Benha University

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Energy Storage & Transmission

By

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Lecture (2)

16– 02 - 2020

Syllabus

1. • Introduction to energy resources.
2. • Energy Conversion.
3. • Transmission & Distribution & Consumption.
4. • Units of Energy and Power and Important Constants.
6. • Conservation of Energy and energy conversion techniques.
7. • Electricity generation, transmission and storage.

Cont.

8	• Energy consumption; Domestic and industrial.
9	• Case studies.
10	• Introduction to green energy policy and climate change mitigation.
11	• Renewable energy systems; wind power, hydro power, solar, biomass, and biofuel, geothermal.
12	• Case studies of major installations.
13	• Economics and politics of renewable energy systems.
14	• Structure, design, efficiency of electrical transmission grids.

Cont.

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- Power electronics and their application in energy storage and conversion.

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- Integrated approach for the storage and transmission of energy.

17

- Efficiency trade-off analysis of such systems.

INTRODUCTION

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Energy Definition

- Energy is the amount of force or power when applied can move one object from one position to another.
- Energy defines the capacity of a system to do work.
- Energy are broadly classified into two main types:
  - Renewable Energy
  - Non Renewable Energy

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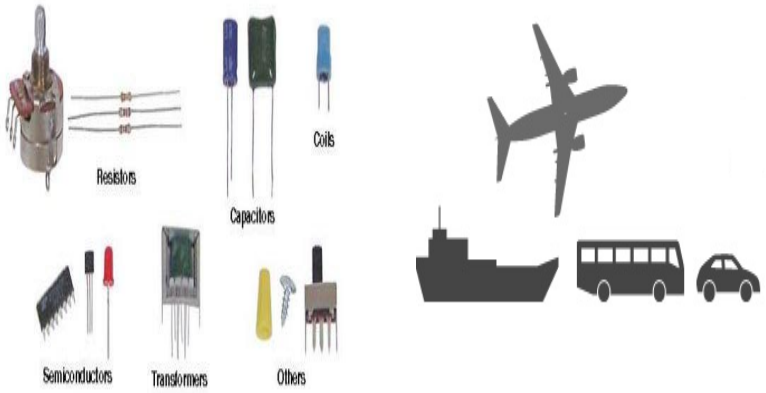
Energy Applications

Energy Uses

- Electronics
- Transportations
- Heat
- Computers
- Communications



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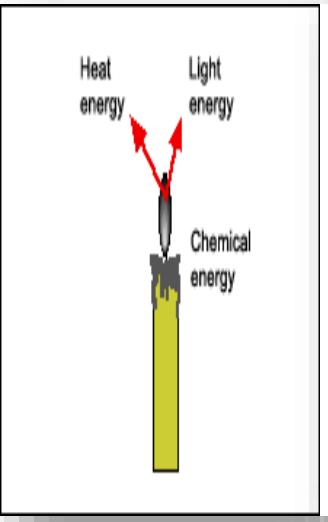
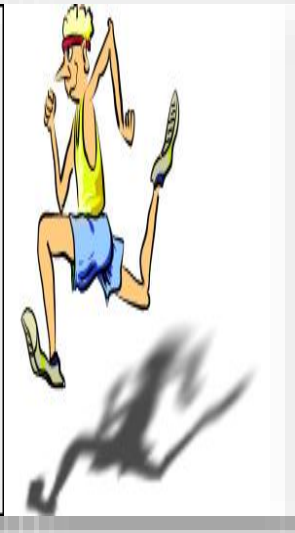
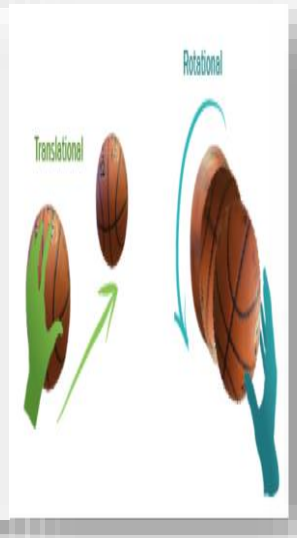
Common Forms of Energy

