

Unit 6

Energy Resources and Consumption

What is energy? Review from previous classes

Energy- The capacity to do work

Energy Units

- Joule (J)
- Calorie (cal)
- British thermal unit (BTU)
- Kilowatt hour (kWh)

Types of energy

- Potential- energy at rest
- Kinetic- energy in motion
- Radiant- energy from sunlight

Power Units

- Watt (W)
- Horsepower (hp)

* Do you remember the First & Second Laws of Thermodynamics

Renewable & Nonrenewable Resources

Definitions

Renewable Energy Sources

- Energy sources that can be replenished naturally, at or near the rate of consumption, and reused
- Nondepletable

Nonrenewable Energy Sources

- Energy sources that exist in a fixed amount and involve energy transformation that cannot be easily replaced.

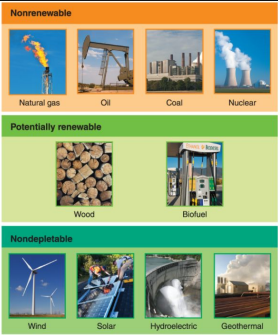
Examples

Renewable Energy Sources

-

Nonrenewable Energy Sources

-



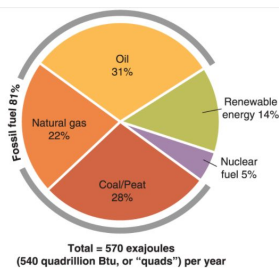
Global Energy Consumption

What is the most widely used source of energy?

Fossil Fuels

- Coal
- Crude Oil
- Natural Gas

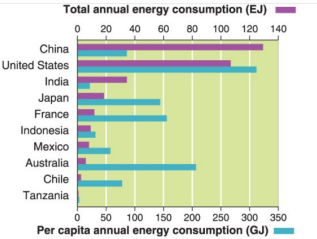
*fossil fuels are formed from the fossilized, buried remains of plants and animals that lived millions of years ago.

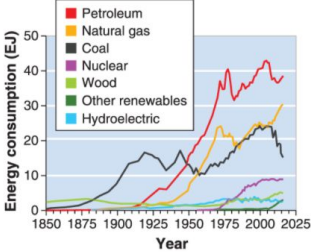


Key Points of Global Energy Consumption

- Energy resources are not evenly distributed between developed and developing countries
- There is a pattern to energy use as a developing country becomes more developed
- As the world become more industrialized, the demand for energy increases
- Availability, price and governmental regulations influence which energy sources people use and how they use them

The Trends of Energy Usage





Energy Consumption in the United States from 1850 through 2016

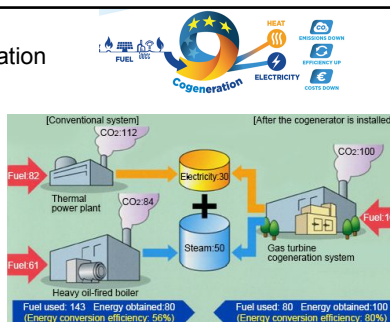
Fuel Types and Uses

The Types of Fuel

- Wood
 - Firewood
 - charcoal
- Peat
- Fossil Fuels
 - Coal
 - Lignite
 - Bituminous
 - Anthracite
 - Natural Gas
 - Crude Oil

Vocab - Cogeneration

Cogeneration occurs when a fuel source is used to generate both useful heat and electricity



WOOD

- Firewood
 - Charcoal
- ❖ Often used in developing countries because it is easily accessible.



PEAT

- Definition- Partially decomposed organic material that can be burned.
- From the dictionary - a brown deposit resembling soil, formed by the partial decomposition of vegetable matter in the wet acidic conditions of bogs and fens, and often cut out and dried for use as fuel and in gardening.
- Rarely used outside of Northern Europe
 - The bogs of Ireland
- Releases more carbon dioxide than natural gas and coal.



COAL



Three Types of Coal

- Lignite
- Bituminous
- Anthracite

Heat, Pressure and Depth are the factors that make up the different types.



Positives

- Energy dense & Abundant
- Easy & Safe to transport
- The Economic Backbone of some small towns
- No refining necessary

Negatives

- Only have about 200 years of coal left
- Mining practices
- Contributes to acid rain
- Highest emitter of CO₂
- Sulfur & trace amounts of toxic metals (mercury)

NATURAL GAS

Positive

- Cleanest of the Fossil Fuels
- Cogeneration power plants can have efficiencies up to 60%
- Fewer impurities than coal or oil



Negative

- Risks of leaks/explosions, pipelines
- Releases methane, hydrocarbons, hydrogen sulfide
 - 25x more effective as greenhouse gases than CO₂

