



Benha University

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Postgraduate (Pre-master) Course



Generation of Electrical Power from Renewable Resources

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Syllabus

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• **Introduction.**

2

• **SOLAR PHOTOVOLTAIC POWER SYSTEM.**

3

• **SOLAR THERMAL POWER SYSTEM.**

4

• **WIND POWER SYSTEM.**

5

• **ENERGY STORAGE SYSTEMS.**

6

• **STAND-ALONE SYSTEM.**

7

• **GRID-CONNECTED SYSTEM.**

Engineering Definition

What is Engineering?

Engineering is the application of math and science by which properties of matter and the sources of energy in nature are made useful.



*Electricity
Changes
Life style*

Six key questions

What is the electrical energy?

How do we produce electric energy?

Why do we think the electrical energy is important?

What are the resources of electrical energy?

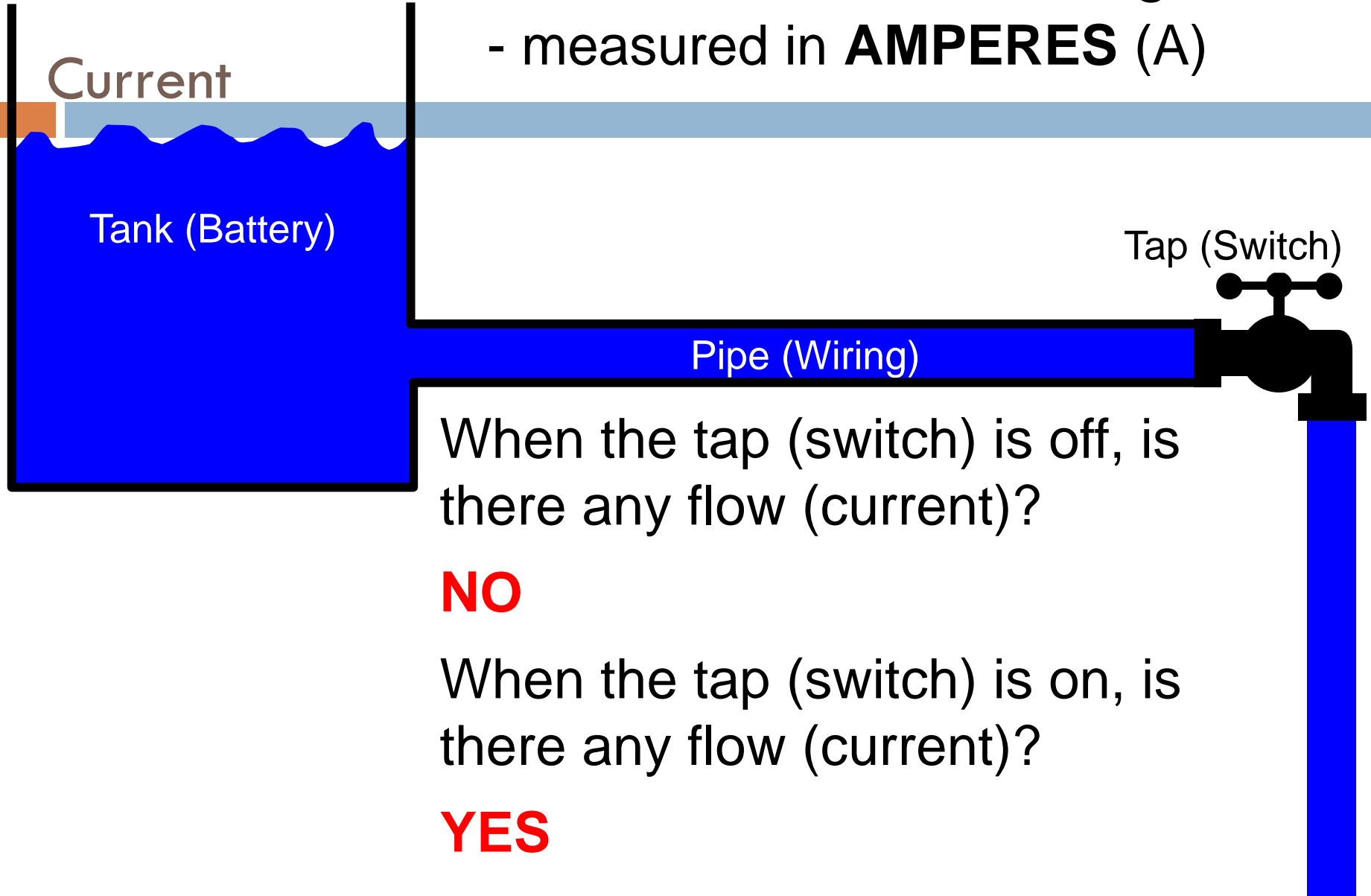
What about renewable energy resources?

What about the concept of smart grid?

