Energy Workshop

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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?
- United States
- Saudi Arabia
- Iran
- Russia
- 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

This simplified drawing shows many of a refinery's most important processes.
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.

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, camp area system, and energy-efficient appliances.

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

Haggrave Community Center...
4.25 kWdc, PV array

House in Delaware...
The 2.25 kW system provides about 30 percent of their energy needs.

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.

Lord home, coastal Maine
This home 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.

Solar electricity...
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.
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 tank.
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

Types of Biomass:
- Wood
- Crops
- Garbage
- Landfill Gas
- Alcohol Fuels
Biomass Energy

- Alcohol Fuels – Ethanol
  - Used To Replace Gasoline

THE CARBON CYCLE

Crops like corn are finely ground and separated into their component sugars. That is reabsorbed by the original crops.

CO₂, which releases carbon dioxide, which can be used as an alternative fuel. The sugars are distilled to make ethanol.
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?

Trash Burned In Waste-To-Energy Plants
Geo Thermal Energy

- Energy From Earth’s Core
- Earth’s Interior
Geo Thermal Energy

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