OIL

Can be recovered from tar sands

*Tar Sands are a combination of clay, sand, water, and bitumen



Positives

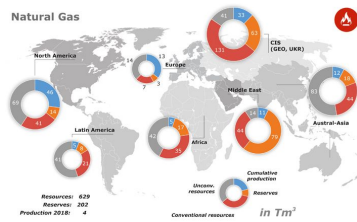
- Cleaner burning than coal
- Ideal for mobile combustion
- Quick ignition

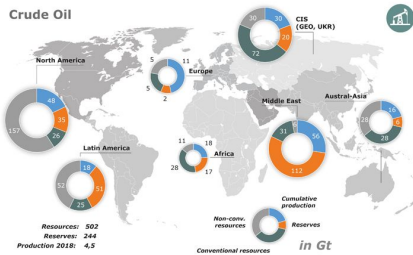
Negatives

- Oil spills
- Significant refining required
- Will be less available in the next 40ish years
- Second highest emitter of CO₂
- Earth Moving Equipment (bad for the environment & human safety)

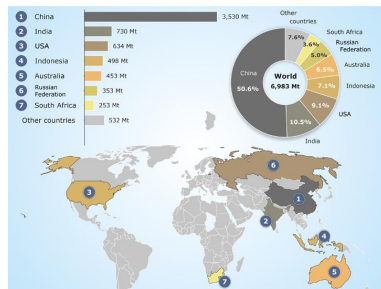
Distribution of Natural Energy Resources

The global distribution of natural energy resources is NOT uniform and depends on a regions' geologic history.

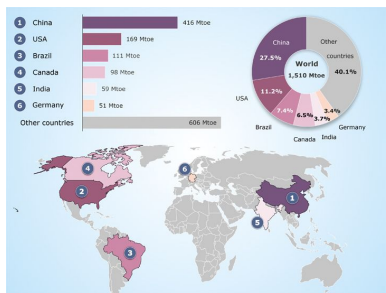




The largest hard coal production countries 2018



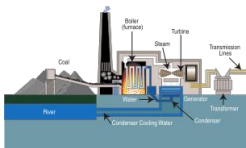
Renewable Energy



Fossil Fuels

How Do Fossil Fuels Generate Power?

- Combustion
 - Chemical reaction between the fuel and oxygen
 - Yields carbon dioxide and water, released energy
- Burning
 - Generate heat
 - Can heat water to create steam to turn a turbine, that make electricity

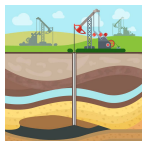
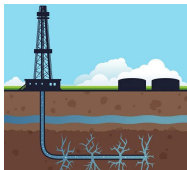


How Do We Extract Fossil Fuels?

Drill

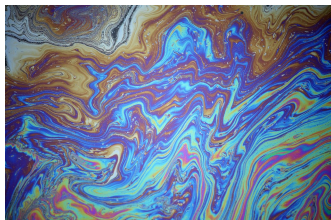
Mine

Hydraulic Fracking



How Do Fossil Fuels affect the Environment?

- Global warming Emissions
- Air Pollutants
- Water use
- Coal Waste
- Oil/Gas Wastewater



Nuclear Power

What is Nuclear Power?

It's all about Fission.



- Nuclear power is power that is generated through the fission of Uranium-235.
- Nuclear fission releases large amounts of heat.
 - The heat can be used to generate steam which powers a turbine and generates electricity.
- Is a nonrenewable energy source
- High energy density
- Considered cleaner because it does not produce air pollutants.....but what does it create.....

Nuclear Power's impact on the environment

- Thermal Pollution
- Hazardous Solid Waste
 - Uranium-235 is radioactive
- Nuclear Meltdown/ Explosion
- Nuclear Weapons "Dirty Bomb"

Short term Effects

- Irritation
- Damage
- Death

Long Term Effects

- Damage to DNA
- Damage to the eyes, brain, immune & reproductive systems.
- Radioactive waste is dangerous for hundreds of thousands of years

Examples of Meltdown & Nuclear Waste



3 Mile Island, Pennsylvania
Nuclear Meltdown
3/28/1979



Chernobyl, Ukrainian SSR
Nuclear Explosion, 4/26/86

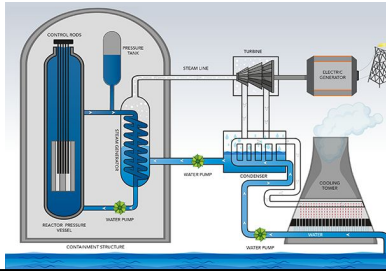


The Hanford Site, Washington
53 Million Gallons of radioactive waste



Fukushima Daiichi, Japan
Nuclear accident, 3/11/11

How do nuclear reactors work?



Energy from Biomass

What is Biomass? How do we use it?