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)**



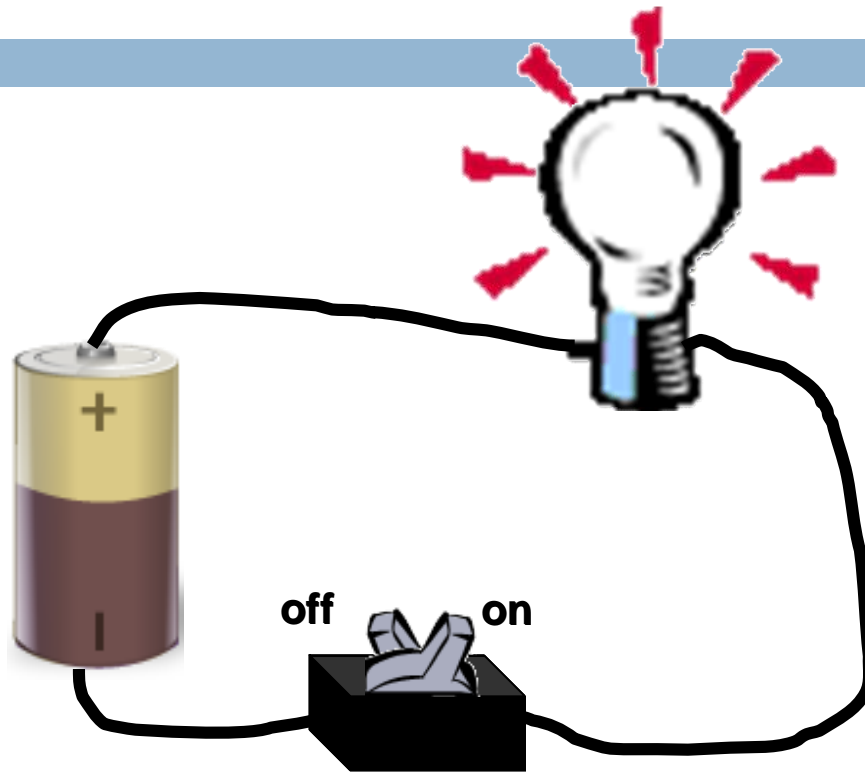
When the tap (switch) is off, is there any flow (current)?

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.



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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.

Edison and Swan...continued

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.

Electric energy changes the life style

- *We can say that the electric energy is the source of life*
- *Imagine life without electricity!!!!!!!!!!!!*



