Nonrenewable Energy Sources

Lesson Plan: NRES F1-1

Anticipated Problems

1. What are nonrenewable energy sources?
2. What are advantages and disadvantages of nonrenewable energy sources?

Terms

- acid rain
- coal
- conventional energy
- energy
- exhaustible energy source
- fossil fuel
- global warming
- greenhouse effect

Terms

- inexhaustible energy source
- natural gas
- nonrenewable energy source
- nuclear fission
- peat
- petroleum
- renewable energy source uranium

Energy

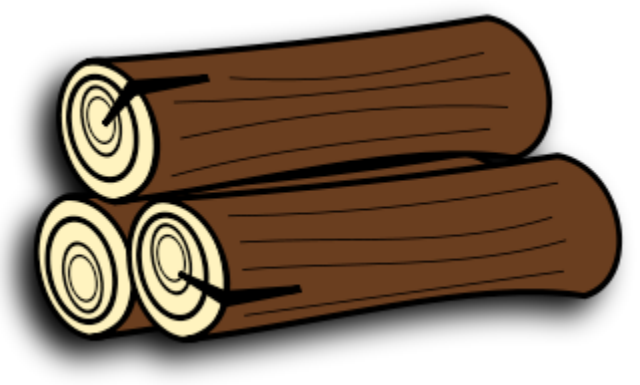
- ***Energy*** is the ability to do work. Energy exists in different forms, including:
  - Heat
  - Kinetic or mechanical energy
  - Light
  - Potential energy
  - Electrical
  - Chemical
  - Other

Energy

- The modern world is greatly dependent on energy. The energy humans have harnessed throughout much of history is referred to as conventional energy.

Conventional Energy

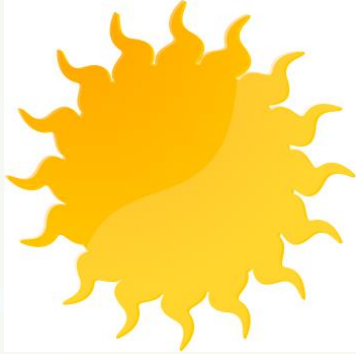
- ***Conventional energy*** is power obtained from traditional sources, such as wood, coal, and gas.
  - When these materials are burned, chemical energy stored in the fuel is converted to heat energy.
  - The chemical reaction that takes place involves a hydrocarbon in the fuel and oxygen in the atmosphere.



Sources of Energy

- Sources of energy are considered inexhaustible or exhaustible and renewable or nonrenewable.

Inexhaustible



- An ***inexhaustible energy source*** is a source that will not run out in the foreseeable future.
  - Sunlight
  - Wind
  - Geothermal energy

Exhaustible

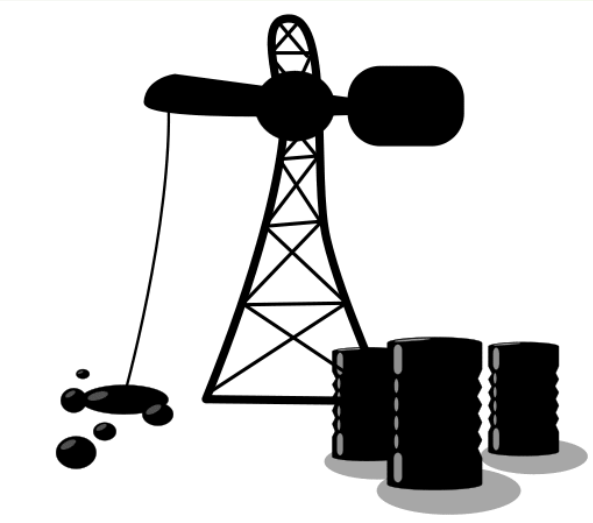
- An ***exhaustible energy source*** is a source available in limited quantity that can be completely used.
  - Some exhaustible natural sources are renewable, while others are nonrenewable.