Biomass- any plant or animal material used as fuel
*includes ethanol & biodiesel
Low Cost



Biomass' impact on the Environment

- Produces
 - Carbon Dioxide
 - Carbon Monoxide
 - Nitrogen oxides
 - Particulates
 - Volatile Organic Compounds
- Overharvesting of Trees ----> Deforestation

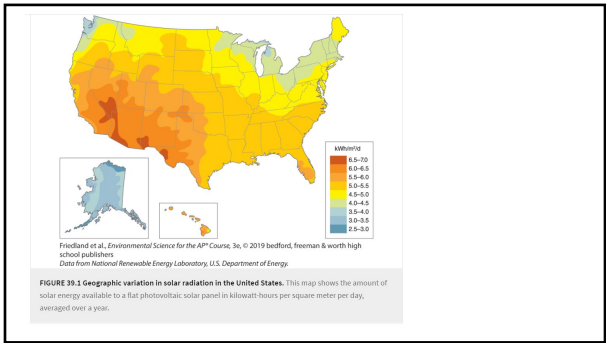
Modern Carbon Vs. Fossil Carbon

Solar Energy

What is Solar Energy?


- Energy of the Sun
- *Limited by the availability of sunlight
- Active Solar Energy Systems
 - Storage Capable
 - Photovoltaic solar cells capture light energy from the sun and transform it directly into electrical energy.
 - Solar water heater
 - Passive Solar Energy Systems
 - Cannot be collected or stored
 - Window position in houses
 - Dark colored roofs
 - Building homes into a hill
 - Solar ovens





What is Solar Energy's impact on the environment?

- Low environmental impact
- Produces clean energy
- Can be expensive
- Large solar farms may negatively impact the ecosystems that they are in



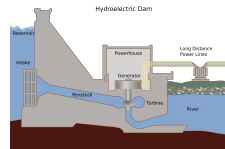
Hydroelectric Power

What is hydroelectric power?

Hydroelectric power- all power generated using water

It's all about the turning of turbines!

Dams
River Turbines
Tidal Flows



What are the hydroelectric energy impacts?

- Does not produce air pollution or waste once built
- Cement production is responsible for 5% of global anthropogenic CO₂ emissions
- Construction is expensive
- Habitat loss or change
- Water flow changes (heat retention and life cycle problem)

Positives

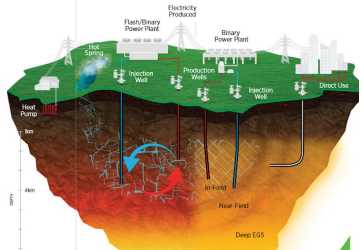
- Creates recreation
- Flood control
- Fish ladders



Geothermal Energy

What is Geothermal Energy?

Energy obtained by using the heat stored in the Earth's interior to heat up water, which is brought back to the surface as steam. The steam is used to drive an electric generator.



What's the environmental impact of geothermal energy?

- Expensive
- Not easily accessible in many parts of the world
- Can cause the release of hydrogen sulfide
- Depends on groundwater

Fun Fact- Iceland heats 85% of its homes this way



Hydrogen Fuel Cell

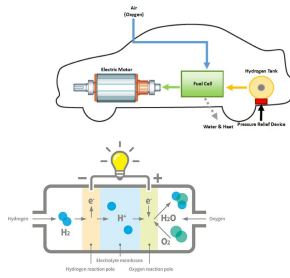
What are Hydrogen Fuel Cells?

Fuel Cell- an electrical-chemical device that converts fuel into an electrical current.

An alternative to non-renewable fuel

Use Hydrogen as a fuel source by combining it with the oxygen in the air to form water and release energy (Electricity)

Water is the product (emission)



What are the environmental impacts of hydrogen fuel?

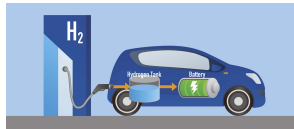
Low environmental impact

No carbon dioxide emissions

The technology is super expensive

Electricity can be produced at any time

Other energy is still needed to create the hydrogen gas



Wind Energy

What is wind energy?

The Kinetic energy of moving air (wind) is used to spin a turbine

The turbines convert the mechanical energy into electricity



What are the impacts of wind energy?

- Renewable resource, Nondepletable
- Clean energy
- Bird and bats die by flying into the spinning turbine blades
- Can take up a lot of space
- Battery Storage can be expensive to produce



Energy Conservation

What is Energy Conservation?

Definition- finding and implementing ways to use less energy

Energy Efficiency is part of Conservation



I recycle, isnt that enough?

Methods of Energy Conservation

In Your Home

- Adjusting the thermostat
- Conserving water (shorter showers, turning the sink off while you brush your teeth, low flow toilets, ect.)
- Use of energy-efficient appliances
- Conservation landscaping
- Carpool
- Do laundry in cold water
- Weatherize, insulate, seal gaps
- Unplug/ Use a powerstrip

Large Scale

- Improving fuel economy for vehicles
- Using BEVs (battery electric vehicles)
- Hybrid vehicles
- Using public transportation
- Implementing green building design features