Classification of electrical energy resources

Electric energy resources can be classified as

According to its nature

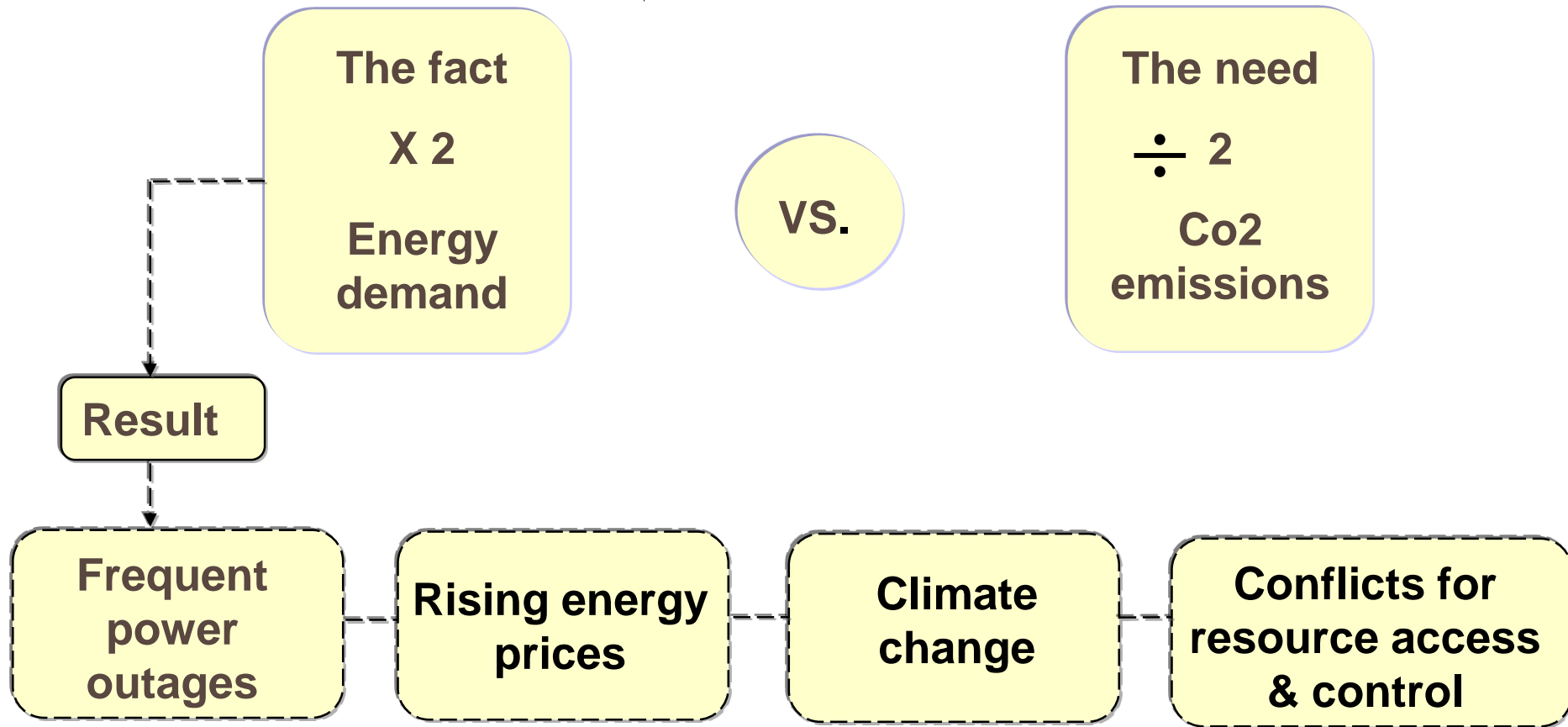
Non-renewable

Renewable

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



Example: Energy Dilemma



Proposed Solution

The fact
New and
Renewable
Energy
Production

with

The need
Energy
Control

Result

Result

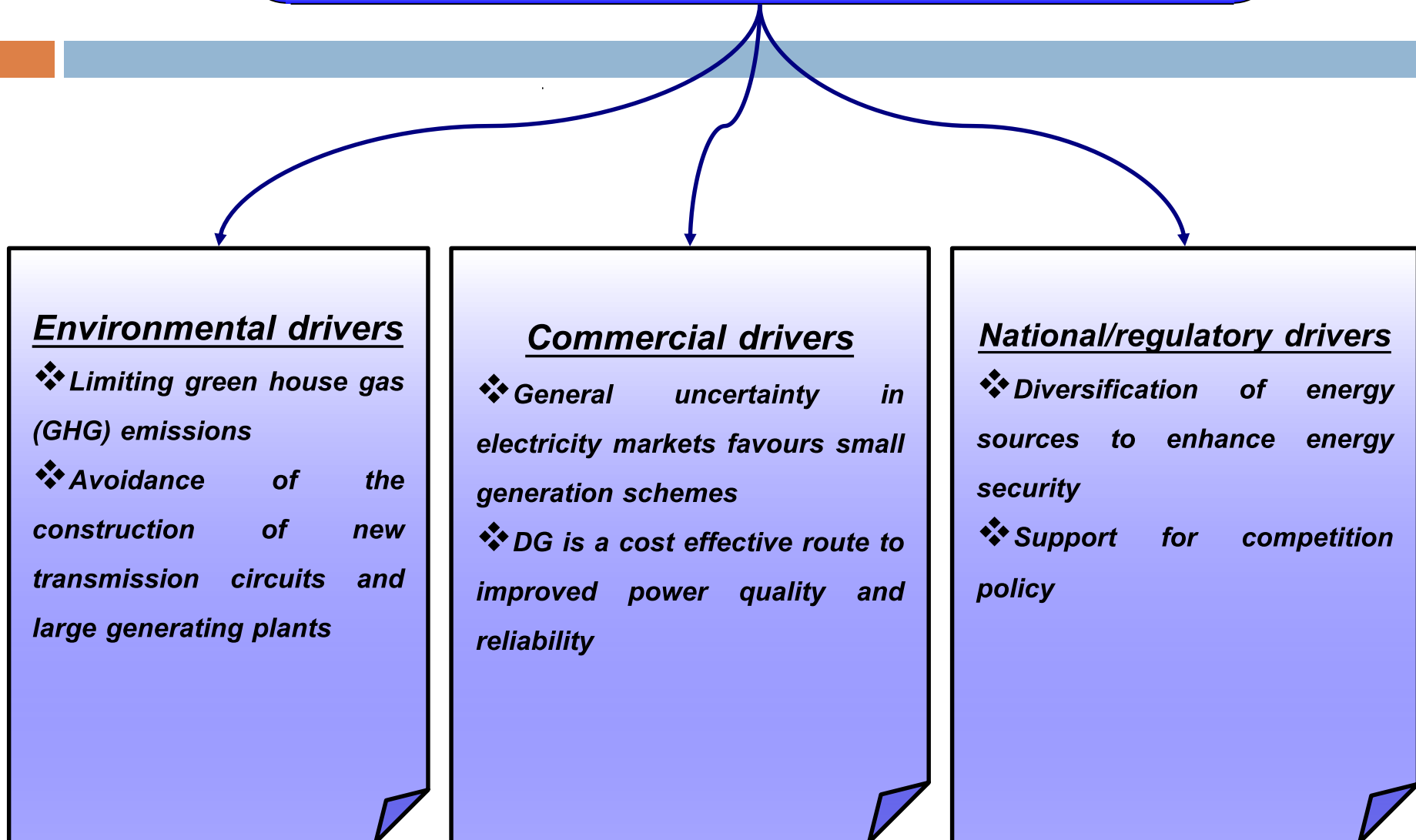
Productive
& Green

Reliable

Efficient

Safe

Classifications of main drivers behind the focus on renewable energy



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?

THE 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.

