Benha University

Dr . Mohamed Ahmed Ebrahim

Benha University
Faculty of Engineering at Shoubra
Electrical Engineering Dept.

Ameeria Integrated
Technology Education Cluster

Undergraduate Course

Renewable Energy Systems

Dr. Mohamed Ahmed Ebrahim

E-mail: mohamed.mohamed@feng.bu.edu.eg

Web site: http://bu.edu.eg/staff/mohamedmohamed033

Lecture (1)

Dr . Mohamed Ahmed Ebrahim

Content

1. *Introduction to renewable energy systems.*
2. *Solar thermal and photovoltaic systems.*
3. *Photovoltaic array systems.*
4. *Wind power systems.*
5. *Faults on renewable energy systems.*
6. *Renewable energy systems efficiency and maintenance.*
7. *Renewable energy systems codes and standards.*

Dr . Mohamed Ahmed Ebrahim

Introduction

Dr . Mohamed Ahmed Ebrahim

What is the Meaning of Energy?

- Energy is the amount of force or power when applied can move an object from one position to another.

- Energy defines the capacity of a system to do work.

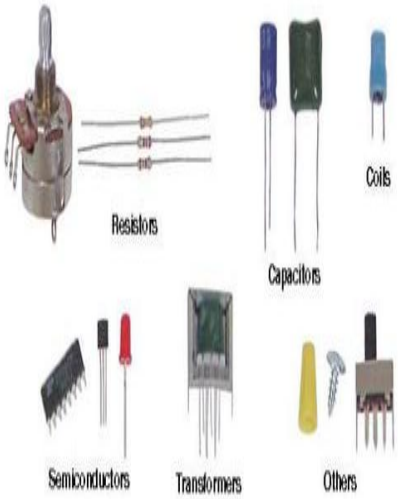
- Energy are broadly classifies into two main types:

- Renewable Energy - Non Renewable Energy

Energy Applications

Energy Uses

- Electronics
- Transportations
- Heat
- Computers
- Communications

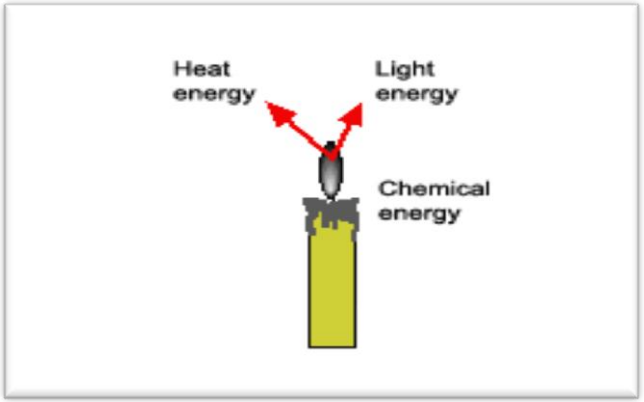


Dr . Mohamed Ahmed Ebrahim

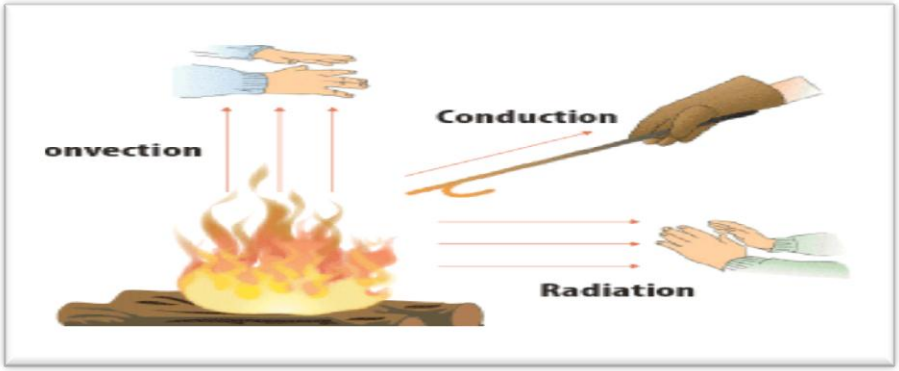
Common Forms of Energy

The most common forms of energy:

1- Chemical energy.