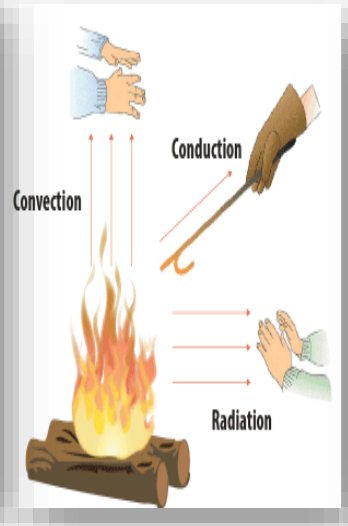
The six most common forms of energy:

Chemical Kinetic Rotational Solar Thermal Nuclear









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Electricity Changes Life style

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Five key questions

1. What is the electrical energy?
2. How do we produce electric energy?
3. Why do we think the electrical energy is important?
4. What are the resources of electrical energy?
5. What about renewable energy resources?

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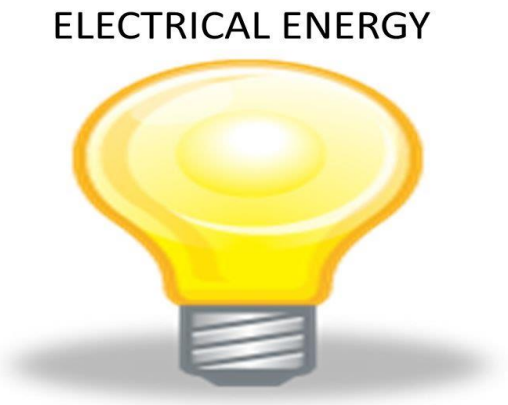
1. What is the Electric Energy?

- It is one of the most important energy forms.
- Energy cannot be created or destroyed.
- In all devices and machines, including electric circuits, energy is transferred from one type to another.



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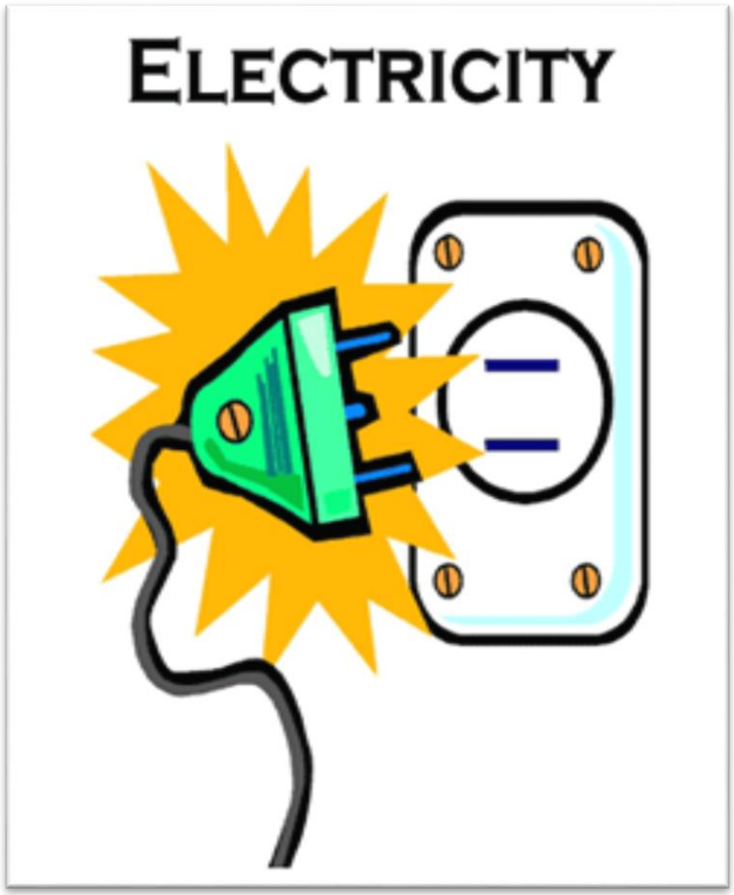
The Idea

