Energy Workshop

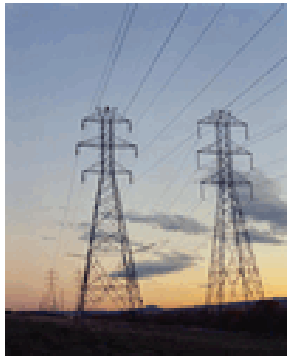
Dr. Bob Kosak

What Is Energy?

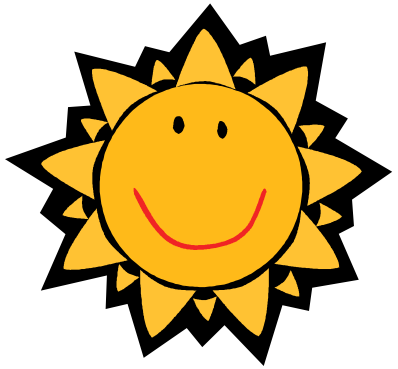
- Energy Makes Change
- Definition - Ability To Do Work
- Form of Energy
  - Heat
  - Light
  - Electric
  - Sound Waves
  - Mechanical
  - Radio Waves

Heat Energy

- What Is It?
  - Energy of Moving Particles
- How Do You Make It?
  - Burning
  - Sun
  - Nuclear
  - Earth's Core
  - Electricity
- What Do We Use It For?
  - Heat, Air, and Water
  - Melting
  - Cooking
  - Transportation



Light Energy



- What Is It?
  - Radiant Energy
- How Is It Generated?
  - Sun
  - Light Bulbs
  - Lasers
  - Burning Fuel
- How Do We Use It?
  - Light Places
  - Laser Surgery
  - Communications

Electricity

- What Is It?
  - Energy of Moving Electrons
- How Is It Generated?
  - Solar Panels
  - Generators/Alternators
  - Batteries
  - Fuel Cells
- How Do We Use It?
  - Motors
  - Heat
  - Run Computers/Light/Sound
  - Communications

Mechanical

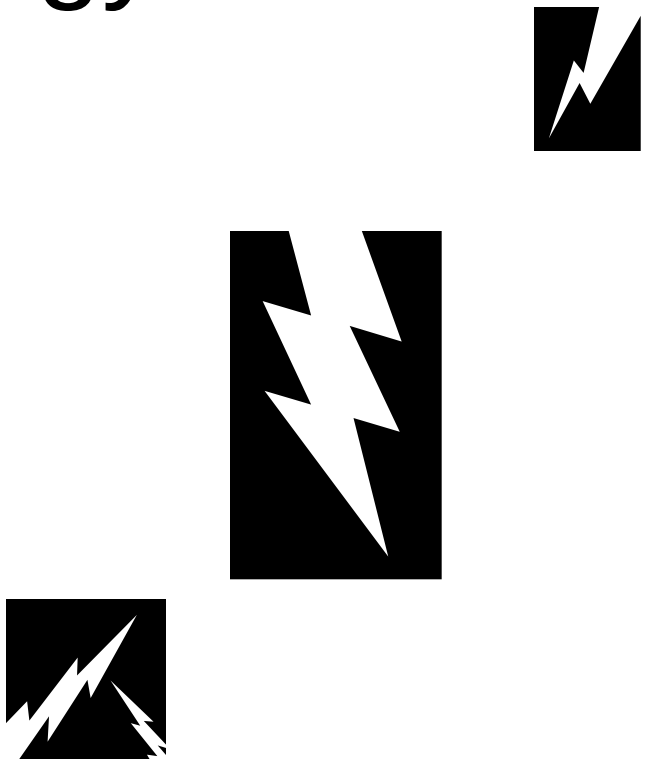
- What Is It?
  - Force of Moving Objects
- How Is It Made?
  - Falling Water
  - Motors/Engines
- How Do We Use It?
  - Autos
  - Appliances/Tools
  - Generate Electricity

Sound Energy

- What Is It?
  - Vibrations In Air/Water/Solid
- How Is It Made?
  - Vibrating Surfaces
- How Do We Use It?
  - To Heat
  - Communications

Types of Energy

- Non-Renewable
- Renewable

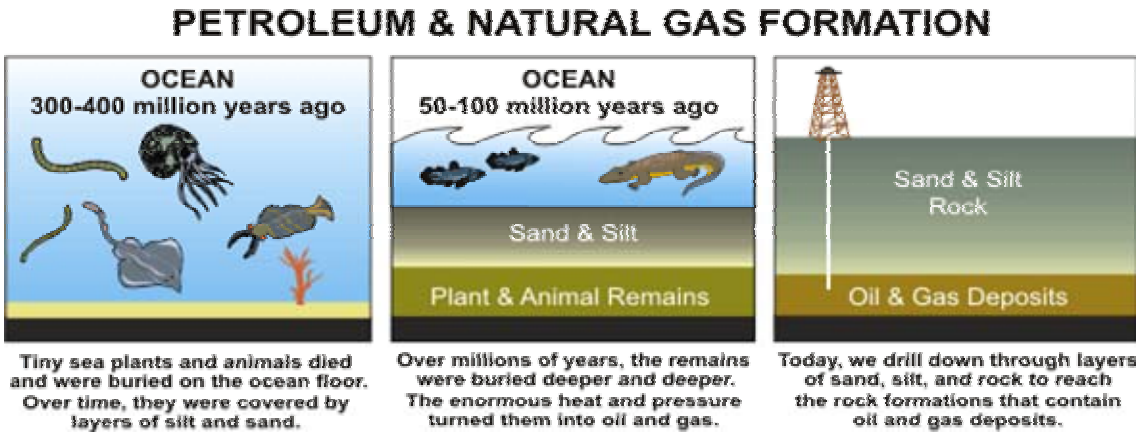


Non-Renewable Energy

- Petroleum (oil)
- Coal
- Natural Gas
- Nuclear

Petroleum (Oil)

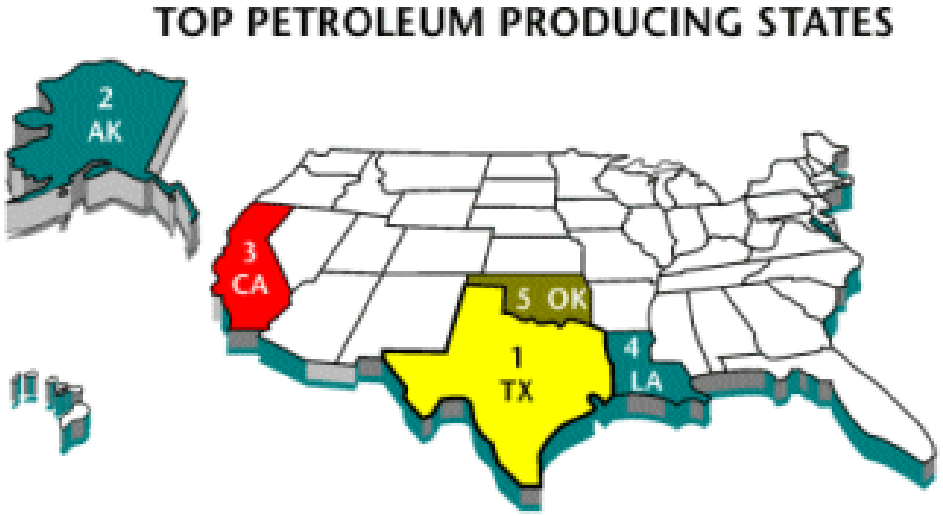
- How Was It Formed?
  - Remains of Animal & Plants That Live Millions of Years Ago



- How Do We Get Oil?
  - Drill
- Who Has The Oil?
  - Saudi Arabia
  - Russia
  - United States
  - Iran
  - China & Mexico

Oil

- Where In The U.S. Is The Oil?