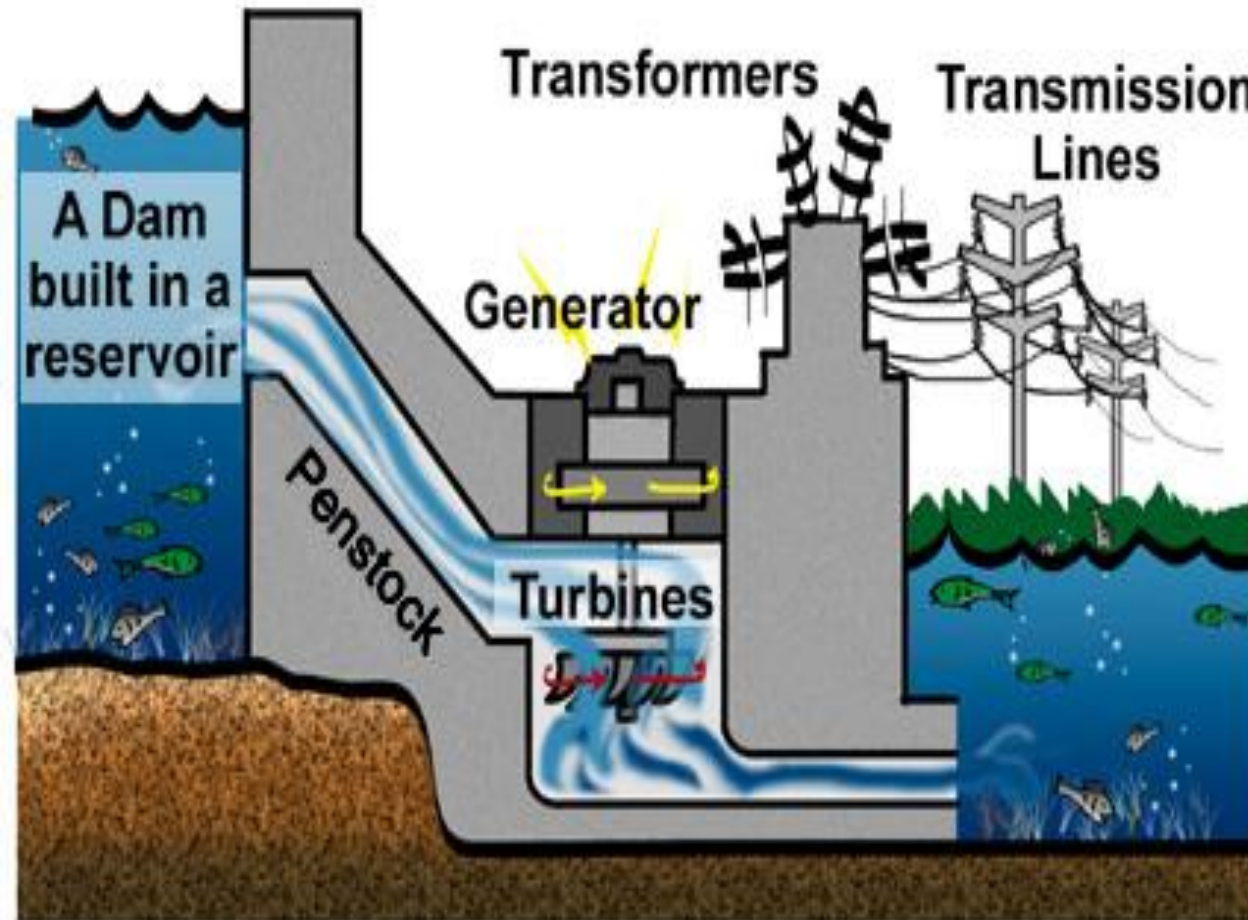
What can Edison say about the electricity today?