Renewable & Nonrenewable

- A ***renewable energy source*** is a source that can be replaced naturally.
- A ***nonrenewable energy source*** is a source that cannot be replaced after use.
  - Fossil fuels
  - Nuclear energy

Fossil Fuels

- Most of the energy obtained today comes from nonrenewable energy sources, commonly known as fossil fuels.
  - It is estimated that fossil fuels provide around 83% of the United States' total energy demands for heating, transport, electricity generation, and other uses.



Fossil Fuels

- A ***fossil fuel*** is a fuel formed from the remains of dead plant and animal material deposited in a previous geologic time, typically millions of years ago.

Fossil Fuels

- The energy in fossil fuels originates from the high carbon and hydrogen content of the deceased plants and animals.
  - Come in different forms: peat, petroleum, natural gas, and coal

Peat

- ***Peat*** is partially decayed vegetable matter that accumulates in bogs, where low oxygen levels and acidity inhibit decomposition.

Petroleum

- ***Petroleum*** (crude oil) is the liquid form of fossil fuels used to make gasoline and oils.
  - Easier to get out of the ground than coal
  - Can flow through pipes
  - Cheaper to transport
  - Provides about 37% of our energy needs

Natural Gas

- ***Natural gas*** is the gaseous form of fossil fuels used for heating homes, cooking foods, and generating electricity.
  - Easy to transport through pipes
  - Gas power stations produce little pollution
  - Provides around 25% of the US' energy
  - Used to produce 24% of the country's electricity

Coal

- ***Coal*** is the solid form of fossil fuels used in factories and for generating electricity.
  - Provides around 21% of the total energy
  - Used to produce 45% of the country's electricity

FIGURE 2. A coal-fired power plant in Utah.

Uranium

- Nuclear power is generated using ***uranium***, a nonrenewable, radioactive heavy metal mined in various parts of the world.

Nuclear Power

- Nuclear power meets around 9% of the total energy needs and is used to produce 20% of the electricity in the United States.
  - Huge amounts of energy
  - Produced from small amounts of fuel
  - Without the pollution that comes from burning fossil fuels

FIGURE 3. Nuclear power is used to produce 20 percent of the electricity in the United States.