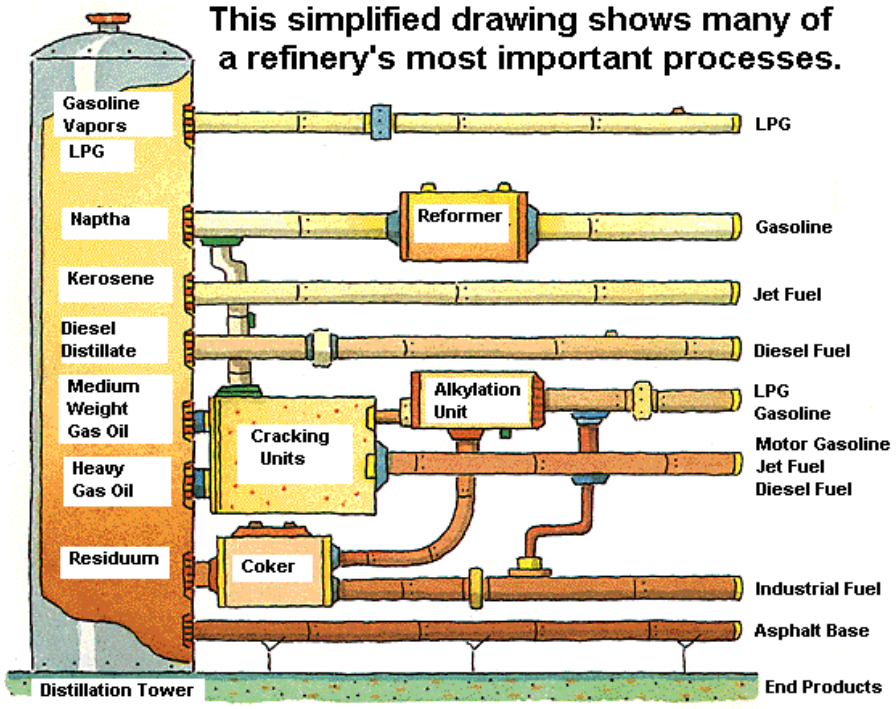
Over 56% of crude oil for use in U.S. comes from other countries.

Oil

- What Do We Do With The Crude Oil?
  - Send It To A Refinery

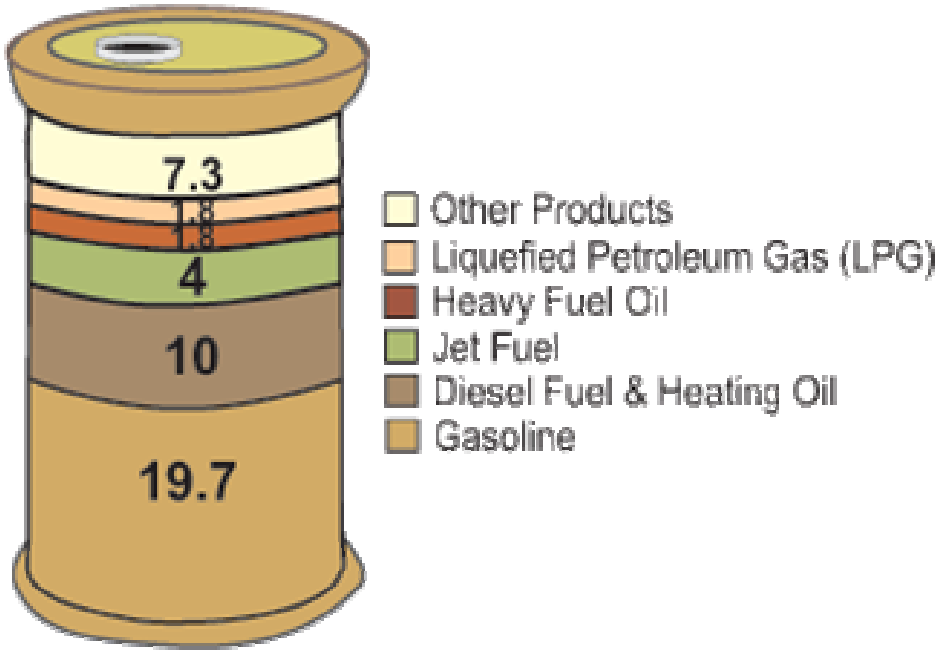
Oil

- What Happens At A Refinery?
  - Break Crude Oil Into Different Components



Oil

- What Do We Make?
  - From A Barrel Of Oil (42 gallons), We Make:

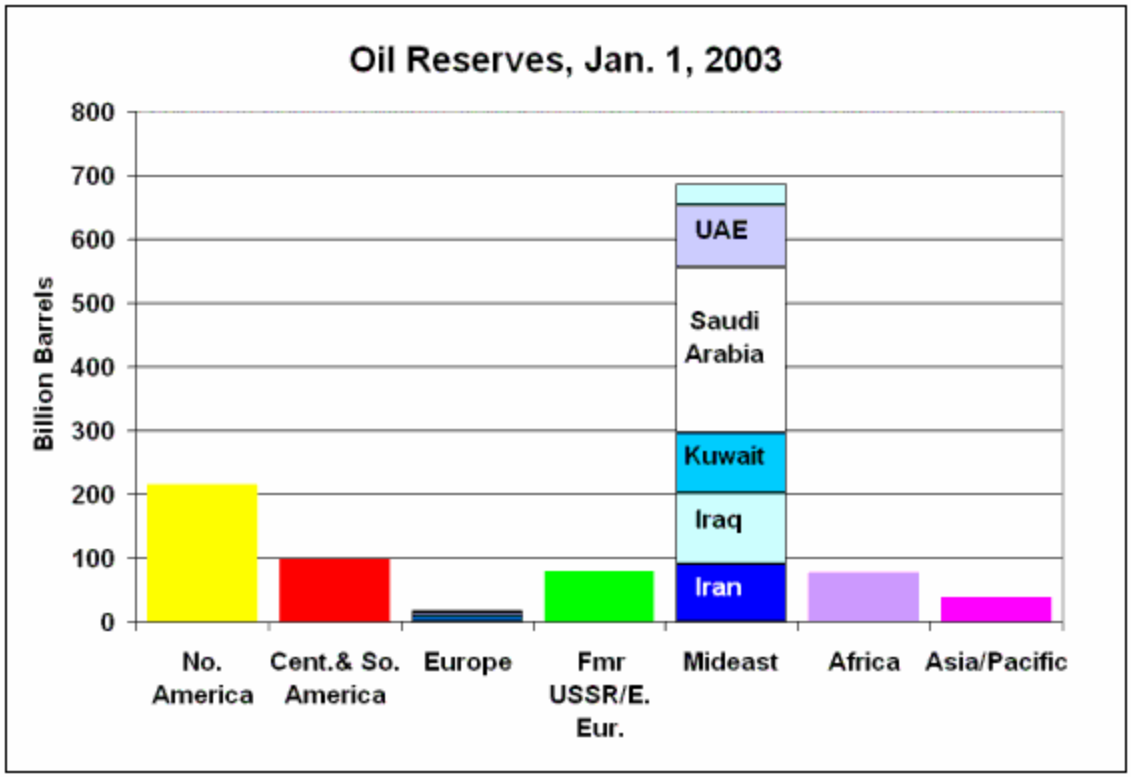


Oil

- What Do We Do With The Products?
  - Fuel Planes, Trucks, Cars
  - Heat Our Homes
  - Generate Electricity
  - Make Plastics
  - Make Medicines