Electricity is flowing Electrons



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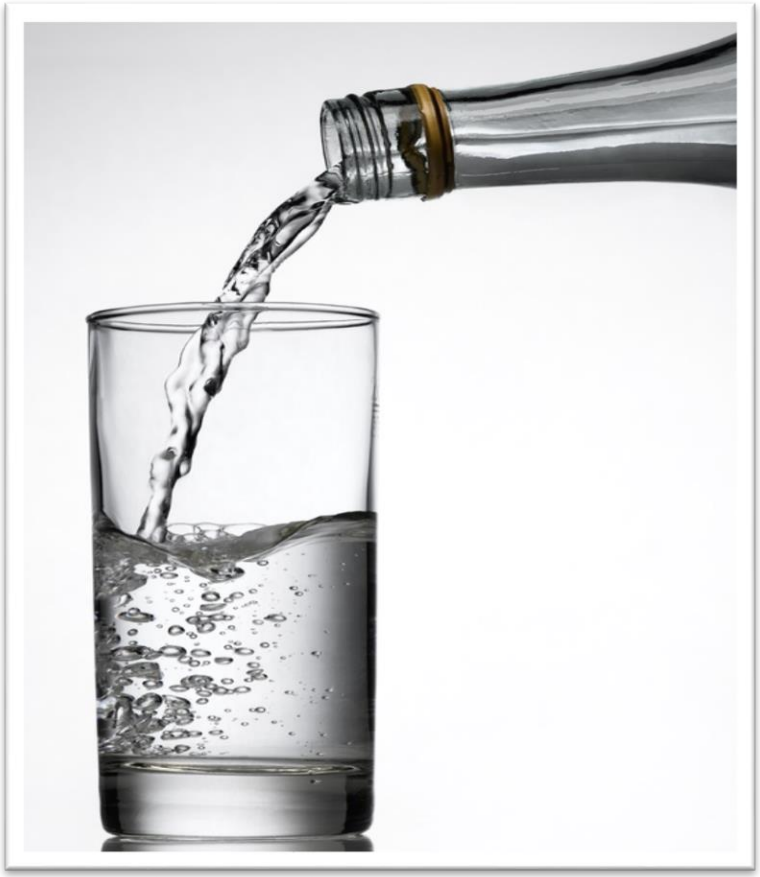

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Terminology

1. **Voltage**
   - Measured in Volts.
   - Electrical potential.
   - “Height” of water on one side of a dam compared to the other side.
2. **Current**
   - Measured in Amps.
   - Rate of electron flow.
   - “Speed” at which water flows through the dam.

3. **Resistance**

- The opposition of a material to the flow of an electrical current.
- Depends on
  * Material
  * Cross sectional area
  * Length
  * Temperature

4. **Watt**

- Measure of Power.
- Rate of electrical energy.
- Not to be confused with Current.
- Watt-hour (Wh) is a measure of energy:

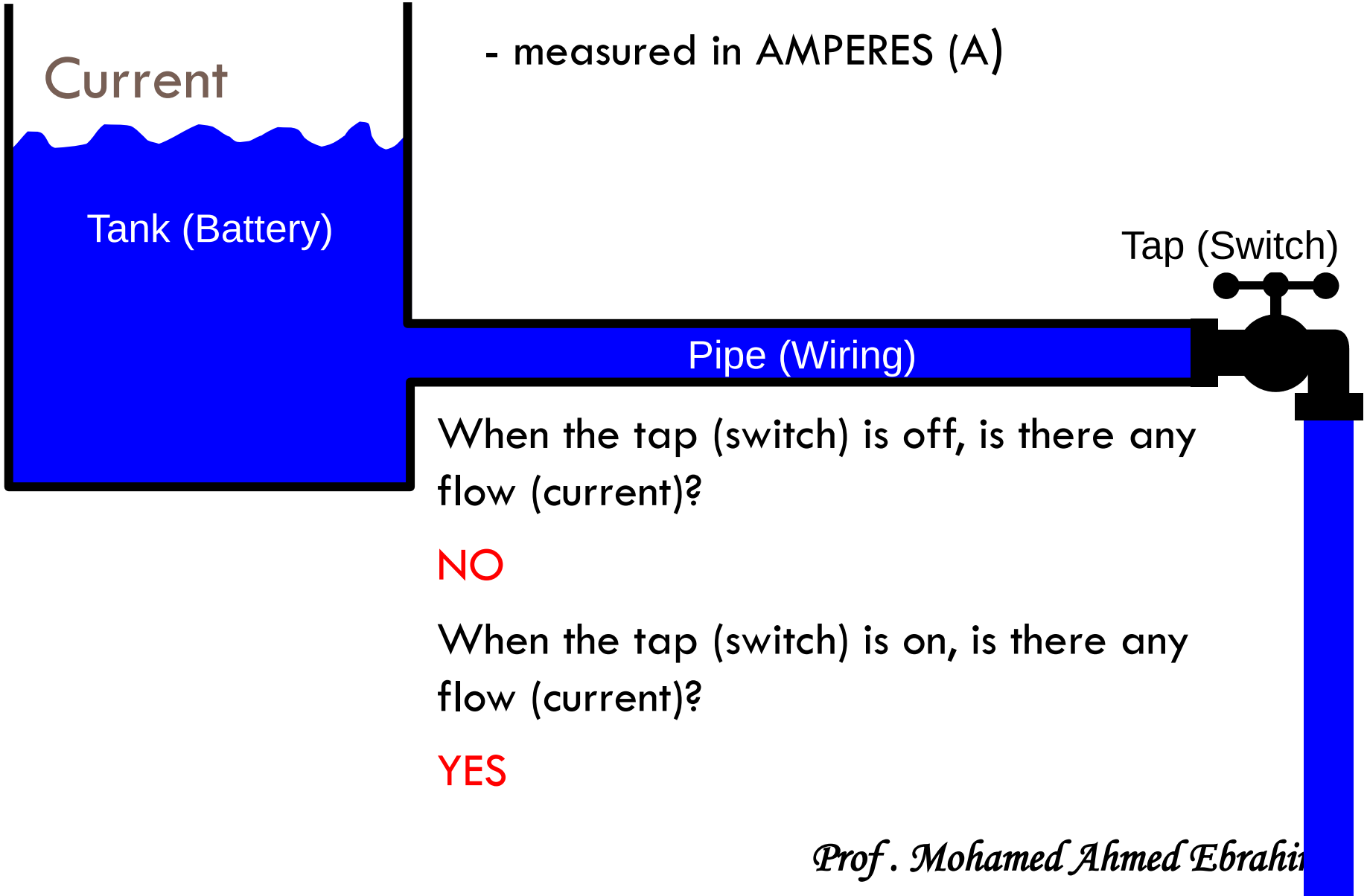
  * Unit quantity of electrical energy (consumption and production).

  * Watts x hours = Watt-hours.

  * 1 Kilowatt-hour (kWh) = 1000 Wh

The flow of electric charge

- measured in AMPERES (A)



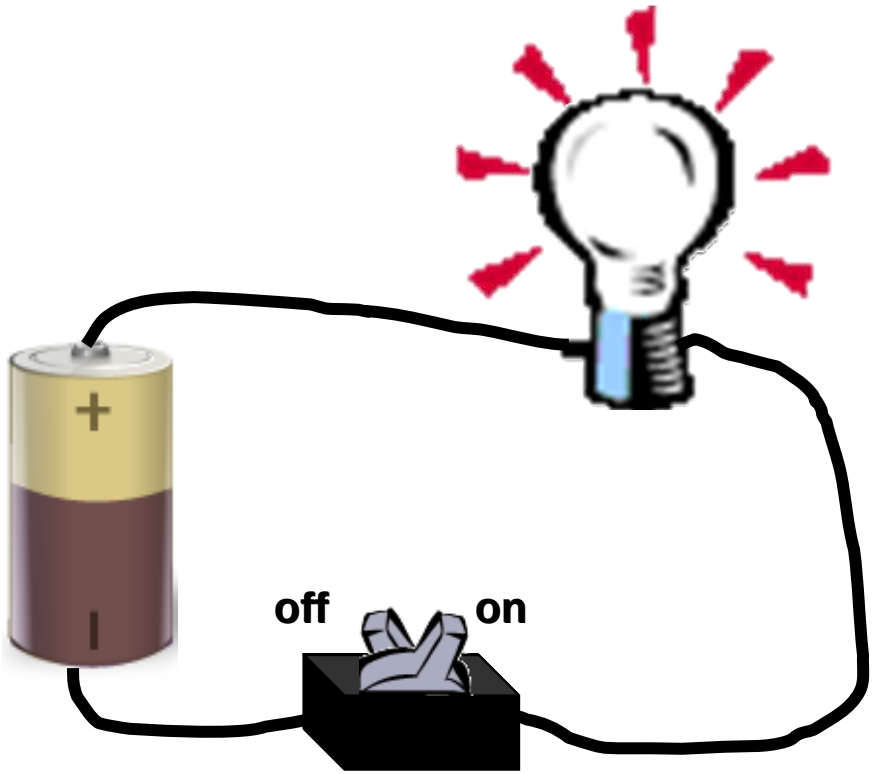
When the tap (switch) is off, is there any flow (current)?