2- Thermal energy.



3- Kinetic energy.

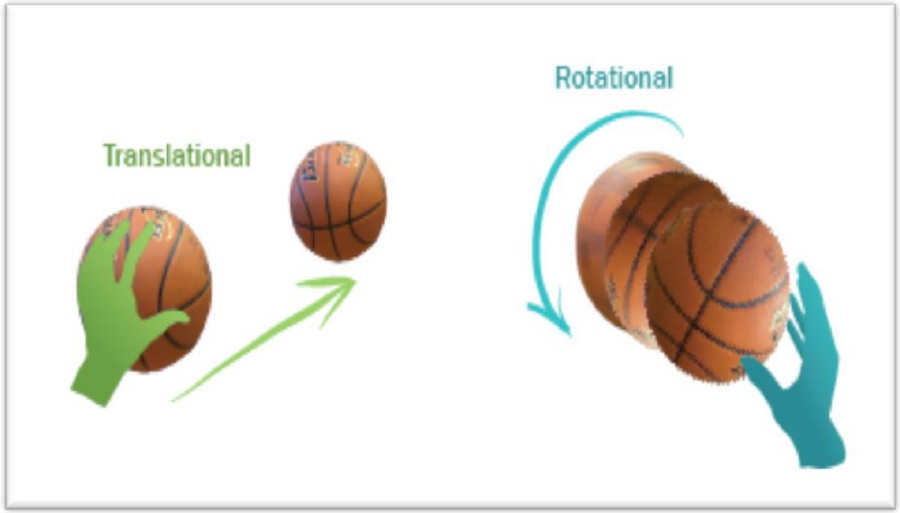
Dr . Mohamed Ahmed Ebrahim

Continue

4- Nuclear energy.

5- Solar energy.

6- Rotational Energy



Dr . Mohamed Ahmed Ebrahim

Electricity Changes Life style

Dr . Mohamed Ahmed Ebrahim

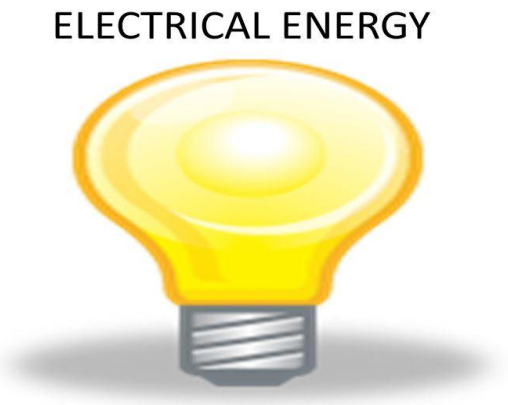
Five key questions

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?

