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COLLEGE OF SCIENCES
DEPARTMENT OF ATMOSPHERIC SCIENCES

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Solar Energy

Welcome Students

TO LECTURE TWO



General Concepts

What is Power?

- The definition of work says nothing about how long it takes to do the work.

When carrying a load up some stairs, you do the same amount of work whether you walk or run up the stairs. So why are you more tired after running upstairs in a few seconds than after walking upstairs in a few minutes?

- To understand this difference, we need to talk about how fast the work is done, or power.
- **Power is the rate at which work is done.**

Power: equals the amount of work done divided by the time interval during which the work is done.

$$\text{Power} = \frac{\text{work done}}{\text{time interval}}$$

The unit for power is called the **Watt**

$$1 \text{ watt (W)} = \frac{1 \text{ J}}{\text{s}} = \frac{1 \text{ kg} \cdot \text{m}^2}{\text{s}^2}$$

$$\text{Power} = \frac{\text{energy}}{\text{time}}$$

Example:

A power plant with generating capacity 500 million Joules of electric energy, how many watt of power can it preceded in one second?

Answer:

$$\begin{aligned} \text{Power} &= \frac{\text{energy}}{\text{time}} \\ &= \frac{500,000,000 \text{ J}}{1 \text{ sec}} \\ &= 500 \text{ Megawatt} \end{aligned}$$

Key Point !

POWER ≠ ENERGY

Work = Force x Distance (Joules)
Work = Energy





General Concepts

Heat:

in an electric power plant, the water is heated (for example, by burning coal) to temperature ($1\ 200$ degrees C), thus produce electricity (by turning the turbines within the magnetic field of an electric generator). In this transformation, the chemical energy stored in coal is converted to thermal energy of water vapor, which in turn is converted to mechanical energy (work) of the rotating turbine, which is finally converted to electricity.



Radiation:

Life on earth is possible because of the sun, and most of earth's energy comes from the sun. The energy from the sun reaches our planet in the form of a very wide spectrum of rays (or waves) (electromagnetic wave) of different intensity, which we call solar radiation. Most of it is benign, like radio waves and light (or visible radiation), and some can be harmful (for example, ultraviolet rays).





Renewable Energy

Energy units in the International System of Units (SI)

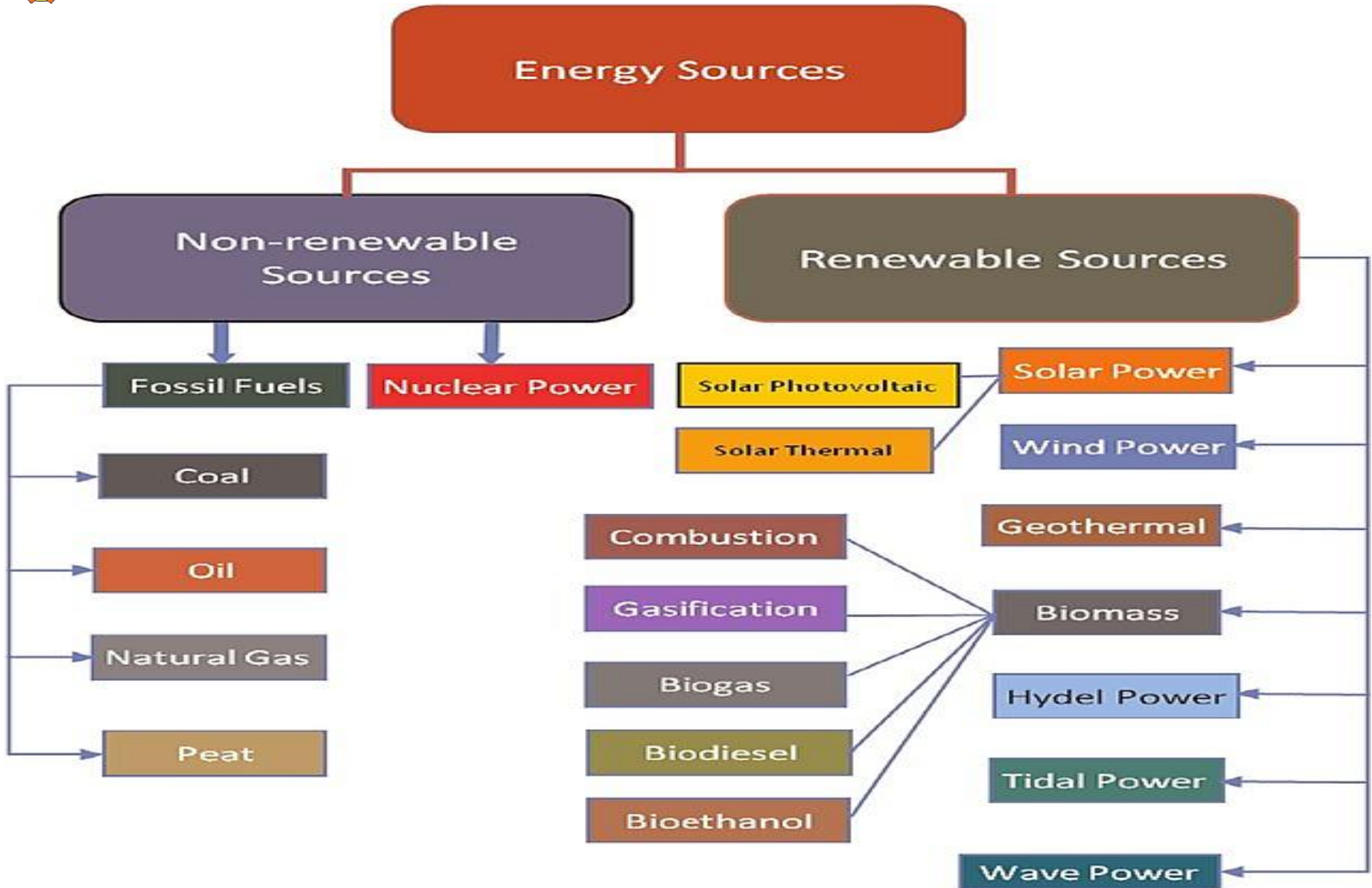
- the unit of work or energy is the Joule (J):
1 Watt = 1 Joule/second
- For very small amounts of energy, the erg (erg) is sometimes used:
1 Joule = 10,000,000 ergs
- Power sometimes measured in horsepower (hp):
1 horsepower = 746 Watts
- Electrical energy is generally expressed in kilowatt-hours (kwh):
1 kilowatt-hour = 3,600,000 Joules
- Heat energy measured in calories. One calorie (cal) is defined as the heat required to raise the temperature of 1 gram of water from 14.5 to 15.5 °C:
1 Calorie = 4.189 Joules.
- **the British Thermal Unit (BTU)**. It is the heat energy required to raise the energy temperature of 1 pound of water from 63 to 64°F:
1 BTU = 1055 Joules.