NO

When the tap (switch) is on, is there any flow (current)?

YES

Current in a Circuit



When the switch is off, there is no current.

When the switch is on, there is current.

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2. How do We Produce Electric Energy?

Magnetic field + movable conductor = electricity

Edison and Swan

Nearly 40 years went by before a really practical DC (Direct Current) generator was built by Thomas Edison. In 1878 Joseph Swan, a British scientist, invented the incandescent filament lamp and within twelve months Edison made a similar discovery in America.

- Swan and Edison later set up a joint company to produce the first practical filament lamp. Prior to this, electric lighting had been crude arc lamps.
- Edison used his DC generator to provide electricity to light his laboratory and later to illuminate the first New York street to be lit by electric lamps, in September 1882. Edison's successes were not without controversy, however - although he was convinced of the merits of DC for generating electricity, other scientists in Europe and America recognized that DC brought major disadvantages.

3. Why do we think the Electrical Energy is important?

- Electricity is a part of modern life and one cannot think of a world without it.
- Electricity has many uses in our day to day life.
- We can say that the electric energy is the source of life.
- Imagine life without electricity!!!!!!!!!!

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4. What are the resources of electrical energy ?

Electric energy resources can be classified as

According to its nature

Non-renewable

Renewable

Most of our electricity comes from the burning of the fossil fuels coal and gas.