Dr . Mohamed Ahmed Ebrahim

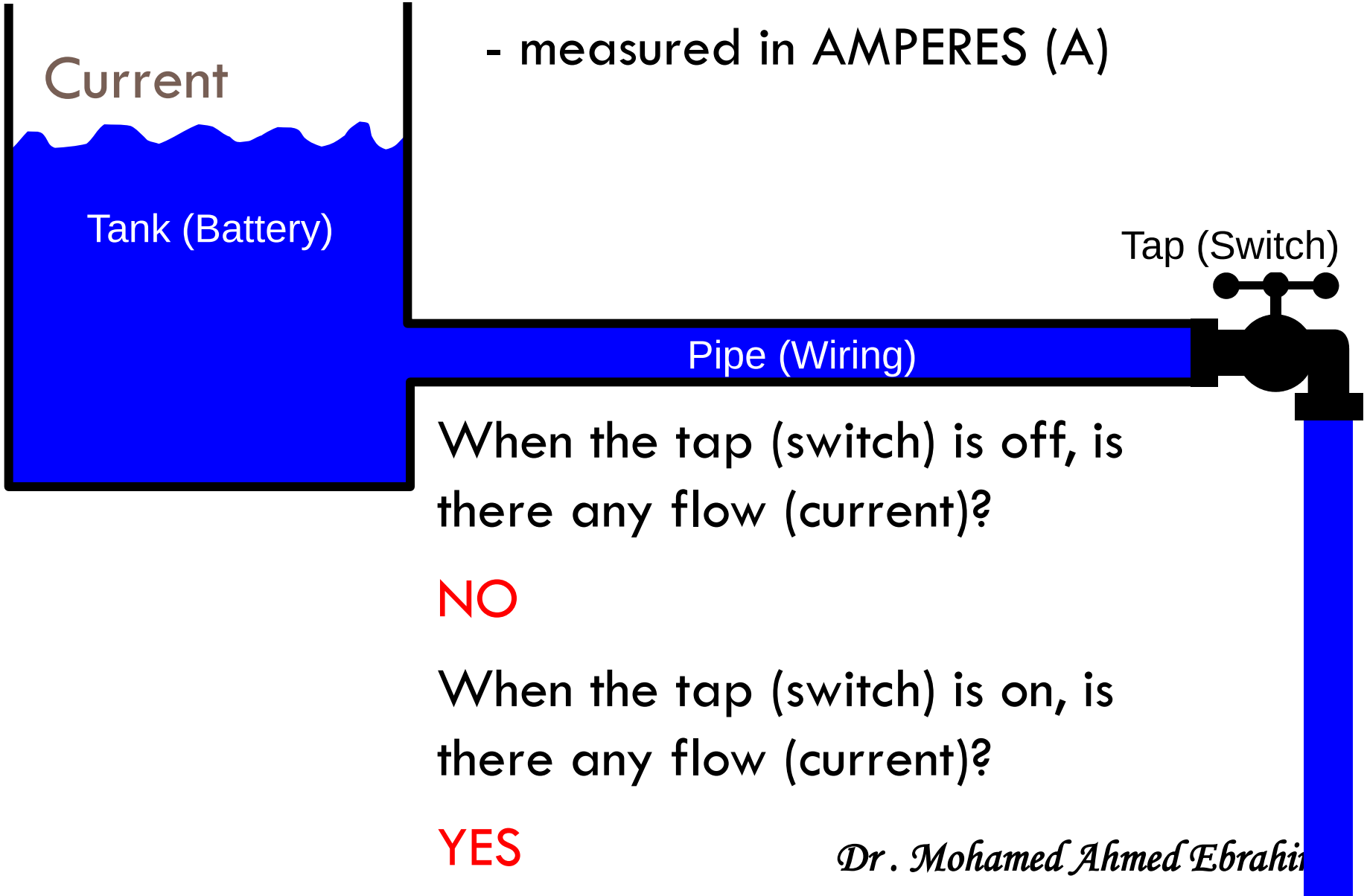
1. What is the electric energy?

- 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.



The flow of electric charge

- measured in AMPERES (A)