Types Of Power Plants

Hydroelectric Power Plants



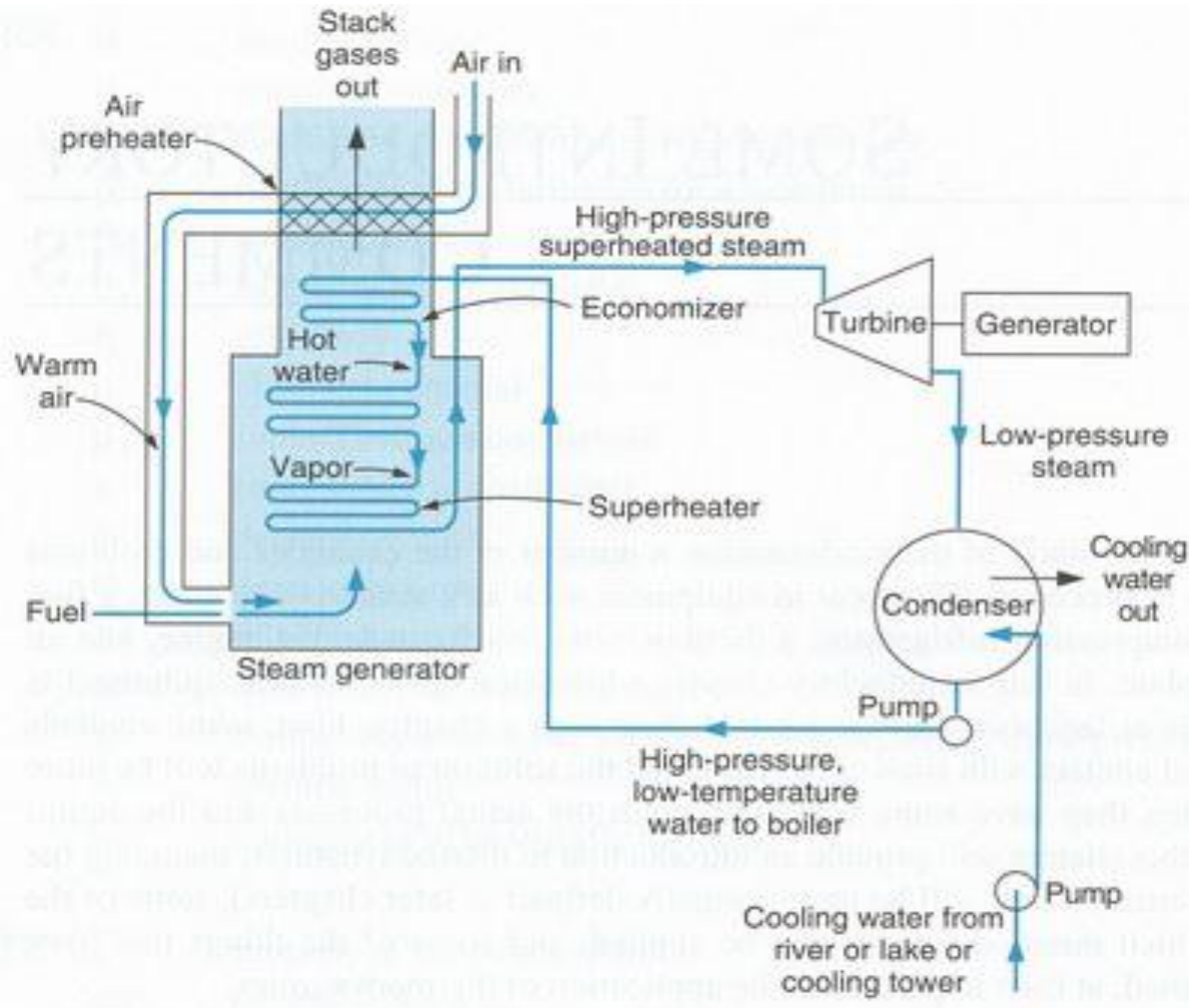
□ Theory of Operation

Hydroelectric Power Plants

- **Advantages of hydroelectric power plant**
- **Disadvantages of hydroelectric power plant**