Oil

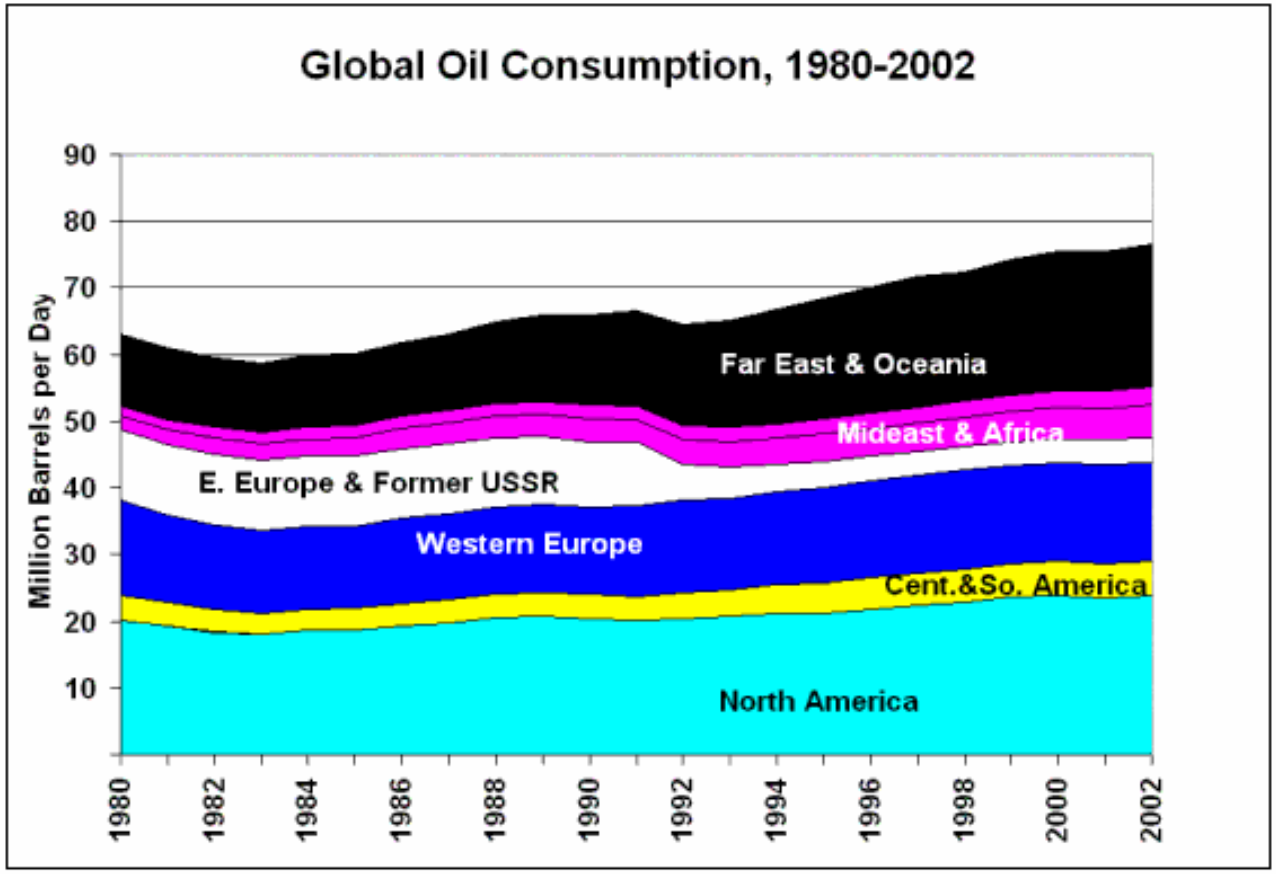
- How Much Do We Have?



  - 1.215 Billion Barrels

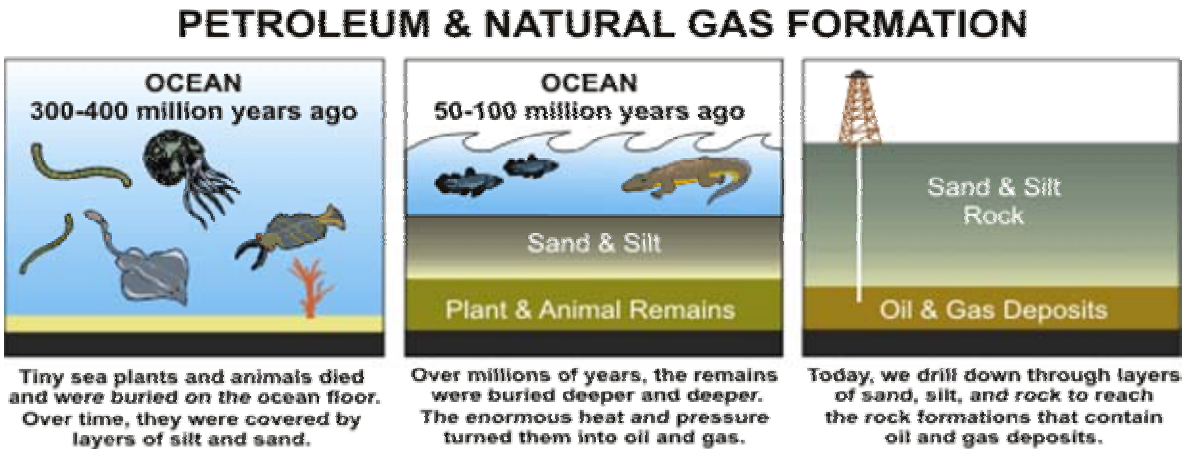
Oil

- How Much Do We Use?
  - 78 Million Barrels Per Day
  - 28,500 Million Barrels Per Year
- How Long Will It Last?
  - 42 Years



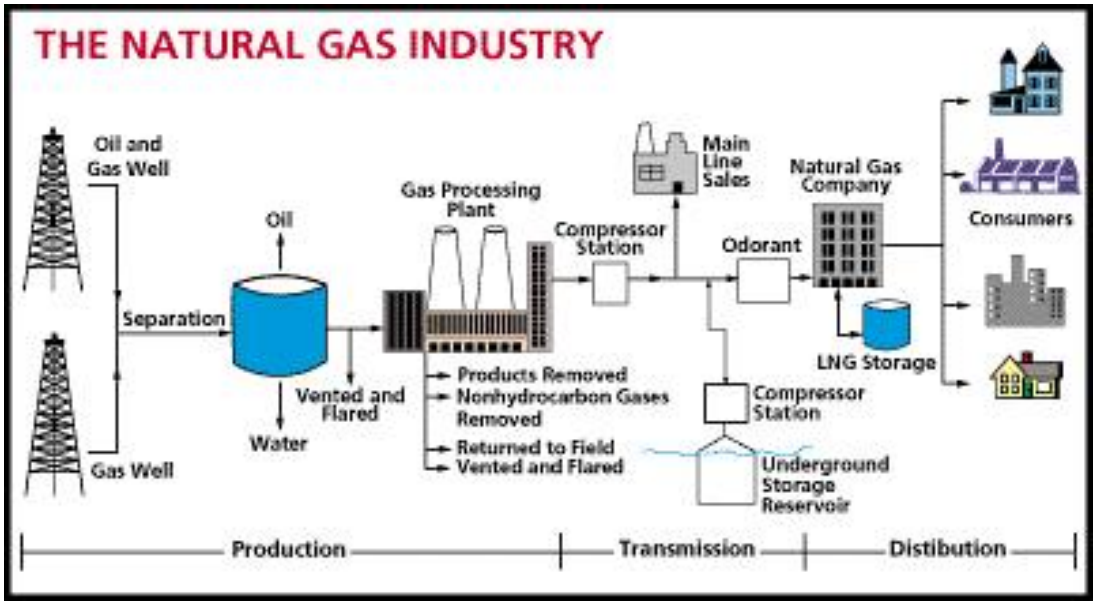
Natural Gas

- How Is It Made?
  - Dead Plants And Animals
  - Change Organic Material To Coal, Petroleum and Natural Gas



Natural Gas

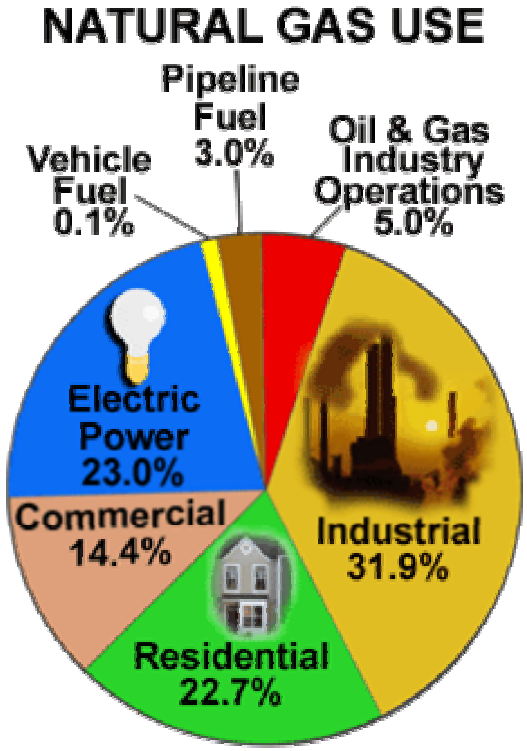
- How Is It Stored and Delivered?