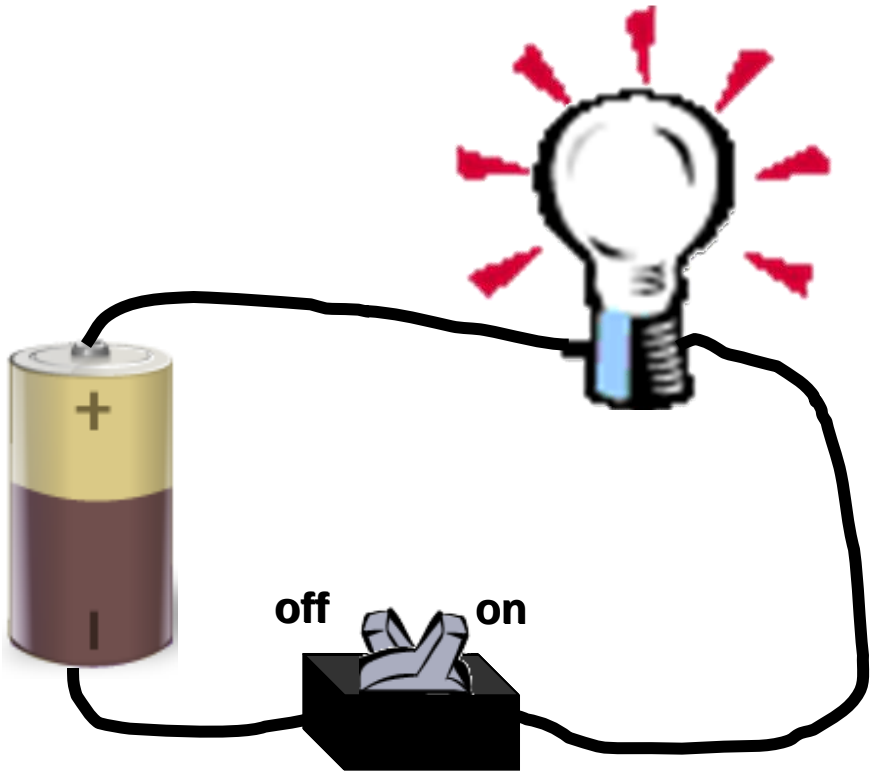
When the tap (switch) is off, is there any flow (current)?

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.

Dr . Mohamed Ahmed Ebrahim

Dr . Mohamed Ahmed Ebrahim

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.

Continue

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.

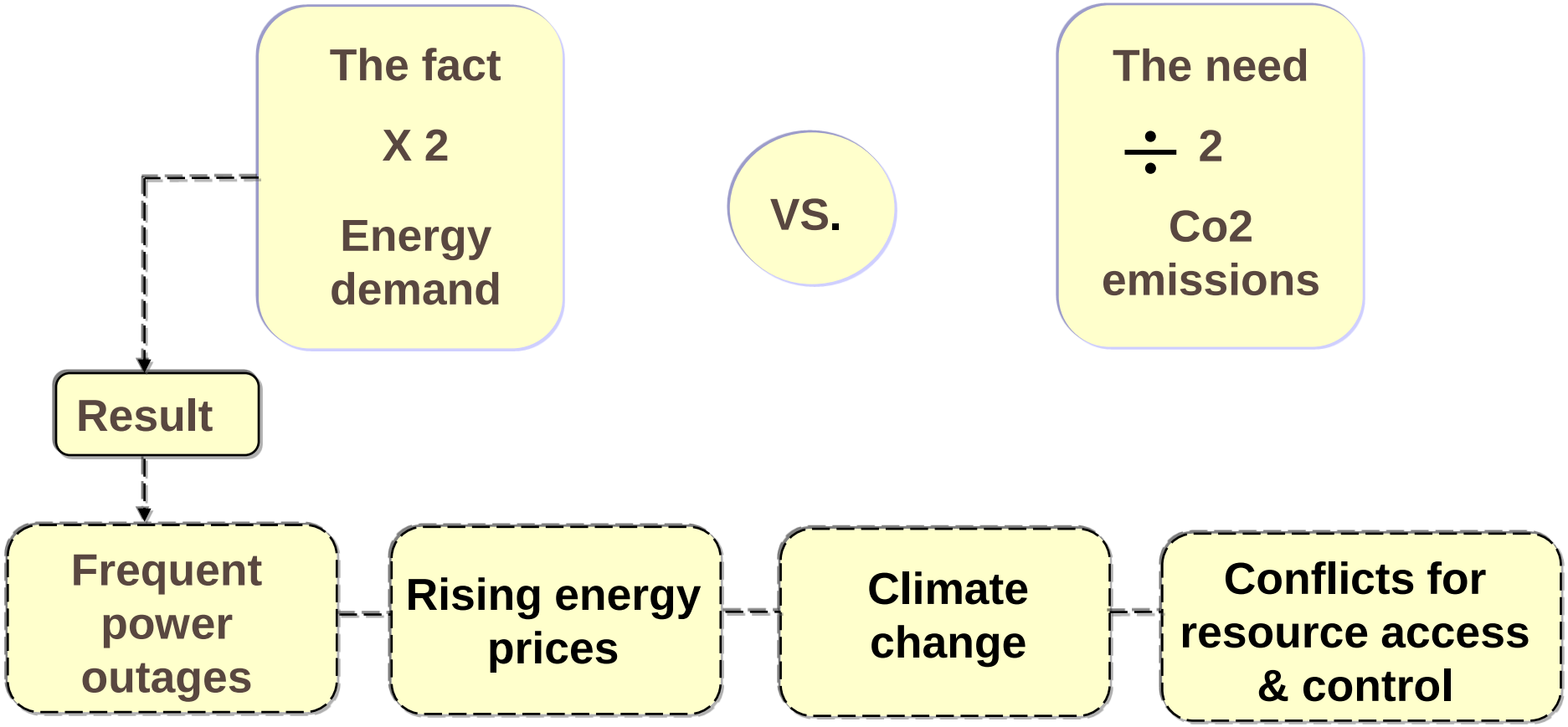
Edison used his DC generator to provide electricity to light his laboratory and later to illuminate the first New York street to be lit by electric lamps, in September 1882. Edison's successes were not without controversy, however - although he was convinced of the merits of DC for generating electricity, 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!!!!!!!!!!