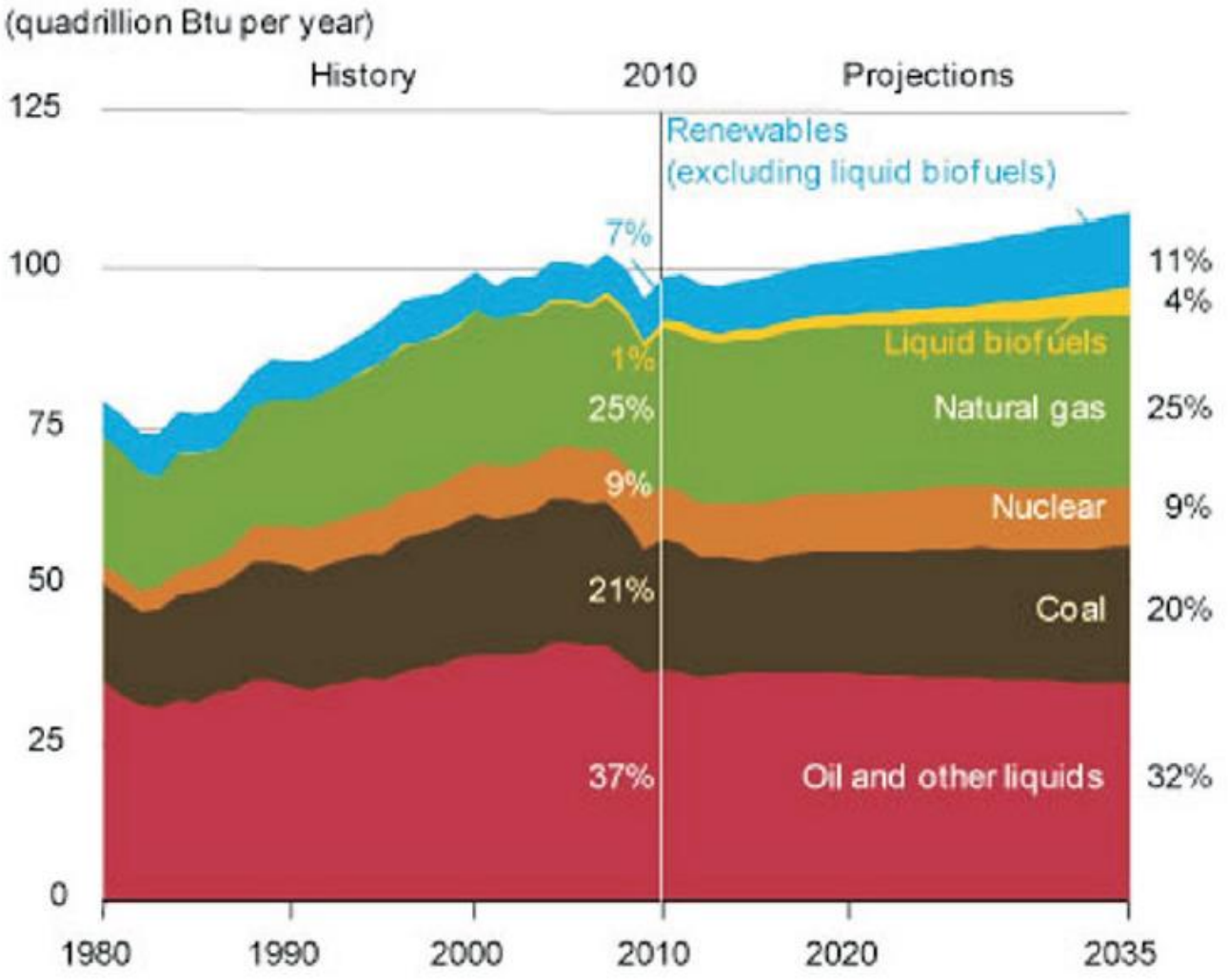
Nuclear Fission

- Nuclear power stations rely on nuclear fission.
- ***Nuclear fission*** is either a nuclear reaction or a radioactive decay process in which the nucleus of an atom splits into smaller parts and releases an enormous amount of energy.