  - Moved By Pipe Line

Natural Gas

- What Do We Use It For?
  - Heating
  - Cooking
  - Produce Electricity
  - Make Paint, Fertilizer, Plastics, Medicines
  - Used To Product Steel, Glass, Paper

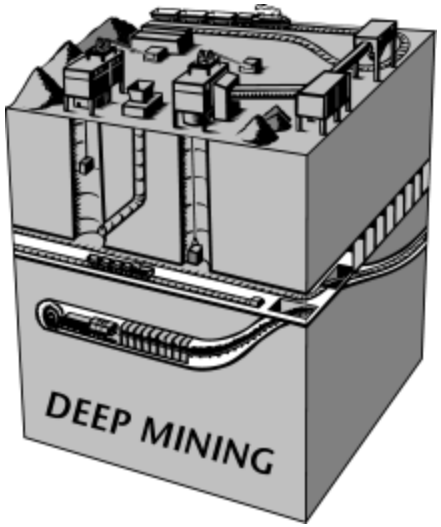


Coal

- Where Is The Coal?

Coal

- Where Do We Get It?



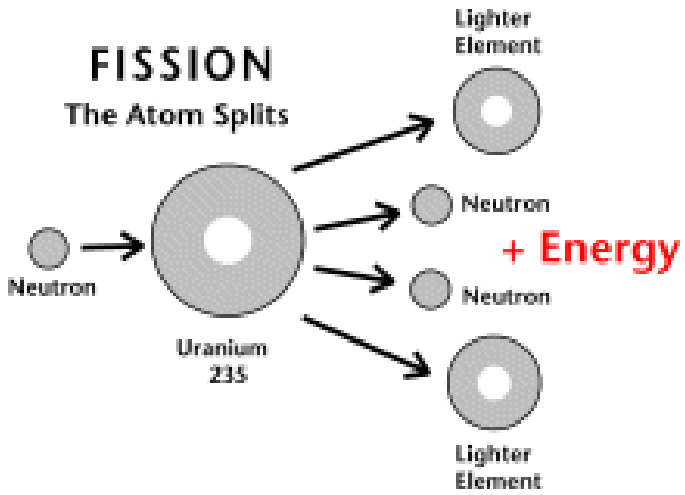
Coal

- What Do We Use It For?
  - Electric Power (used for 90% of coal mined)
  - Industry
    - Methanol
    - Ethylene

    } **to make plastics**
  - Make Steel
  - For Export

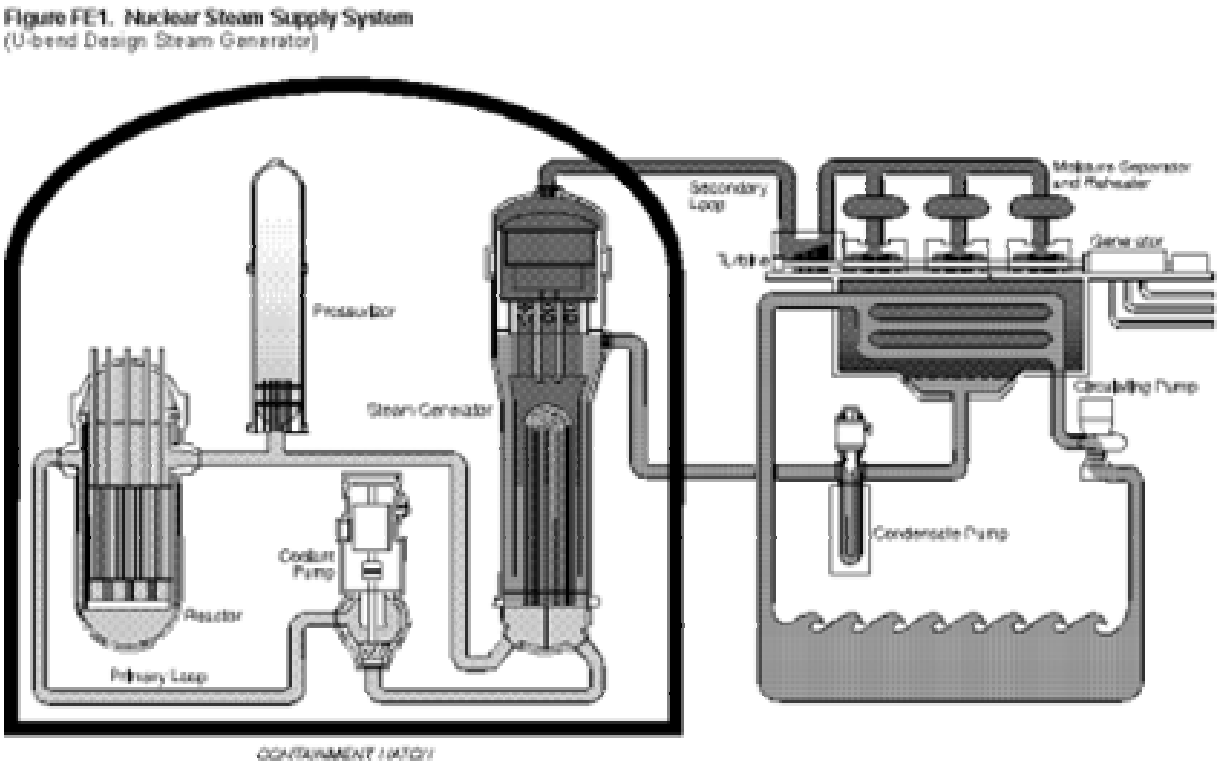
Nuclear Energy

- How Does It Work?
  - Same As Fossil Fuel Plant Except For Source Of Heat
  - Heat Is Produced By Fission