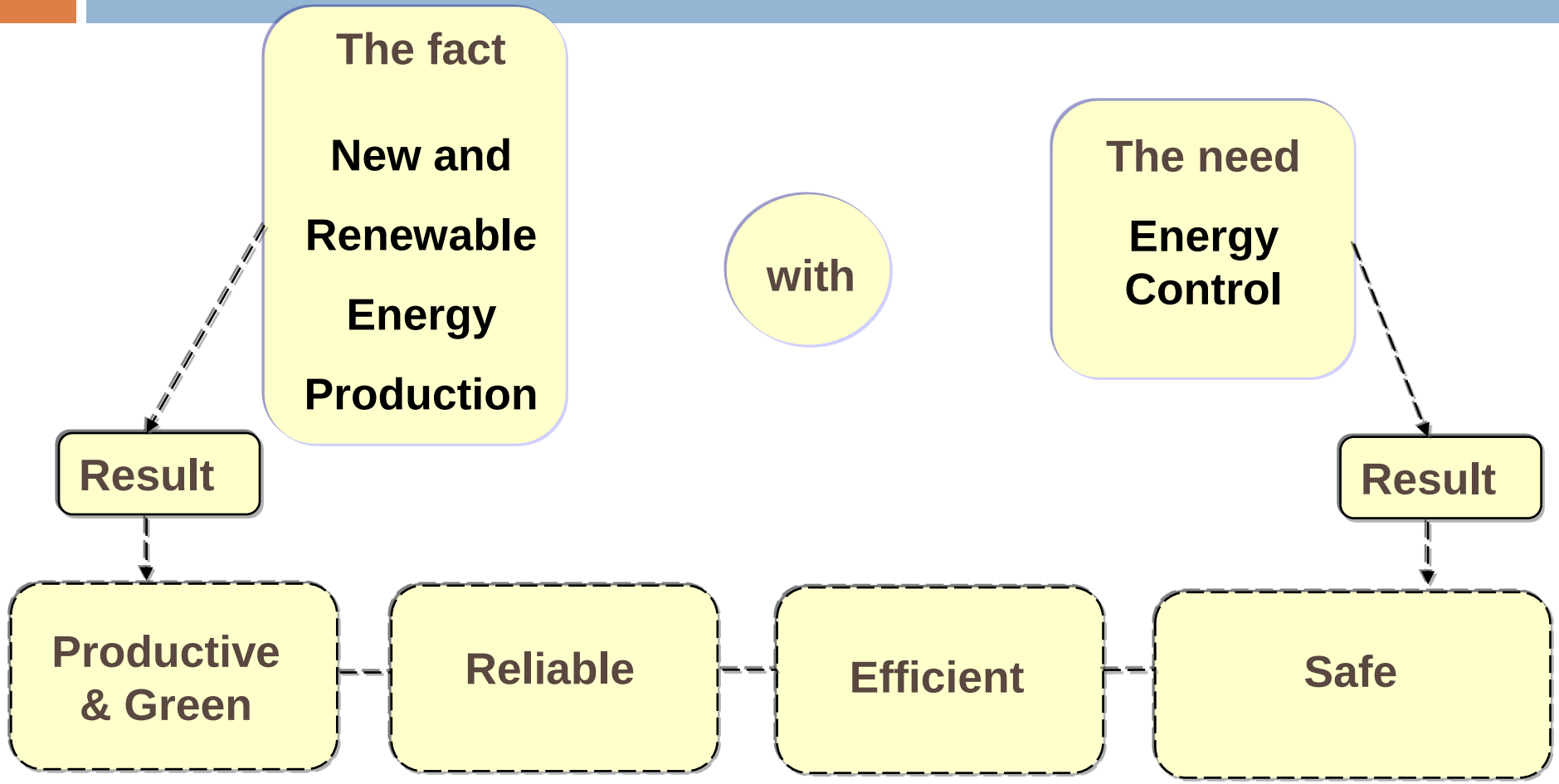
Dr . Mohamed Ahmed Ebrahim

Example: Energy Dilemma



Dr . Mohamed Ahmed Ebrahim

Proposed Solution



Dr . Mohamed Ahmed Ebrahim

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 favours 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