Steam Power Plants



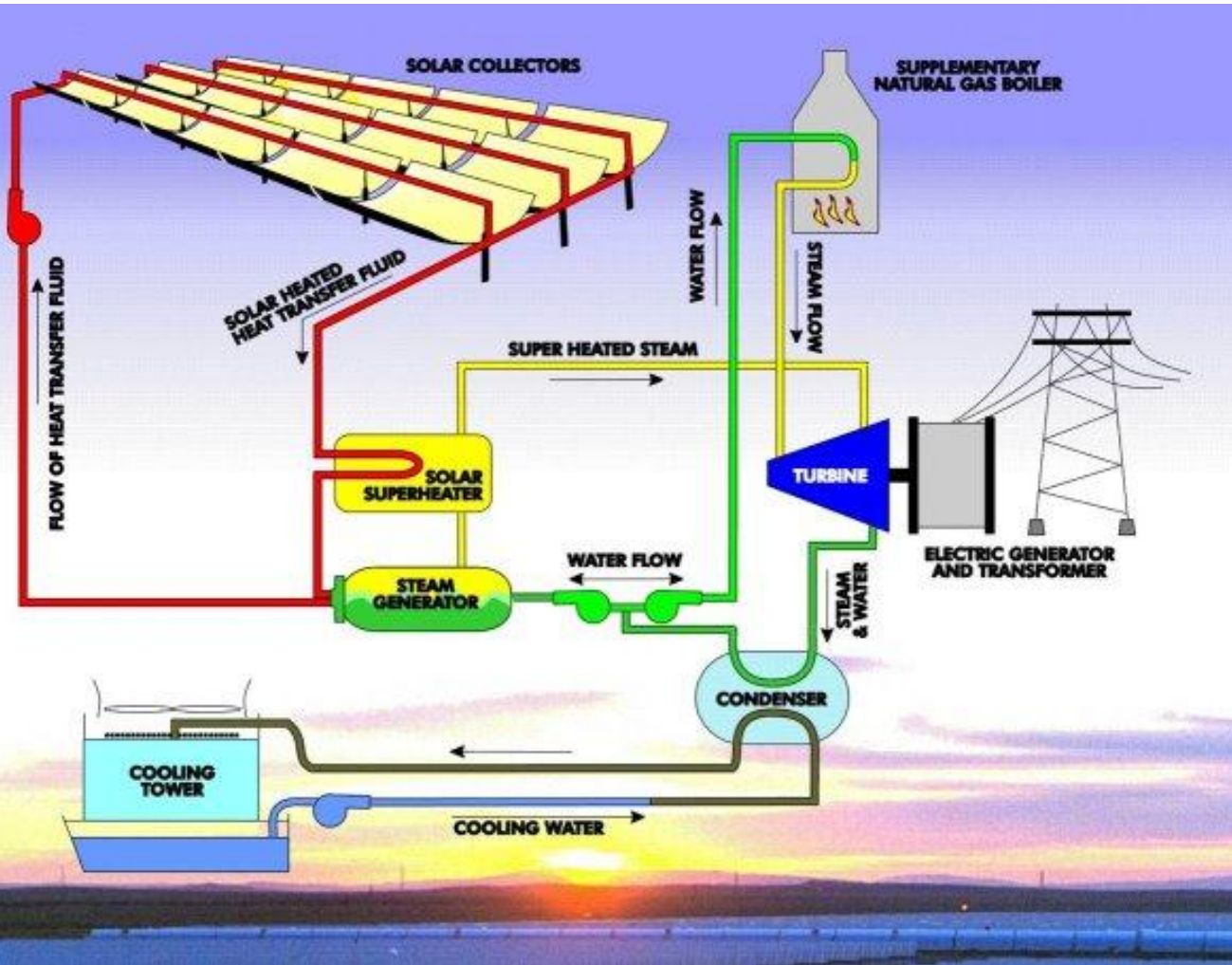
□ Theory of Operation

Steam Power Plants

- **Advantages of Steam Power Plants**
- **Disadvantages of Steam Power Plants**



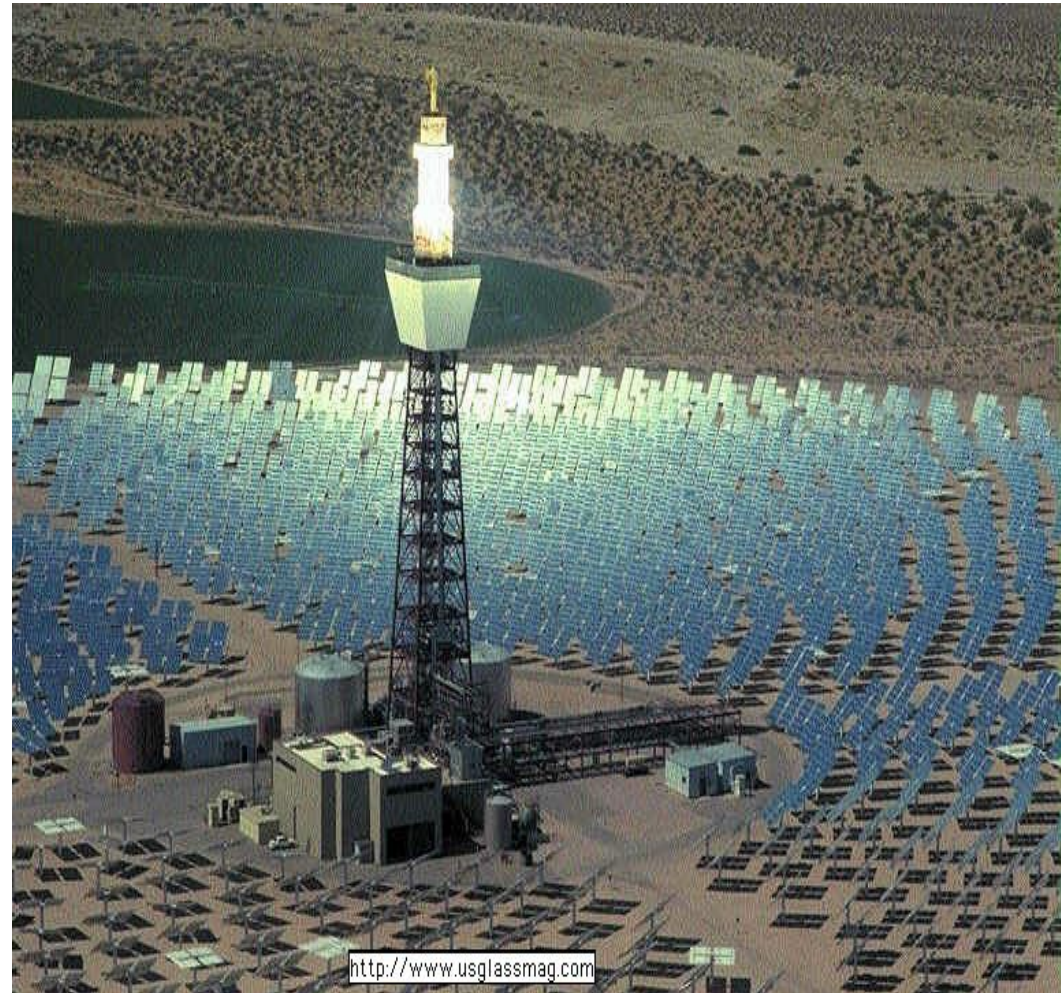
Solar Power Plants



□ Theory of operation