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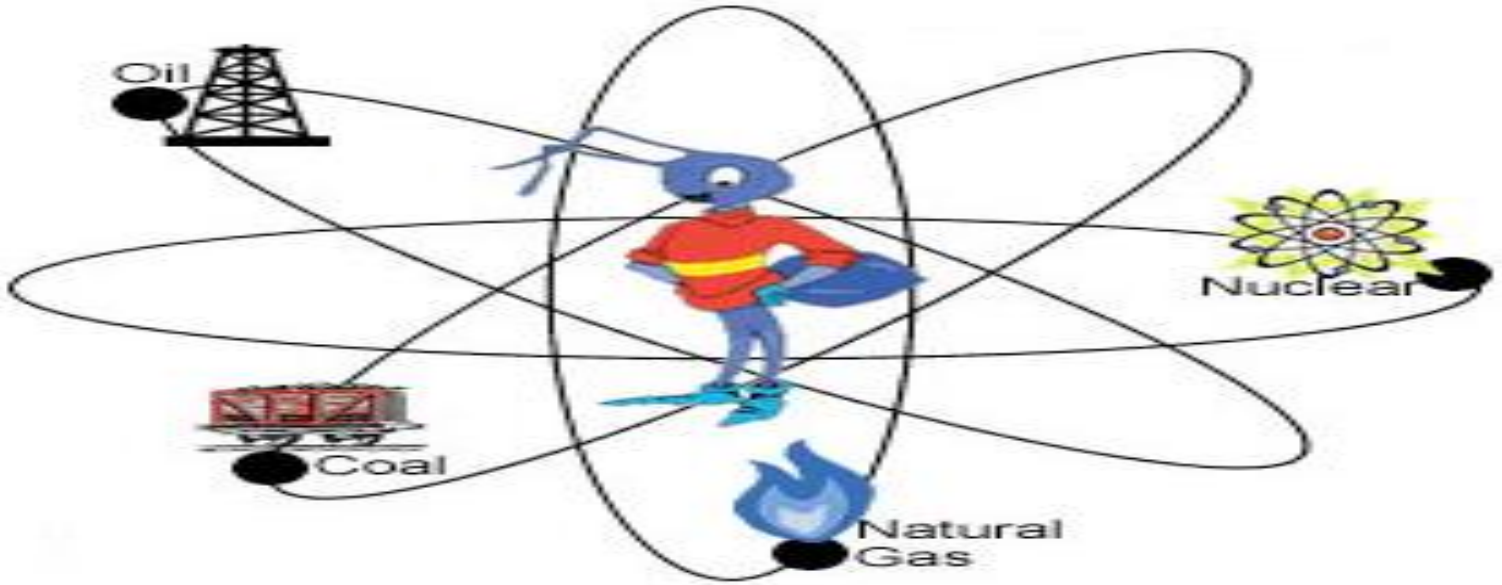
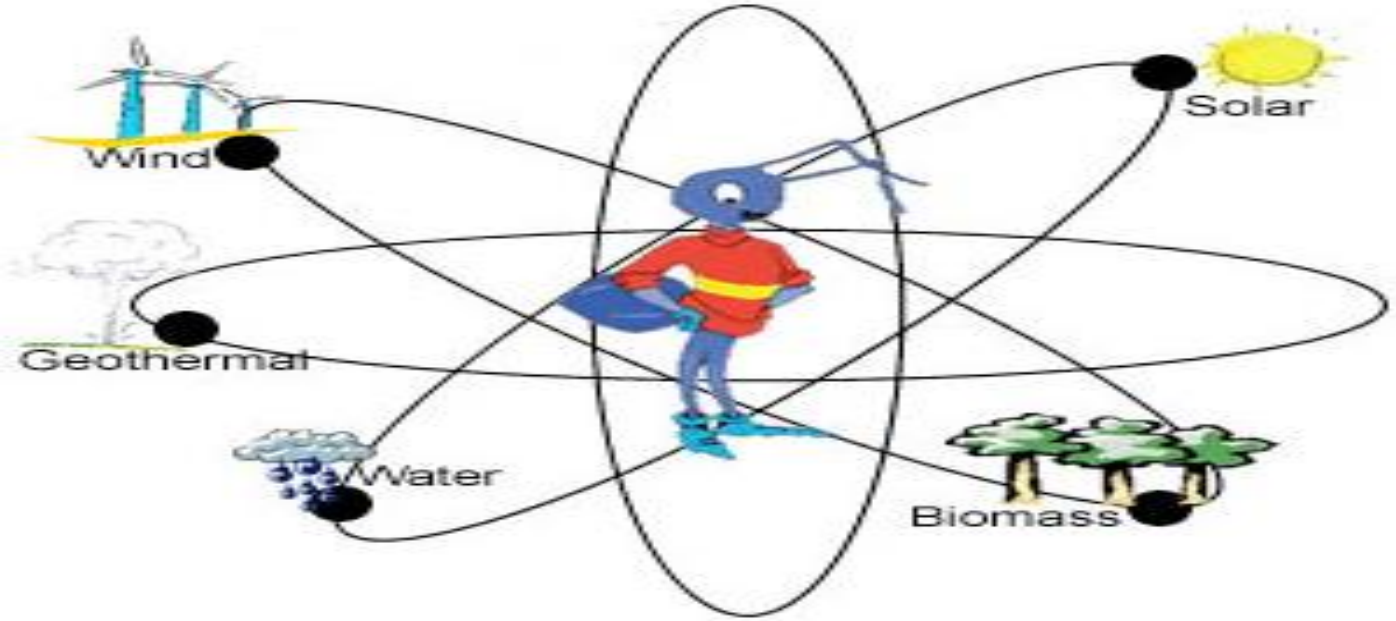
1. Non-renewable energy & its types

- Sources are not environmental friendly and can have serious affect on our health.
- They are called non-renewable because they can not be re-generated within a short span of time.
- Non-renewable sources exist in the form of fossil fuels, natural gas oil and coal.



2. Renewable energy & its types

- Recourses found in nature i.e. Sun, wind, rain, and tides. That are self regenerated, that can be replaced or renewed without harming the environment or contributing to the greenhouse effect.
- These sources are normally used to produce clean energy. This production doesn't lead to climate change.

