. Our students will be needed as the world's next scientists, technologists, and engineers to address large global-energy issues.

A closer look at social issues that arise around energy allows us to better understand how our actions every day, and our choices as consumers, impact the larger picture worldwide.

Teaching Tip

Before teaching this section, you may consider assessing your students' prior knowledge of people who work with coal. Do students have preconceived notions of such people? Are their attitudes positive or negative? Do their ideas come from recent media coverage of coal-mining accidents in the world? You may then consider asking your students to write questions they have about coal workers, because in many cases (especially with younger students), they may not have much prior knowledge on this subject. These questions may help you direct your teaching of the concepts that follow in this chapter.

Coal miners work in confined locations and take risks on the job. Coal-mining history is filled with disasters and accidents.

Pictures of Practice

U.S. Energy Use Today

Americans know that we use a lot of energy, but the numbers that show our use of energy compared to other countries worldwide are staggering. Our need for electricity to support our homes and businesses is substantial. Our energy resources and infrastructure can typically meet these demands, but some countries either do not have the energy resources or do not have the energy infrastructure, therefore, limiting energy use. Discussing energy or carbon footprints with students is important, as well as having students conduct energy audits of their own use. But much of our energy use is hidden from sight, which is the focus of this video.

Students: Grades 4 and 5

Location: San Diego, California (a coastal community)

Goal of Video: The purpose of this video is to watch students discuss U.S. energy use, especially the hidden energy costs of transporting goods to our communities.

Classroom Context

At the end of Ms. Howard's energy unit, students begin to discuss energy footprints (how much we use) and energy conservation actions (how we can reduce our energy use). Students have conducted an energy audit of their homes, specifically focusing on lightbulb use but also identifying types and use of appliances and electronics. This discussion occurred as Ms. Howard attempted to have her students consider hidden energy use.

Video Analysis

In the classroom discussion, students consider U.S. energy use today. Americans use a great deal of energy in their everyday activities—watching television, driving cars, using cell phones and computers, heating and cooling homes and offices, and turning on lights for as long and as much as is needed. While Americans pay for energy, the energy often seems limitless and at our disposal whenever we want it. Although Americans make up just 5 percent of the world population, we emit up to 25 percent of the greenhouse gases. Ms. Howard uses this fact to spark a discussion among students about why this happens. Students share several ideas about Americans using more resources, driving cars, and generally "using too much." One student brings up the food industry, and Ms. Howard uses this moment to introduce the idea that a great deal of energy is used to transport food. Students then brainstorm solutions to reduce this energy use, such as taking "shorter routes" and growing "food closer to home." In the post interviews, students consider what the United States would be like if we ran out of fossil fuels. Students know that we use fossil fuels for almost everything we do in our lives. These interview responses represent their beliefs about what the world would be like without those fuel sources. For example, Martinez believes we would have to walk everywhere, and Ezequiel describes a scenario in which we would go back in time, doing without electronics and using candles. Knowing more about energy use and energy footprints can help students better understand how our world is intimately tied to the future of fossil fuels and energy resources.

Reflect

How would you teach energy footprints to students?

Students hear a lot about energy use and the idea that fossil fuels are running out. What do you think students should understand most about their energy use (or energy footprint)? How could you connect this to students' actions today? Students' projections about a future without fossil fuels can seem alarming. How would you respond to their ideas?

Student Thinking

Who Gets Energy?

Living in the United States, students have easy access to energy and may not realize the energy issues that occur in developing nations. They may take an idealistic view that countries and people should simply share energy, but at the same time, they may believe that if they are paying for energy, it is rightfully theirs to use. What happens to those who cannot afford the market prices for energy resources? Be on the lookout for the following misconceptions, and encourage your students to think about ways to conserve energy.

	Common Student Ideas	Scientific Concepts
Sharing energy	Countries should divide energy resources equally; all countries should share energy.	Energy is not distributed equally around the globe. In poor communities, securing energy often results in conflict.
Paying for energy	Everyone should have to pay for energy; when you pay for energy, that means it's yours to use.	Energy is a commodity, but fossil fuels are limited. Not all countries have the means to provide energy access for their citizens.
Energy poor countries don't need energy	People in rural, developing areas don't have a lot of technology so they don't need as much energy.	Energy use in industrialized nations is much higher than in the developing world. All people need access to energy to meet their daily survival needs.

Ask Your Students

1. How should countries ensure that everyone has access to energy? Is it even the responsibility of the United States to see that this happens?
2. A wealthy country takes energy resources from a poor country. The wealthy country pays for the energy resource, though, so is this fair? Why or why not?
3. Does everyone need energy resources? Why? If a community does not have TVs, computers, and appliances, does it still need energy?

Case Study

Energy and Community Health

We want energy to make our lives easier, but an oil refinery in our neighborhood? Is that something you would want? Oil refineries require a lot of employees, which provides jobs for the community. Those employed have money to spend for shopping, eating at restaurants, going to movies, and paying more taxes. All of these activities are good for the economy. However, the bad news is what is happening to the health of people who live in communities surrounding these refineries.

A recent study published in the *American Journal of Public Health* compared air inside homes in Richmond, California (a community bordering an oil refinery), and homes in Bolinas, California (a nonindustrial comparison community). The study concluded that, "the air indoors, where Americans spend 90 percent of their time, was more polluted than the air outdoors in both communities, with 104 toxics detected inside Richmond homes and 69 in Bolinas" (Brody et al. 2009). The chemicals present in the Richmond homes were also at higher levels of concentration for fine particulates (linked to respiratory and cardiovascular problems and early death), and the levels of vanadium and nickel (resulting from heavy oil combustion) were among the highest in the state.

The emissions from oil refineries can be spilled or leaked into our water and aggregated into our soil, besides wafting in our air. In 1998, the Chevron oil refinery in Richmond was found guilty of violating environmental laws when it periodically bypassed a wastewater-treatment system, discharging wastewater into San Pablo Bay (part of San Francisco Bay) from 1991 to 1995 and failed to make notifications about it. As a result of the lawsuit, Chevron agreed to enlarge its filtration-treatment system (Schmidt 1998).

Over the last few years, California has enacted several laws in addition to federal regulations to insure its citizens a basic standard for air and water, as well as safeguarding their right to be notified when there has been a significant toxic spill or leak. Many of California's oil refineries were built long before these laws were in place (e.g., the Richmond oil refinery was built in 1902).

Recently, the Richmond oil refinery applied to the city of Richmond for a Conditional Use Permit to allow for expansion of its facility. The expansion would allow the refinery to process heavier and dirtier crude oil, but in doing so, there would be increased releases of mercury (a neurotoxin), sulfur compounds (which form acid rain), and greenhouse gasses. The city council not only approved a Conditional Use Permit so Chevron could proceed with their expansion, but also agreed to keep the environmental review outlining these increased hazards confidential. In 2008, a suit was filed by lawyers of Earthjustice against the City of Richmond on behalf of the Asian Pacific Environmental Network, Communities for a Better Environment, and West County Toxics Coalition. They claimed that their rights were being transgressed, and the courts sided with them.

We need energy, and it is not unusual for us to explore ways to increase its production. It is crucial, however, that citizens consider both sides of issues in their communities. What decisions are our local representatives and industry making? Do they act according to the community wishes? Many communities can be impacted by our quest for energy, and it's important to know what's happening in our own backyards.

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Teaching Resources

California Education and the Environment Initiative: http://www.calepa.ca.gov/education/eei/

U.S. Energy Information Administration Energy Kids: http://www.eia.gov/kids/energy.cfm?page=4

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