Solar Power Plants

- Advantages of Solar Power Plants
- Disadvantages of Solar Power Plants



Diesel Power Plants



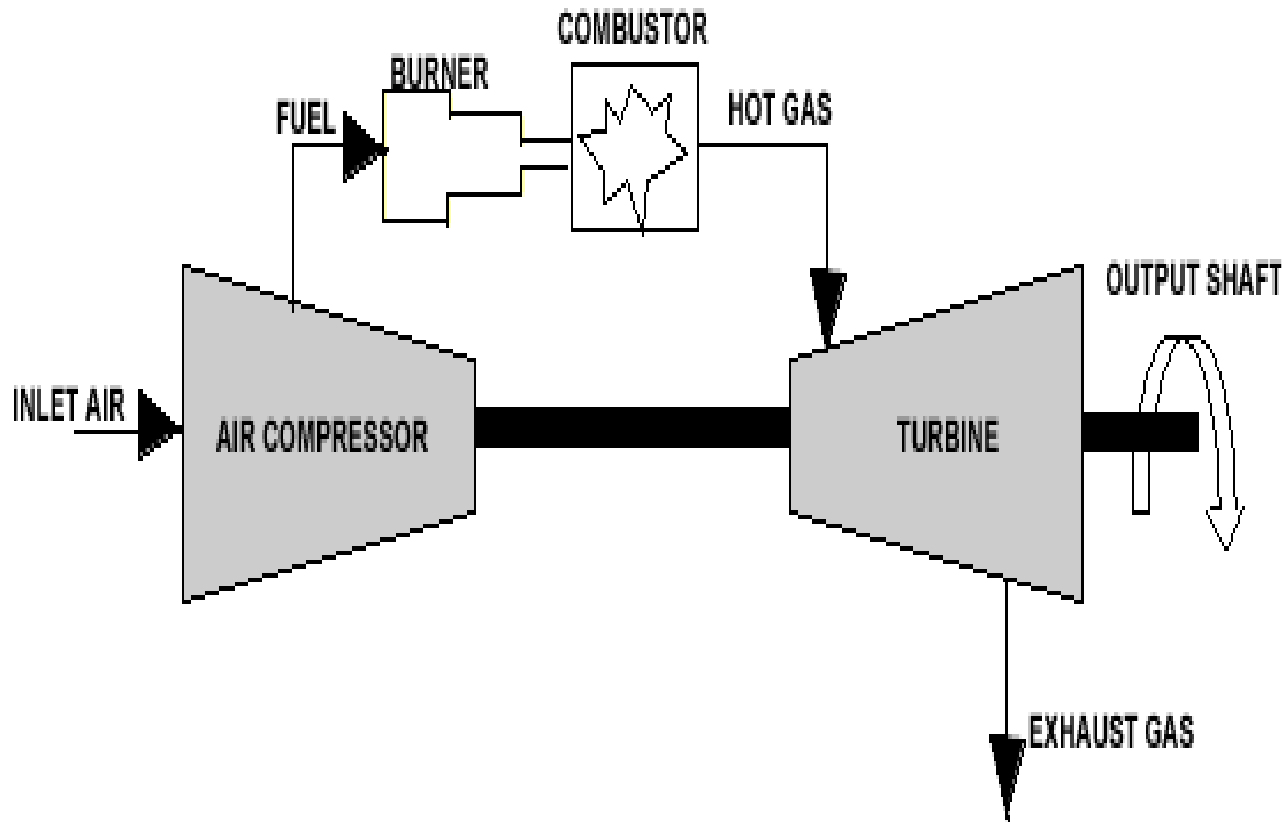
- **Theory of Operation**

Diesel Power Plants

- **Advantages of Diesel Power Plants**
- **Disadvantages of Diesel Power Plants**