Nuclear Chain Reaction

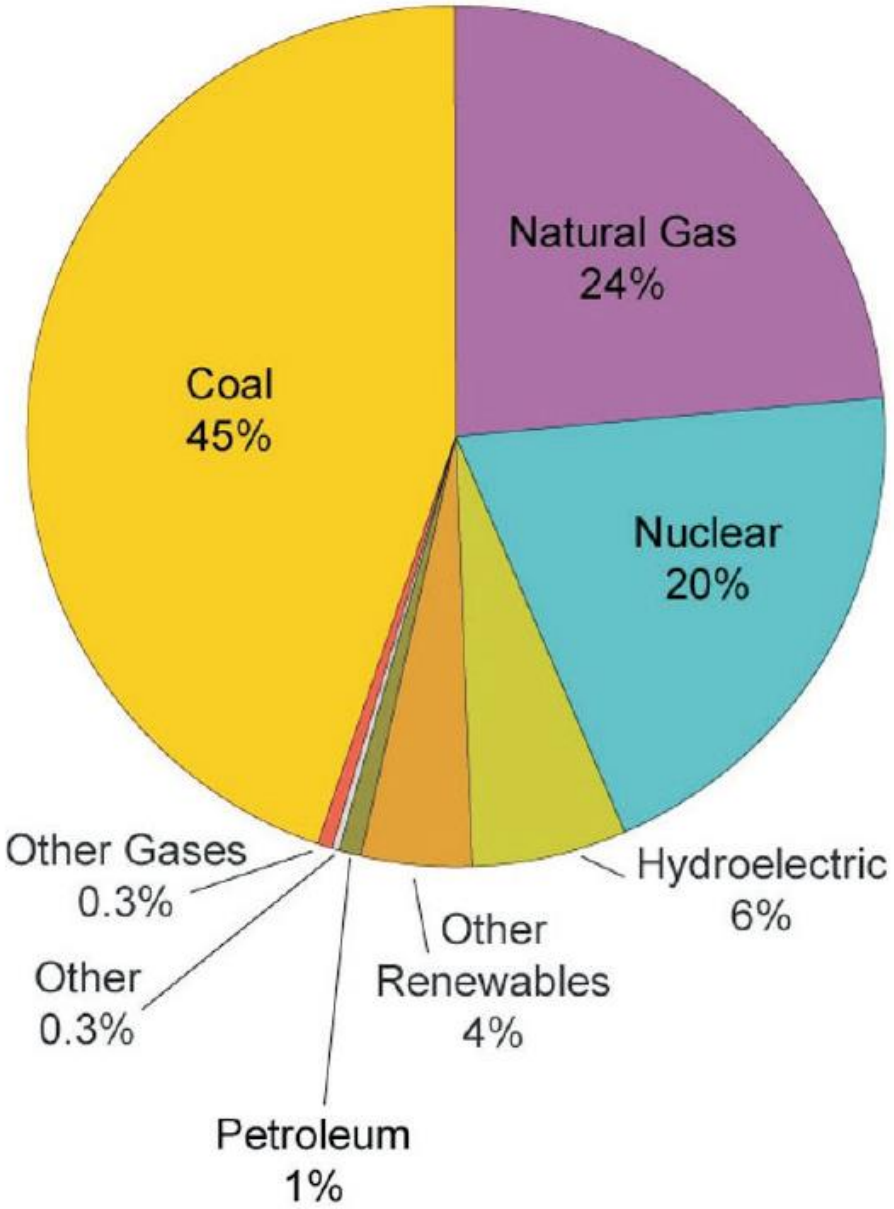
- The nuclear chain reaction that occurs in the process creates the heat that powers the turbines.
- The reactor uses uranium rods as fuel.
- Carbon dioxide is pumped through the reactor to transfer heat for the purpose of producing steam.
- The steam drives turbines connected to electric generators.

U.S. ENERGY CONSUMPTION BY FUEL, 1980–2035



(Source: U.S. Energy Information Administration)

U.S. NET ELECTRICITY GENERATION BY FUEL, 2010



Fossil Fuels

- Fossil fuels are largely responsible for enabling the development of societies across the globe.
  - Along with their advantages come disadvantages.

Fossil Fuels: Advantages

- Peat can make countries with peat reserves less dependent on imported energy.
  - Very inexpensive
  - Extraction process is simple

Fossil Fuels: Advantages

- Petroleum is easy to use and relatively inexpensive.
  - A ready-made fuel
  - Fairly cheap to mine and to convert into energy.
  - Petroleum-based energy is easy to refine, store, transport, and use for powering motor vehicles.
  - Stable in the tank

FIGURE 4. Petroleum is easy to extract and transport.

Fossil Fuels: Advantages

- Natural gas is a ready-made fuel. It is relatively inexpensive and burns cleaner than coal and oil.
- Coal is relatively cheap to mine and to convert into energy. The reserves of coal are projected to last longer than those of petroleum or natural gas.