Dr . Mohamed Ahmed Ebrahim

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.

Dr . Mohamed Ahmed Ebrahim

Continue

1. **Non-Renewable Energy**

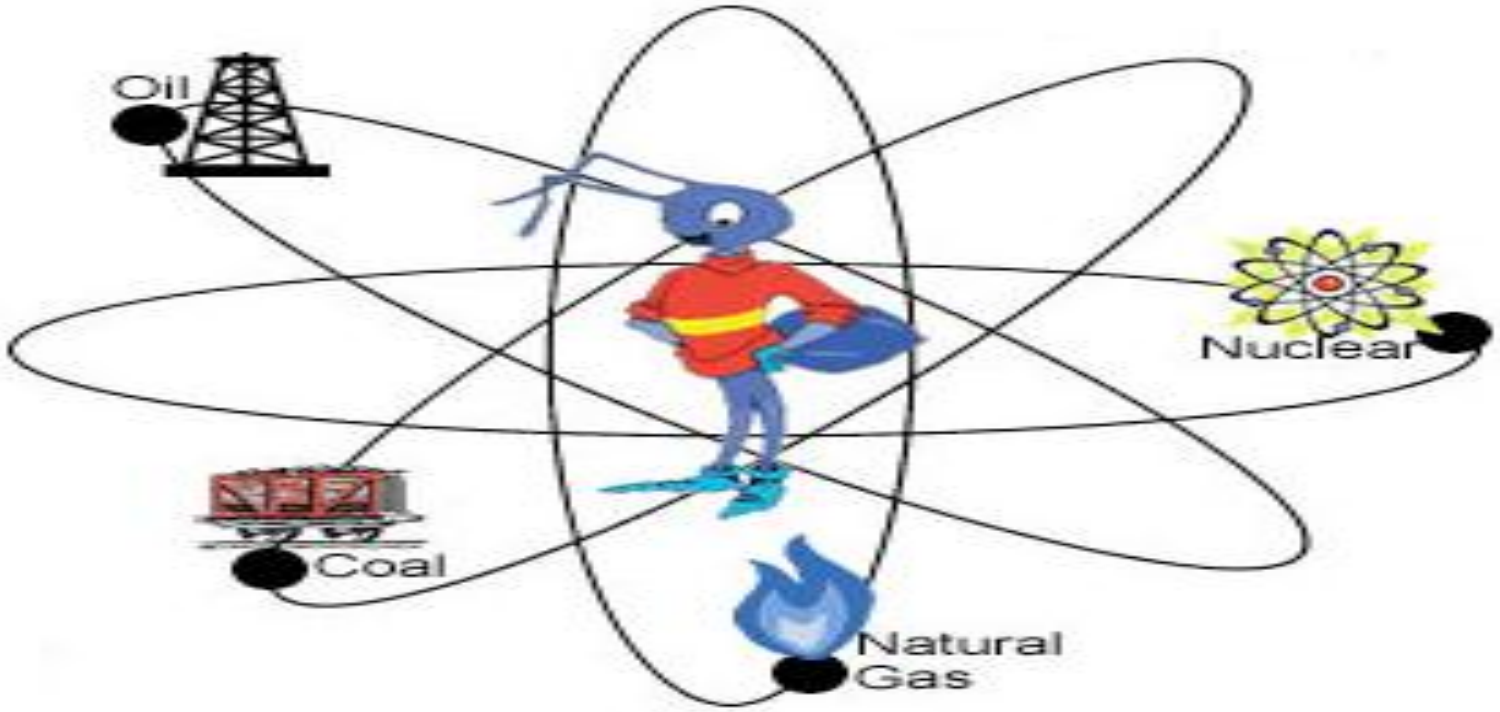
- Sources are not environmental friendly and can have serious affect on our health.