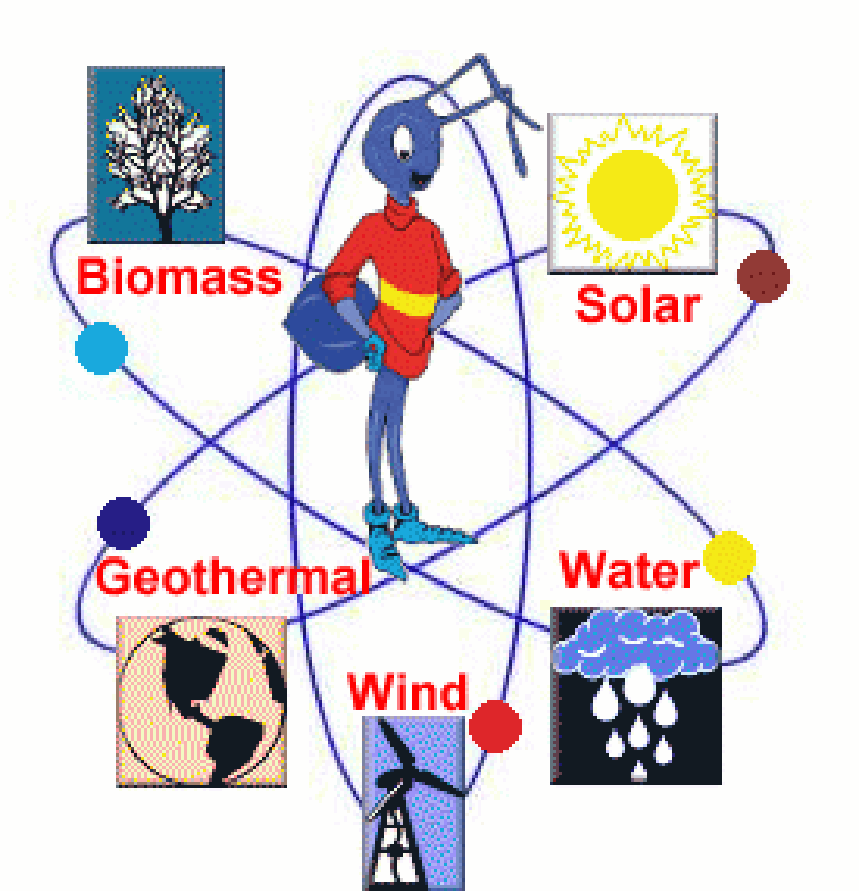
Nuclear Energy

- Nuclear Power Plant

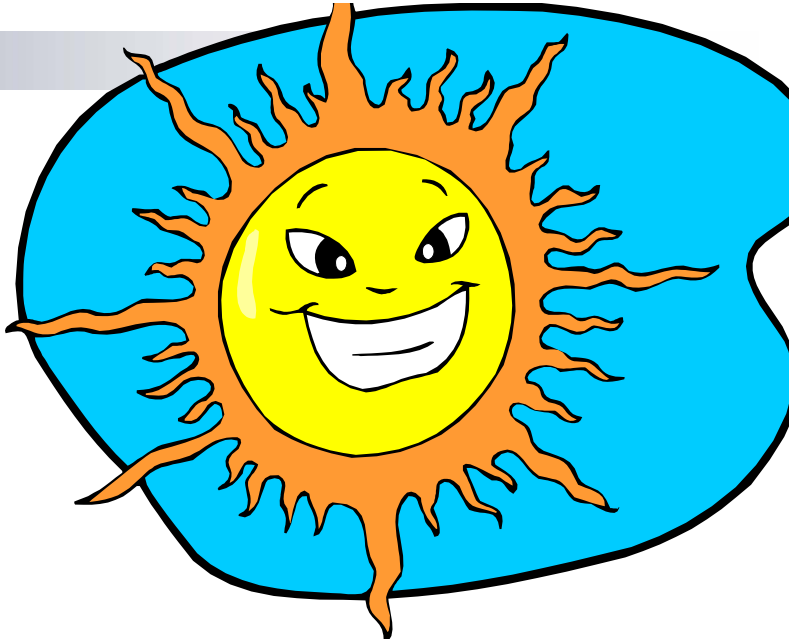


Renewable Energy

- What Is It?
  - Can Be Replenished In A Short Time
  - Solar
  - Wind
  - Water
  - Biomass
  - Geothermal

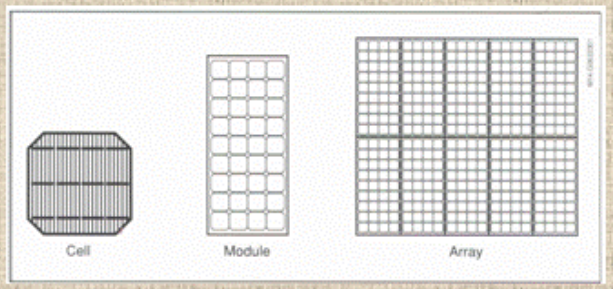


Solar Energy



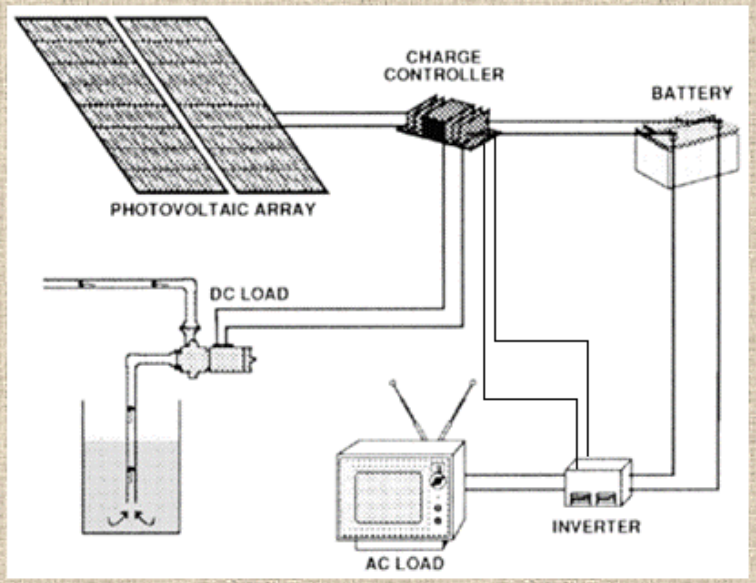
- What Is It?
  - Energy From The Sun
  - Can Be Heat Or Electricity
- Electricity
- Hot Water

Photovoltaic Systems Produce Electricity from the Sun



Solar cells are the basic device that changes sunlight into electricity. These solar cells are combined to form modules which are grouped together to make photovoltaic arrays.

The DC electricity produced by the solar array passes a charge controller which regulates the flow of electricity. This DC electricity flows to charge a battery pack (optional), power a DC device or go to an inverter where it is transformed into AC current for use by household appliances.



Actual Photovoltaic Systems

Elder family home in Boulder, CO, with PV panels on the roof...
This mountain home located in Sunshine Canyon above Boulder, has a 3.6 kW electric power system that meets 50 percent of the family's household electric needs and provides backup power to critical appliances. This backup allows the furnace, well pump, lights and kitchen appliances to remain in operation for an indefinite amount of time during extended power outages. The PV system is connected to Public Service Company of Colorado's power grid, which allows the Elder's to get credit for excess solar electricity sent back to the utility.

Lord home, coastal Maine...
This house in coastal Maine generates its own electricity from a 4.25 kW PV system beautifully integrated into the rooftop. The south roof incorporates an integrated array of solar thermal collectors and large area PV modules to form a single, uniform glass pane. Through a net-metering relationship with Central Maine Power, surplus solar electricity is exported to the utility grid, effectively spinning the utility meter backward. The Lords get this power back in an even exchange at night and during periods of low sun when it's needed.

Installing 17W integrated roofing shingle...
The flexible shingles are rated at 17 watts each. This stand alone 1 kilowatt PV system with battery backup powers the shop's lighting, computer system, and energy efficient appliances.

House in Delaware...
The 2kW system provides about 30 percent of their energy needs.

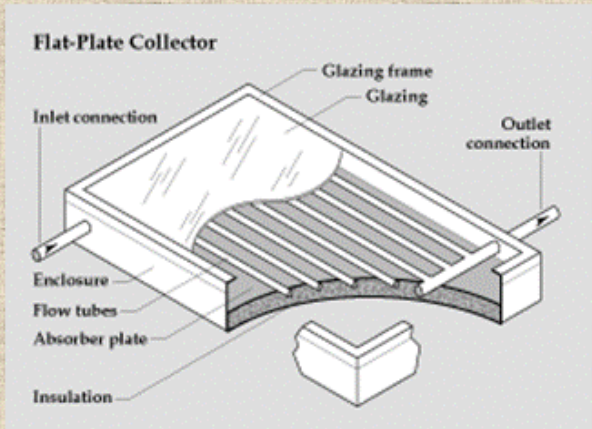
Solar electricity...
Kenwood Elementary School in Bowling Green, OH, has a new photovoltaic system thanks to the Ohio Schools Going Solar Program, which has installed 25 school PV systems around the state.

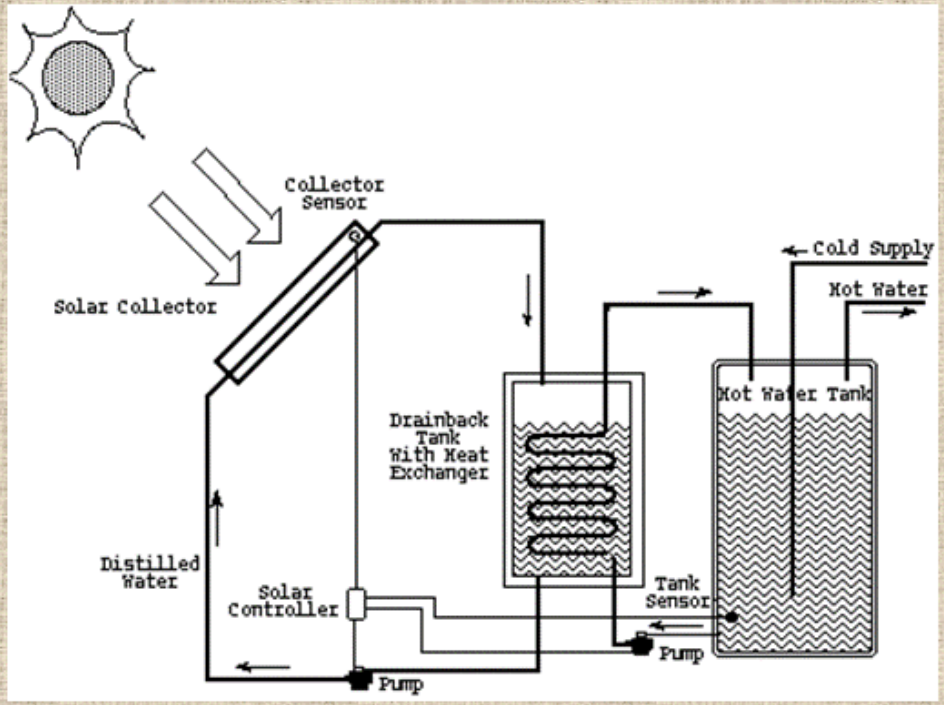
Home with backup PV...
This system features a 1.2 kW system that meets about 25 percent of the households electric needs and provides back-up power to critical appliances during utility power outages.