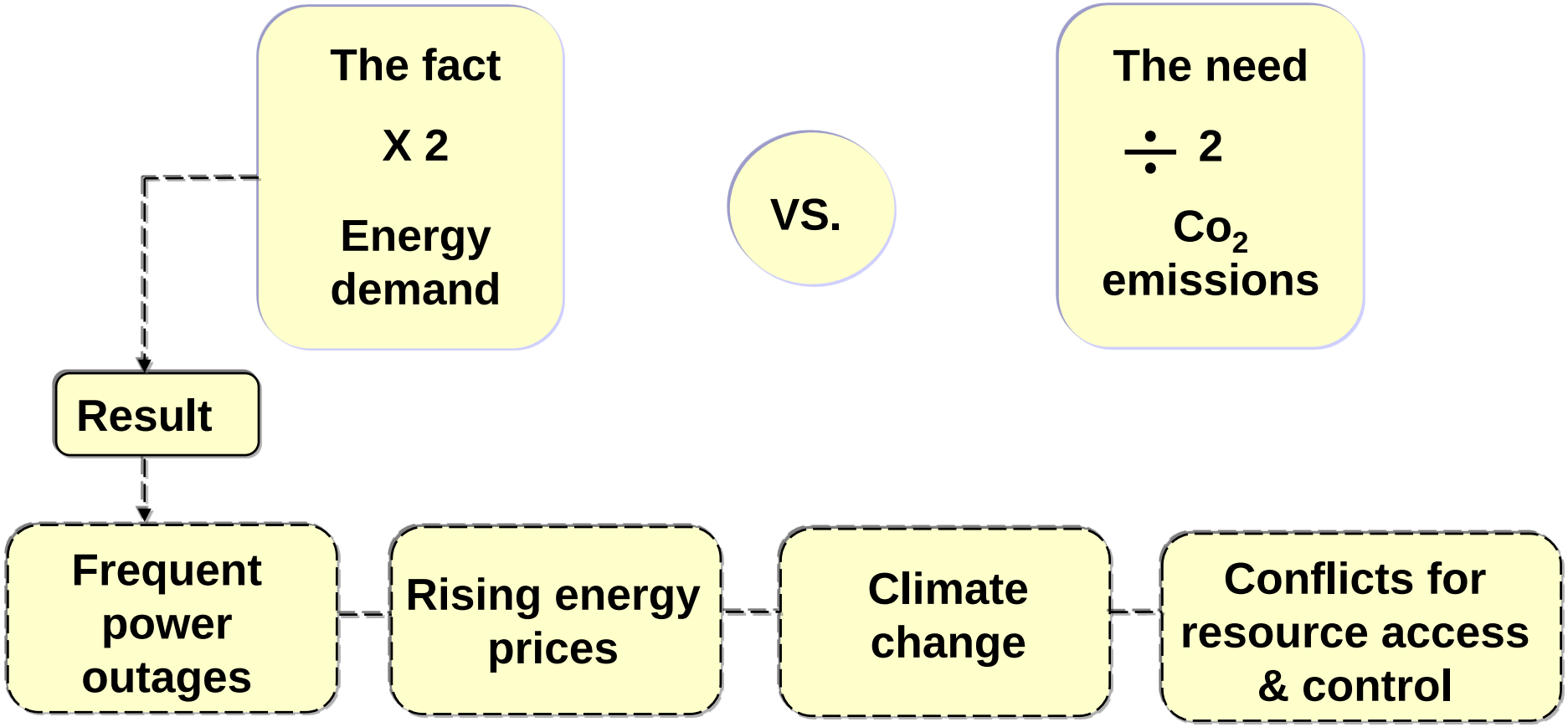


What's wrong with this picture?

- Pollution from burning fossil fuels leads to an increase in greenhouse gases, acid rain, and the degradation of public health.

- Egypt carbon dioxide emissions is at a current level of 212.15M, up from 209.77M one year ago. This is a change of 1.13% from one year ago.