Fossil Fuels: Disadvantages

- Energy from fossil fuels is nonrenewable, and reserves are quickly depleting.
- Energy generation from fossil fuels produces air pollution including
  - Sulfur dioxide
  - Nitrogen oxides
  - Carbon dioxide

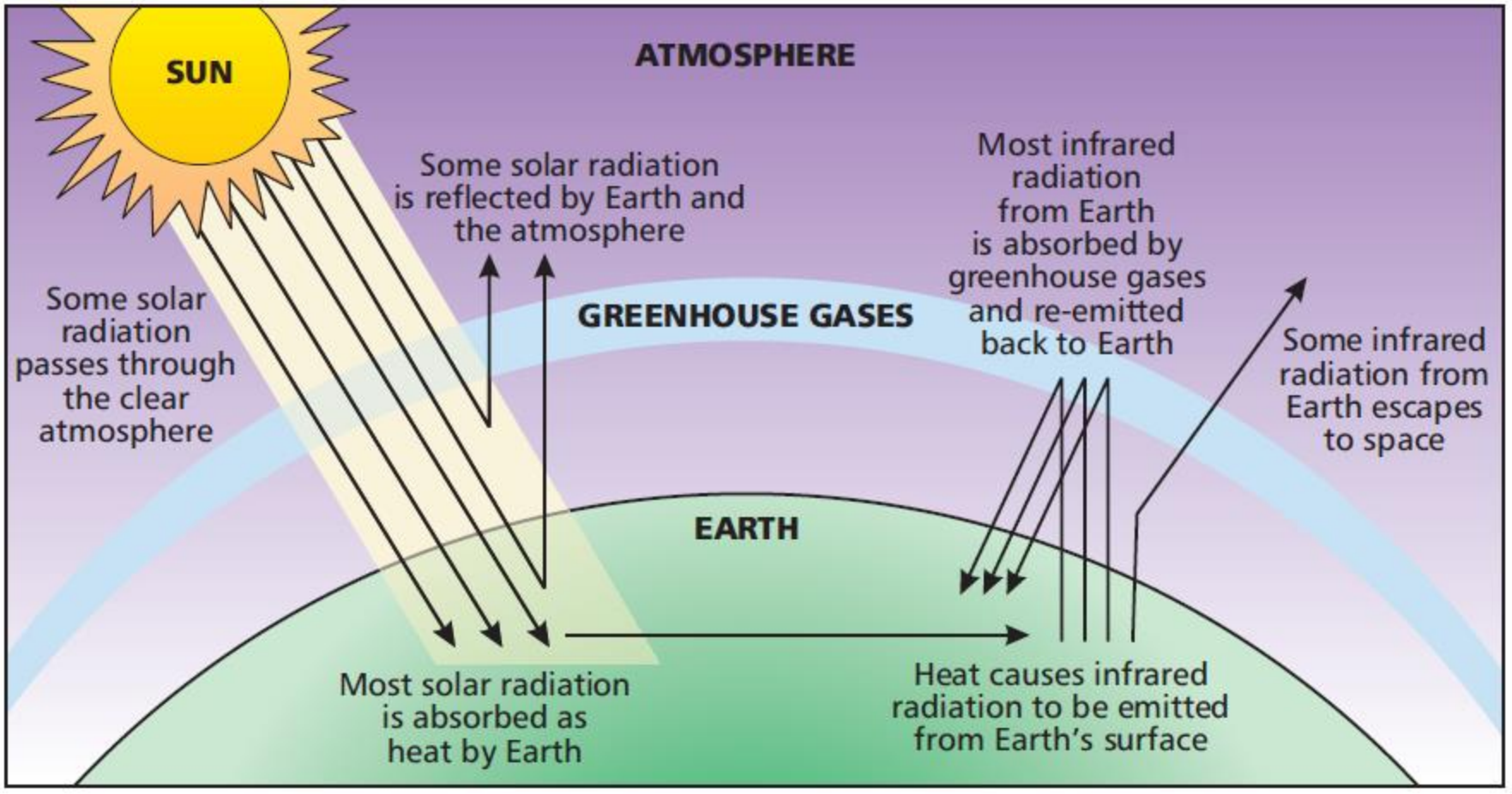
Fossil Fuels: Disadvantages

- Burning fossil fuels produces gases that contribute to global warming. ***Global warming*** is an increase in the earth's atmospheric and oceanic temperatures.
  - Significant because it is triggering changes to the earth's climate, which in turn affect the biosphere.
  - Has been linked to the greenhouse effect

Fossil Fuels: Disadvantages

- The ***greenhouse effect*** is the warming that happens when certain gases in the earth's atmosphere, such as carbon dioxide, water vapor, nitrous oxide, methane, and ozone, trap heat.
  - These gases are called greenhouse gases.