Hargrave Community Center...
4.25 kWdc, PV array

Largest Native American PV installation in the United States...
At the Indian Pueblo Cultural Center in Albuquerque, NM, this PV carport stands ready to impress more than 400,000 visitors each year. The system delivers about 23 megawatt hours of clean electricity annually to the local utility grid (Public Service Company of New Mexico), making it the largest commercial PV system in New Mexico.

Solar Water Heating
How it Works

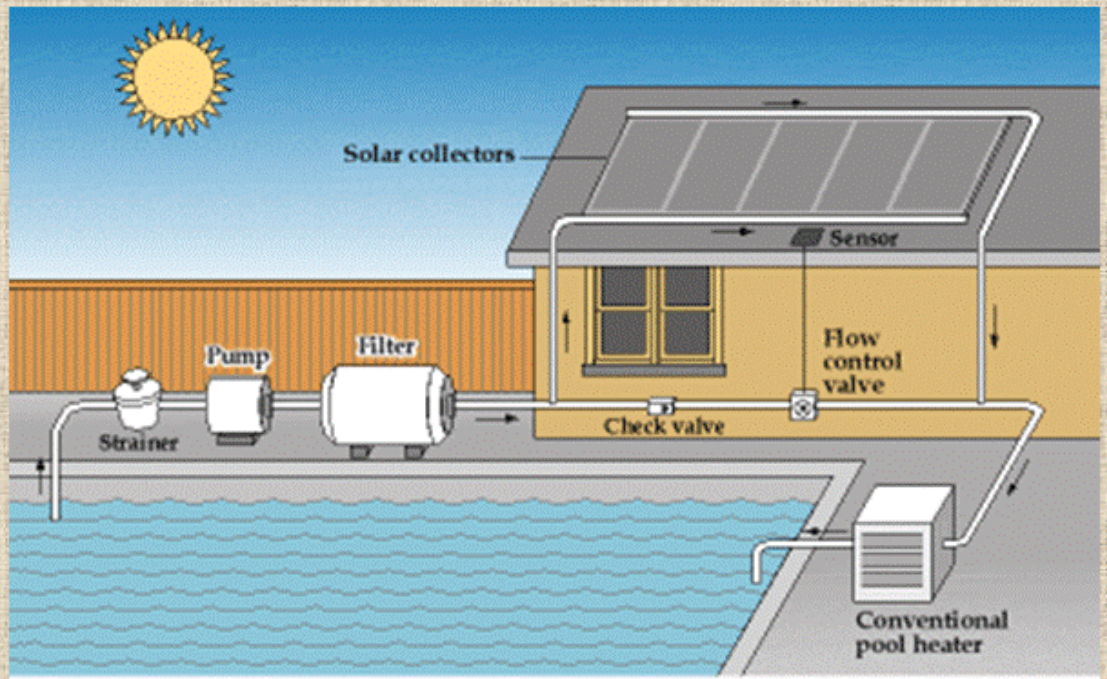




The hot water from the solar collector is pumped into a storage tank, which contains a heat exchanger. This is a closed system in that as hot water enters in the top of the storage tank, warm water is extracted from the bottom and is circulated through the collector and is heated.

The water which is used for bathing and washing is stored in another tank. This water is passed through a heat exchanger in the solar hot water tank and is heated. Normally this tank is a conventional hot water

Pool Heating by Solar Energy



Example of a solar pool heating system.

The swimming pool water is pumped through the solar collector and is returned to the pool. In this picture there is a conventional pool heater to provide supplemental heating if necessary. This is normally not necessary in our region.

Actual Solar Heating Systems

Campground solar hot water system

Solar awning over a back porch

Habitat for Humanity house with solar collectors

Solar heated swimming pool

Solar collectors

Solar water heating

Residential solar hot water system

Roof-mounted solar pool heating system

Chesapeake VA home with solar heating

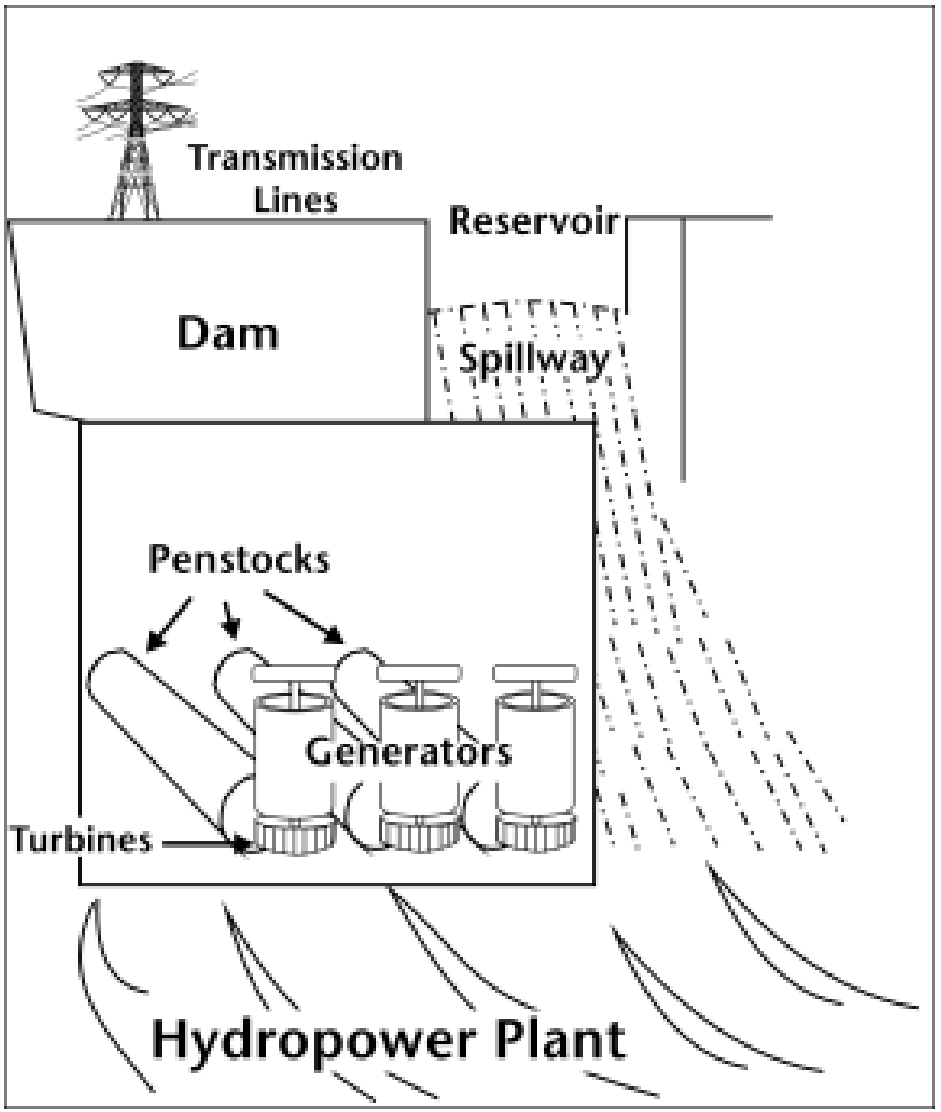
House on tour of solar homes in Delaware