- 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.

Continue

- **Main Types of Non-Renewable Energy**



Continue

- **Advantages of Non Renewable Sources**

1. Non-renewable sources are cheap and easy to use (we can easily fill up car tank, power motor vehicle).
2. Use small amount of nuclear energy to produce large amount of power.
3. Non-renewable sources considered as cheap when converting from one type of energy to another.

Continue

- **Disadvantages of Non Renewable Sources**

1. Non-renewable sources will expire some day.
2. The speed at which such resources are being utilized can have serious environmental changes.
3. Non-renewable sources release toxic gases in the air when burnt which are the major cause for global warming.
4. Since these sources are going to expire soon, prices of these sources are soaring day by day.

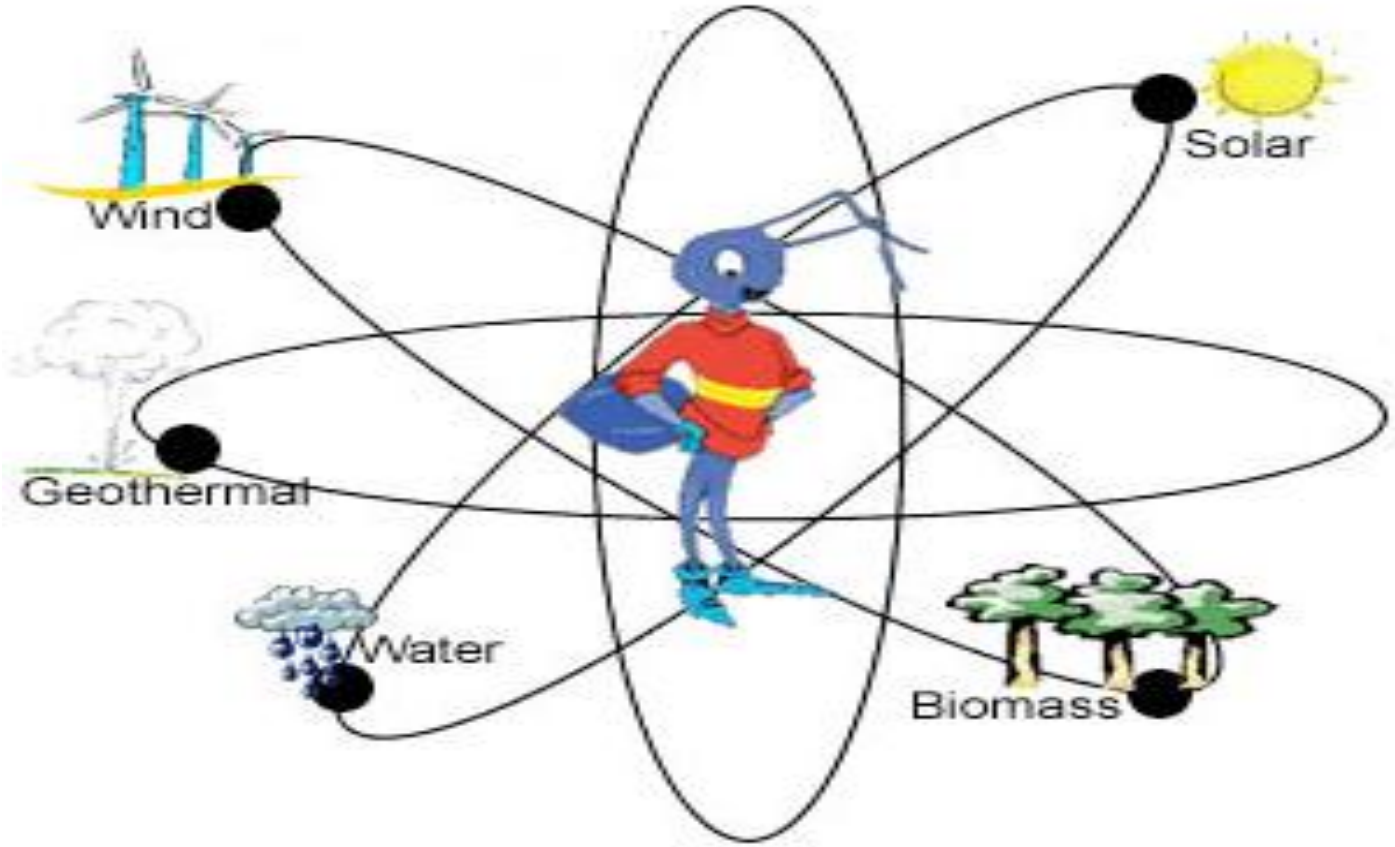
Continue

2. **Renewable Energy**

- 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.

Continue

- **Main Types of Renewable Energy**



Continue

- **Advantages of Renewable Sources**

1. The sun, wind, geothermal, ocean energy are available in the abundant quantity and free to use.
2. Renewable sources can cost less than consuming the local electrical supply and boost the economy.
3. Renewable sources have low carbon emissions, therefore they are considered as green and environment friendly.
4. Avoid the high costs involved in transmission.
5. Avoid the distribution losses.

Continue

- **Disadvantages of Renewable Sources**

1. It is not easy to set up a plant as the initial costs are quite steep, and high maintenance cost.
2. Solar energy can be used during the day time and not during night or rainy season.
3. Large land area is required for the installation of its power plant.
4. Geothermal energy can bring toxic chemicals beneath the earth surface onto the top and can create environmental changes.