BTU content of common energy units

Fuel	BTU Content
1 barrel (42 gallons) of crude oil	5,800,000 BTU
1 gallon of gasoline	124,000 BTU
1 gallon of diesel fuel	139,000 BTU
1 gallon of heating oil	139,000 BTU
1 barrel of residual fuel oil	6,287,000 BTU
1 cubic foot of natural gas	1,028 BTU
1 gallon of propane	91,000 BTU
1 short ton of coal	19,988,000 BTU
1 kilowatthour of electricity	3,412 BTU



Classification of Energy Resources





Definitions of Renewable Energy

sometimes referred to it as a green or sustainable energy

1. Energy obtained from continuous or repetitive currents of energy recurring in the natural environment.
2. Renewable energy is energy that is collected from renewable sources, which are naturally replenished on a human timescale, such as sunlight, wind, rain, tides, waves, and geothermal heat.



Before entering into the details of **renewable energy**, we must understand the difference between it and **alternative energy**



Alternative Energy

- the energy that's produced from any source other than fossil fuels, specifically: (oil, coal, and natural gas) or any source of energy we use to replace traditional energy sources in power generation, spatially that pollute the environment.
- You could almost say the same thing about renewable energy sources. **But** there is one difference between the two.
- All renewable energy sources fall under the category of alternative energy sources, **But** not vice versa.

So What's the Difference Between Renewable Energy and Alternative Energy



The difference is in the existence of **nuclear energy** among the alternative energy sources, although it is a fossil fuels and non-renewable energy, because it has lower carbon emissions, compared to (coal, oil and gas).



Alternative Energy

Alternative Energy

Renewable Energy



- Solar Energy
- Wind Energy
- Hydroelectric Energy
- Geothermal Energy
- Bioenergy
- Hydrogen Energy
- Tidal Energy
- Wave Energy
- Nuclear Energy

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-





Characteristics of Renewable Energy

- The sources of renewable energy are capable of regeneration.
- They are sustainable (non-depletable).
- always available for use, found everywhere across the world.
- Does not have significant pollutant emissions (nonpolluting).

BUT!

- They are variability and low density.
- higher initial cost.

The Sun is the source of all energy resources except: geothermal & nuclear

NOTE: The energy content of the waste (**WASTE ENERGY**) can only be referred to as renewable if it is of non-fossil origin (e.g. organic domestic waste, waste from the food processing industry).