Roof-mounted solar pool heating system

Solar heated swimming pool

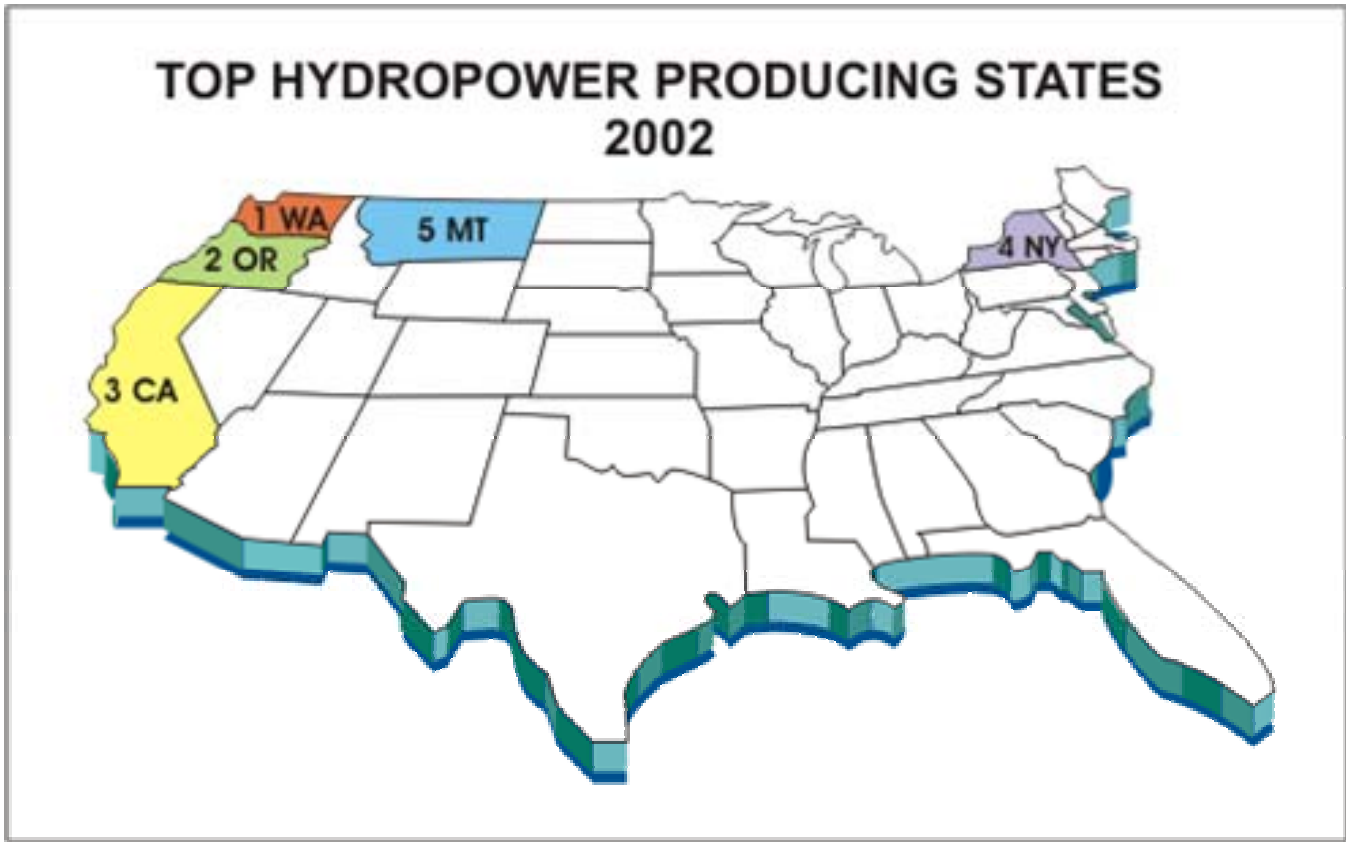
Hydropower

- Energy From Moving Water



Hydropower

- What States Generating Capacity?



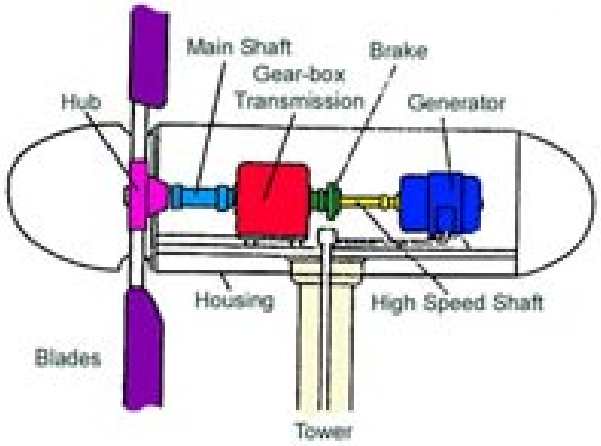
Wind Energy

- Wind Mills – There Are Many Types

  - Used To Pump Water, Grind Flour

Wind Energy

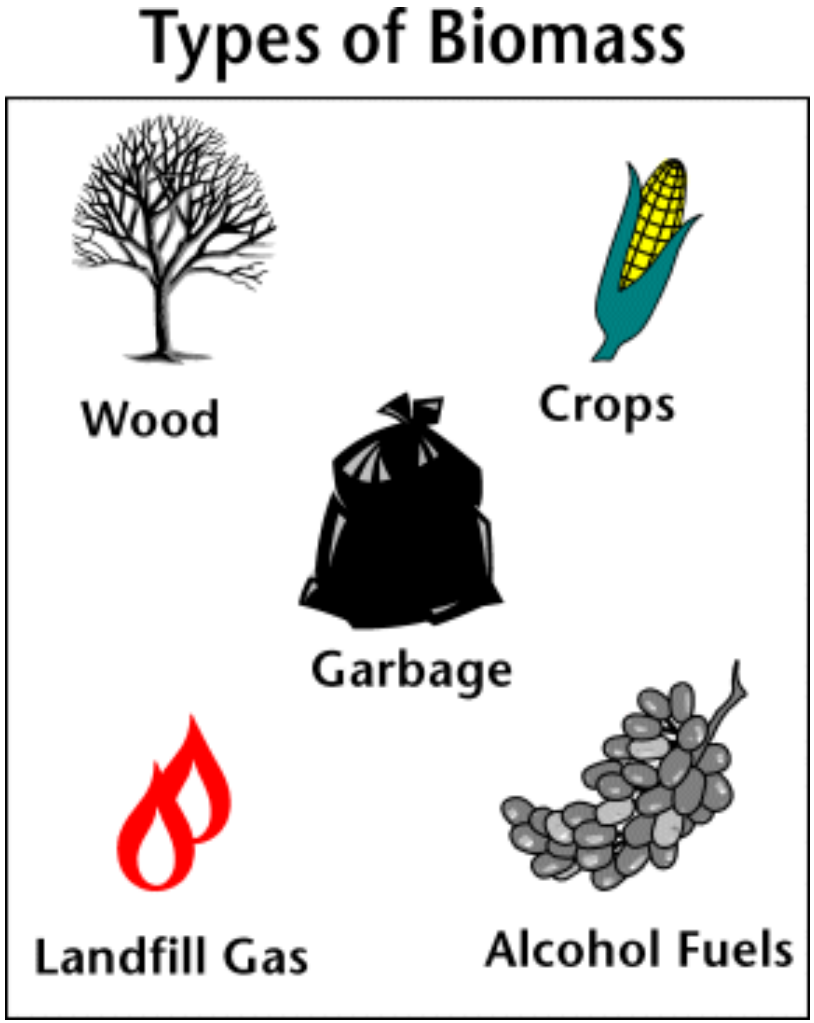
- Electricity Can Be Generated By Connecting The Shaft Of A Windmill To A Generator