Energy Dilemma



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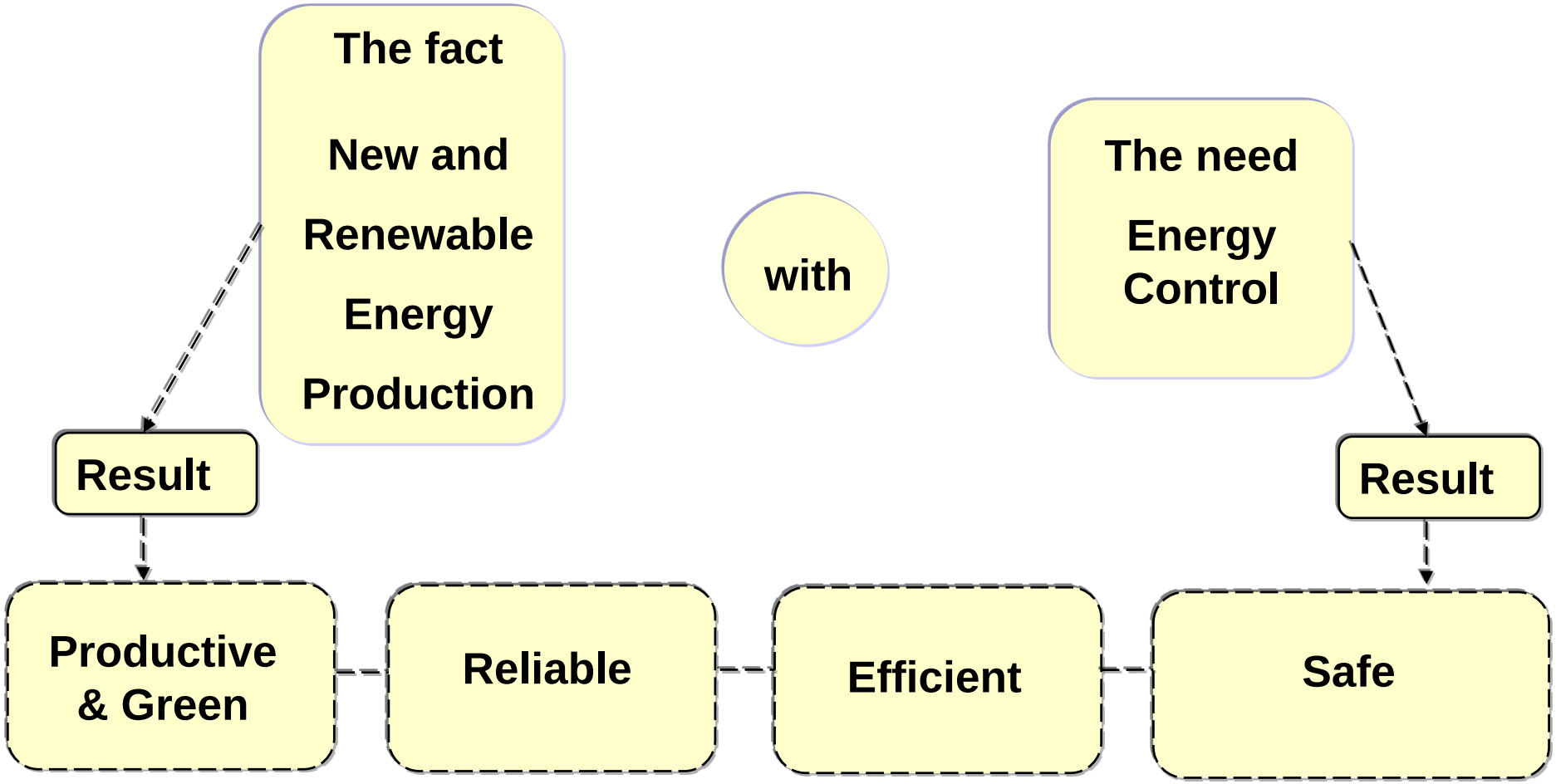
Proposed Solution



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Classifications of main drivers behind the focus on renewable energy

Environmental drivers

- Limiting green house gas (GHG) emissions
- Avoidance of the construction of new transmission circuits and large generating plants

Commercial drivers

- General uncertainty in electricity markets favors small generation schemes
- DG is a cost effective route to improved power quality and reliability

National/regulatory drivers

- Diversification of energy sources to enhance energy security
- Support for competition policy

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Why Sustainable Energy Matters?

- The world's current energy system is built around fossil fuels Problems:

1. Fossil fuel reserves are ultimately finite.
2. Two-thirds of the world' s proven oil reserves are locating in the Middle-East and North Africa (which can lead to political and economic instability).
3. Detrimental environmental impacts (mining operations &Combustion).

Energy Matters

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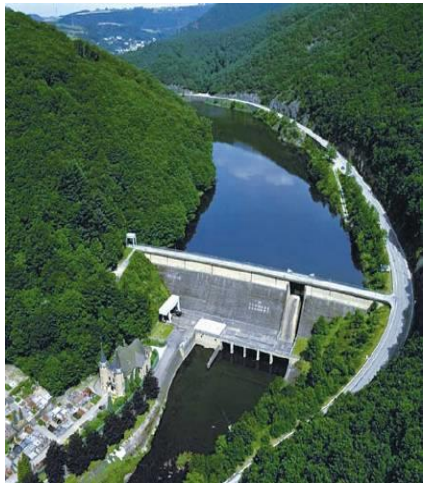
Making the Change to Renewable Energies

Solar

Geothermal

Wind

Hydroelectric



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