5. Building dams for hydroelectric across the river which is quite expensive can affect natural flow and affect wildlife.

Problem Definition

1- Renewable energy resource is a highly variable power source, and there are several methods of characterizing this variability.

A. The most common method is the power duration curve.

B. Another method is to use a statistical representation.

2- In the power system the objective is to generate and deliver power as ***economically*** and ***reliable*** as possible while ***maintaining the voltage and frequency within permissible limits***

What about the concept of smart grid?

Source: European Technology Platform SmartGrids

Smart Grid Definition

- A smart grid is a modern electric system.
- It uses communications, sensors, automation and computers to improve the flexibility, security, reliability, efficiency, and safety of the electricity system.
- It offers consumers increased choice by facilitating opportunities to control their electricity use and respond to electricity price changes by adjusting their consumption.

What can Edison say about the electricity today?

Dr . Mohamed Ahmed Ebrahim

Present Energy Resources

- **Fossil fuels**

are a finite source of energy that tend to release greenhouse gases as they are burned.

- **Nuclear power**

is power that utilizes the intense energy stored in atoms.

- **Renewable energy**

refers to energy from non-depletable sources such as solar, wind, and geothermal.

Activity

Before extensive talking about renewable energy, I will ask you some questions.

1. What are the current and projected Egypt energy (fuel + electricity) demands ?
2. How is the demand for electricity currently being generated and what about the future?
3. What contribution can renewable energy make to future fuel and electricity needs?