Gas turbine Power Plants

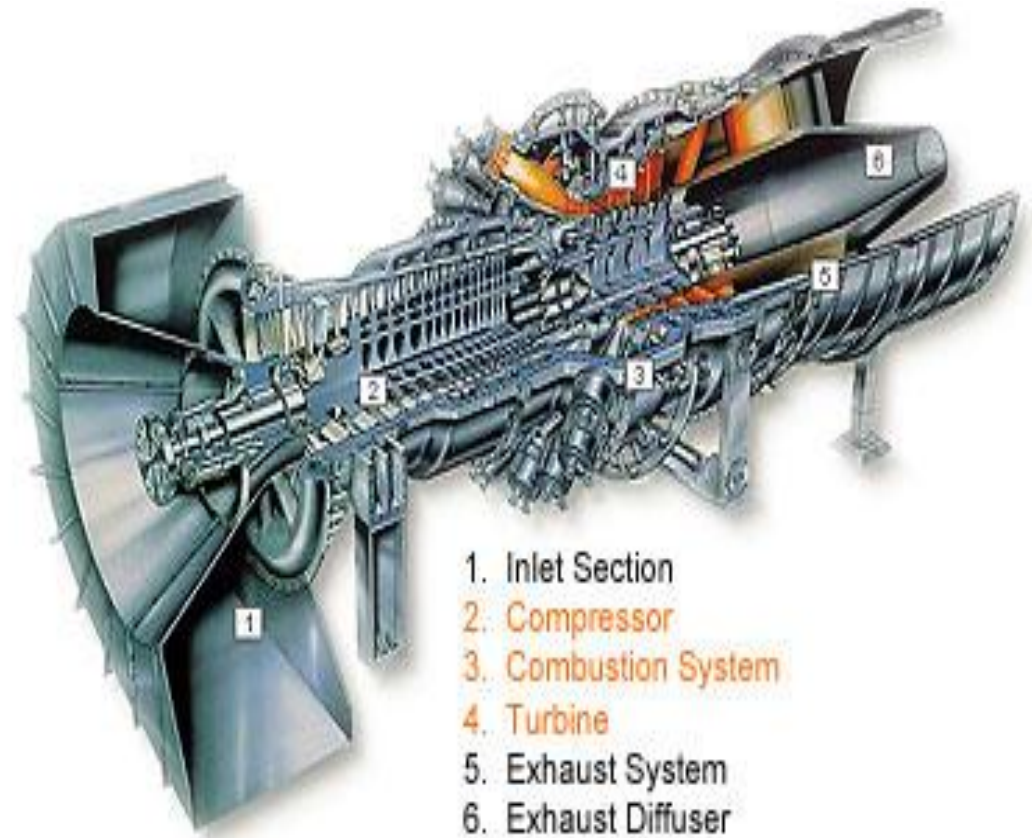


□ Theory of operation

DIAGRAM OF TYPICAL LARGE GAS TURBINE

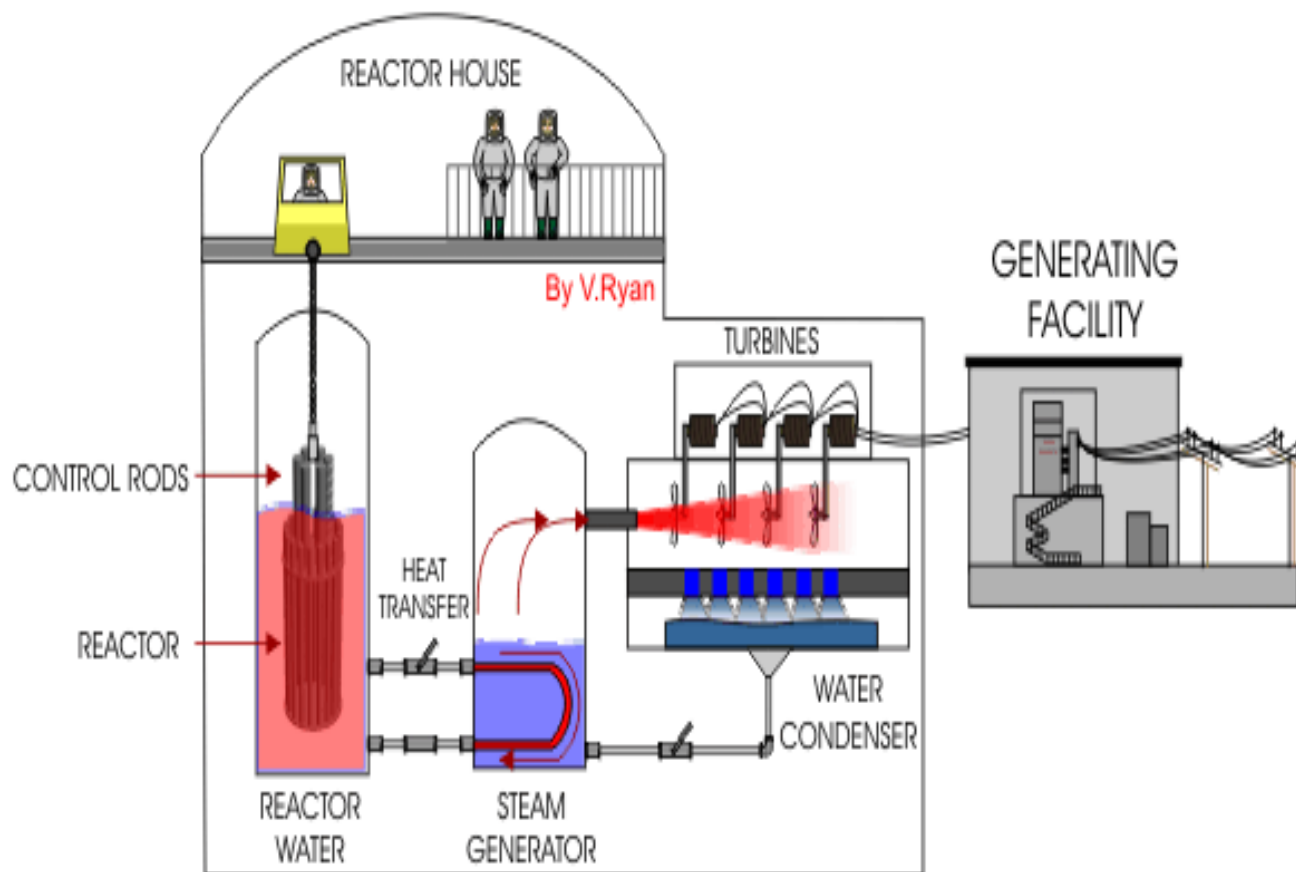
Gas turbine Power Plants

- Advantages of Gas-turbine Power Plants
- Disadvantages of Gas-turbine Power Plants



Courtesy of Siemens Westinghouse

Nuclear Power Plants



□ Theory of Operation

Nuclear Power Plants

- **Advantages of nuclear power plant**
- **Disadvantages of nuclear power plant**



Thank You
For Your Attention



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