Greenhouse Effect



Fossil Fuels: Disadvantages

- The burning of coal and petroleum leads to the creation of acid rain.
- ***Acid rain*** is atmospheric moisture that has a low pH due to a presence of acids.
  - Has been measured at 4.2 and lower
  - Causes disease to plants and aquatic life

Fossil Fuels: Disadvantages

- The mining of fossil fuels leads to irreversible damage to the environment.
  - The draining of peatlands and the cutting away of large parts of the peat layers damages the environment and the unique ecosystems.
  - Strip mining of coal leaves the surface of the earth scarred, and even the best restoration efforts can never return it to its original state.

FIGURE 5. The mining of coal leads to irreversible damage to the environment.

Fossil Fuels: Disadvantages

- Fossil fuel supplies will eventually run out.
- Because of increasing demand and declining reserves, the prices of fossil fuels will rise.
- Fossil fuels contain radioactive materials, including uranium and thorium, that are released into the atmosphere.

Renewable Energy Source Comparison

Energy Source	Advantages	Disadvantages
Coal 	• Abundant, with supplies projected to last longer than petroleum or natural gas. • Currently inexpensive to mine. • Reliable and capable of generating large amounts of power.	• Produces air pollution. • Emits major greenhouse gases that contribute to global warming. • A cause of acid rain. • Mining damages the environment.
Natural Gas 	• Ready-made fuel. • Widely available. • Cleanest-burning fossil fuel. • Relatively inexpensive.	• Transportation costs are high. • Lack of infrastructure makes gas resources unavailable from some areas. • Produces air pollution. • Emits major greenhouse gases that contribute to global warming. • Pipelines affect ecosystems.

(Source: http://www.energy4me.org/energy-facts/)

Renewable Energy Source Comparison

Energy Source	Advantages	Disadvantages
Petroleum 	• Easy to use. • Relatively inexpensive. • Easy to refine, store, transport, and use for powering motor vehicles. • Stable in the tank.	• High CO_2 emissions. • Emits major greenhouse gases that contribute to global warming. • Supply is limited. • Possible environmental damage from drilling and transporting.
Uranium 	• No greenhouse gases or CO_2 emissions. • Efficient at transforming energy into electricity. • Uranium reserves are abundant. • Refuel of power plants yearly. • A small amount of radioactive material produces a lot of energy. • Uranium is relatively inexpensive.	• Higher capital costs due to safety, containment, radioactive waste, and storage systems. • Problem of long-term storage of radioactive waste. • Heated water from nuclear plants harms aquatic life. • Potential terrorist attack and sabotage. • The risk of accidents in nuclear power plants.

Nuclear Energy: Advantages

- The main advantage of nuclear energy is that a small amount of radioactive material produces a lot of energy.
  - Uranium is relatively inexpensive and can last a long time.
  - Nuclear energy doesn't give off atmospheric pollutants.

Nuclear Energy: Disadvantages

- The disadvantages of nuclear energy include
  - Storage and management of dangerous, radioactive waste
  - Possibility of terrorist attack and sabotage
  - High cost of building nuclear facilities
  - Risk of accidents in nuclear power plants
  - Water heated from cooling nuclear plants harms aquatic life.

Nuclear Energy: Disadvantages

- The greatest concern is the disposal of nuclear waste, which can remain hazardous for thousands of years.

Review

- Which type of source supplies most of the energy obtained today?
- Name three examples of a fossil fuel.
- List one advantages and one disadvantage of using a fossil fuel.