- Wind Farm

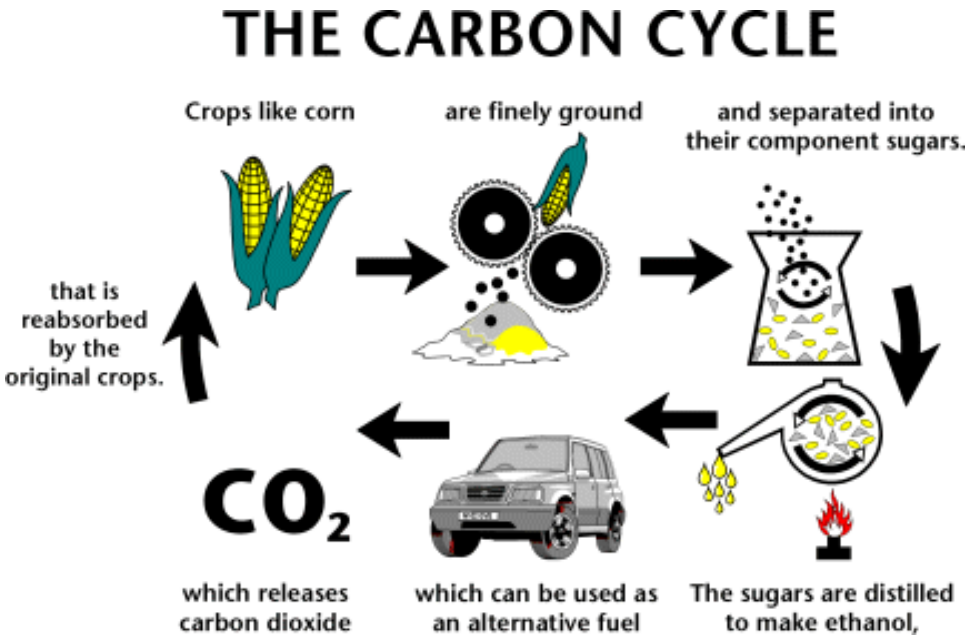
Biomass Energy

- What Is It?
  - Energy From Wood, Garbage, And Agricultural Waste
- Types of Biomass



Biomass Energy

- Alcohol Fuels – Ethanol
  - Used To Replace Gasoline



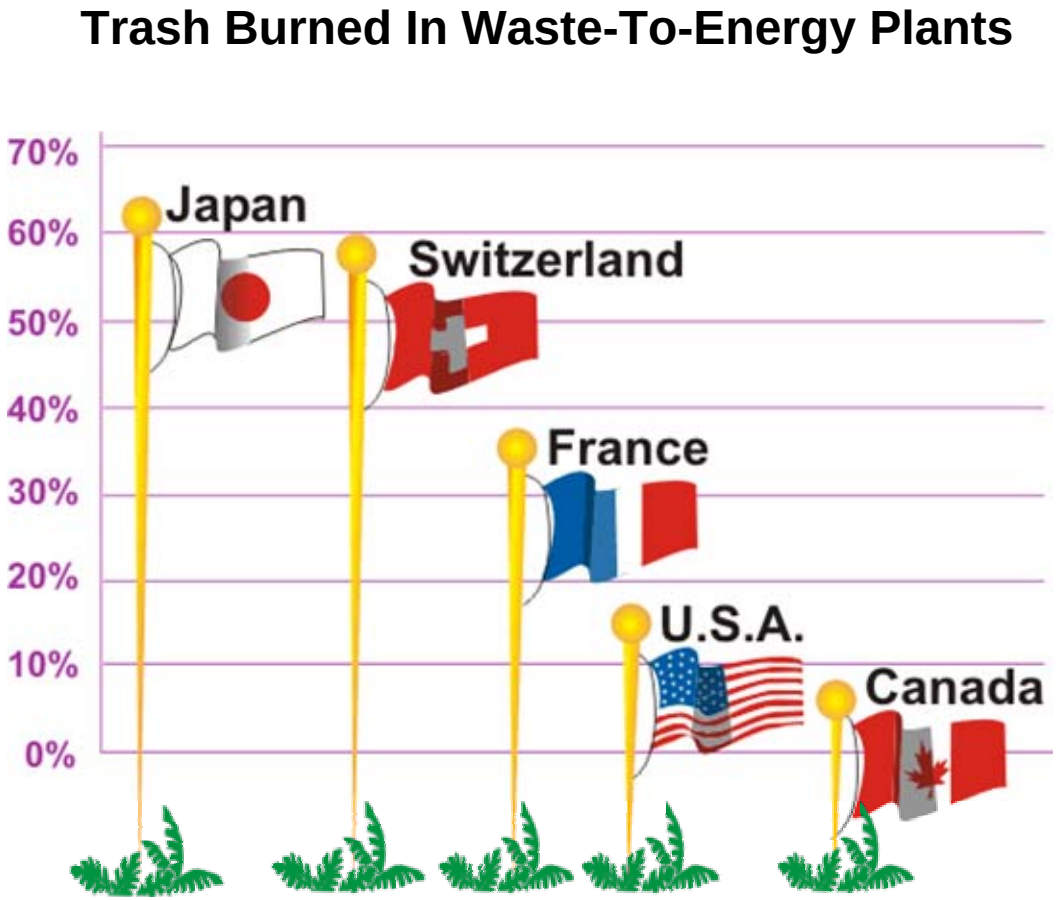
Biomass

- Waste To Energy
  - We Are Generating More Waste Each Year
    - 1960 – 2.7 lbs. Of Trash/Day
    - 2004 – 4.4 lbs. Of Trash/Day
  - What Do We Do?
    - We Burn Some Of It

  - Waste To Energy Plants Generate Enough Electricity To Supply 2.4 Million Homes

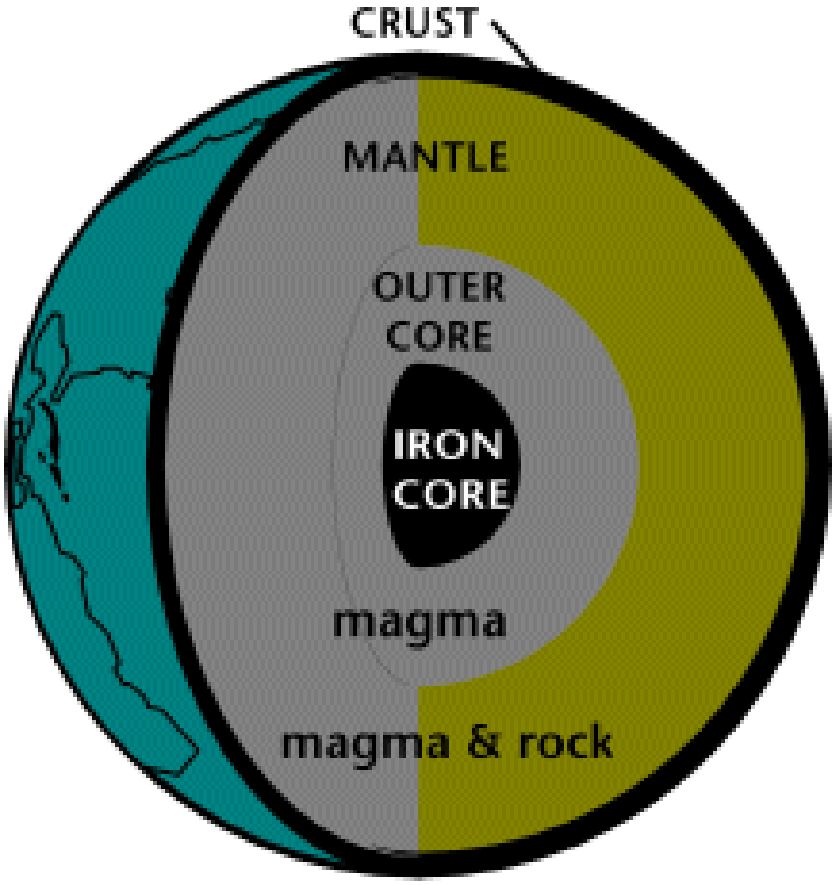
Biomass

- Waste To Energy
  - Why Do We Do It?
  - We Are Running Out Of Places To Dump It
- How Much Do We Do?



Geo Thermal Energy

- Energy From Earth's Core
- Earth's Interior



THE EARTH'S INTERIOR

Geo Thermal Energy

- How Do We Get This Energy?
  - Drill Into Trapped Hot Water Or Steam