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Modeling and Simulation of Different and Hybrid Renewable Energy Systems "

**Proposal for Thesis Research in Partial Fulfillment
Of the Requirements for the Degree of Doctor of Philosophy in
Electrical Power and Machines Engineering**

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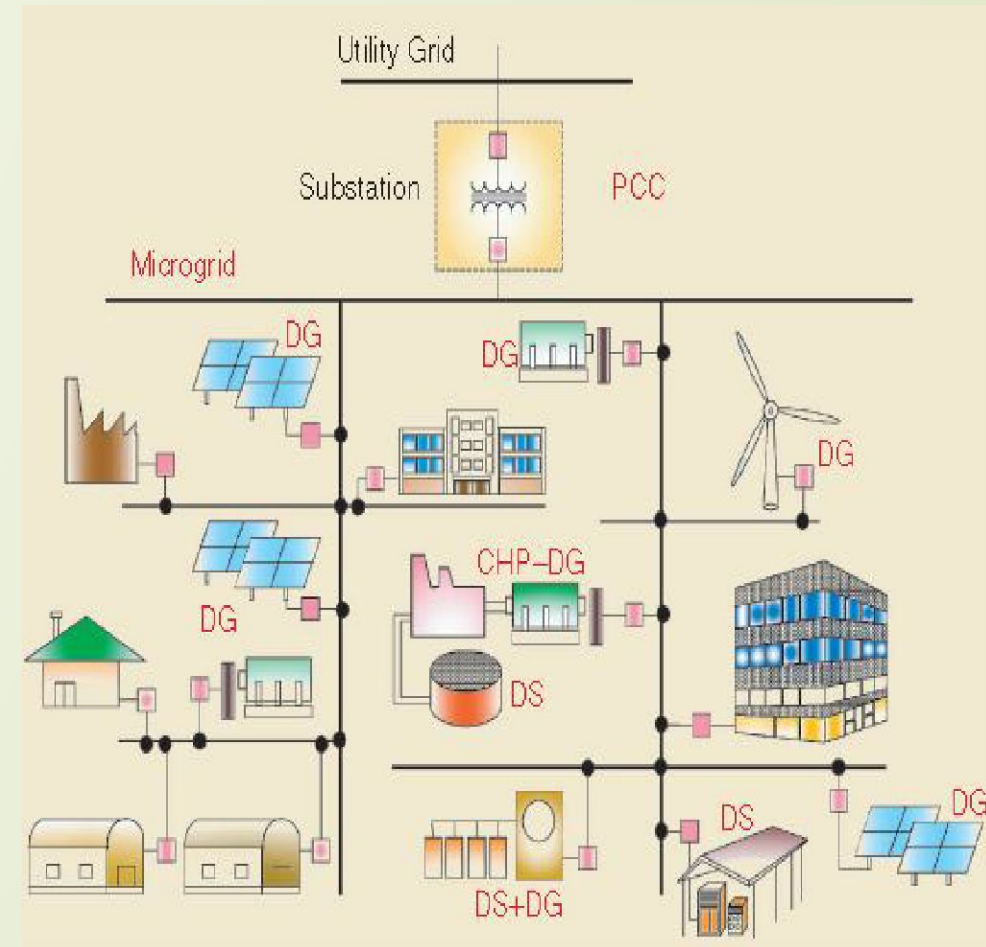
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Introduction

- Renewable energy integration and energy management are the major challenges for developers and professionals of the smart grid in addition to Renewable energy is a promising option for electricity generation [1].
- "Hybrid Renewable Energy Systems (HRES) consist of two or more energy sources, with at least one of them renewable and integrated with power control equipment and an optional storage system [2]."
- Recently, the studies on HRES are in terms of modeling, sizing and performance, while the studies based on integrating these systems into the smart grid are limited. Therefore, it was very important to study the integration of HRES into smart grid for the sustainable development.



Problem Statement

- The smart grid has recently started receiving great interest from various government organizations globally. Therefore, the smart grid and its applications are the focus of interest in this proposal, especially in the field of renewable energy generation. In addition to, a proposed model of a hybrid renewable energy system (HRES) off grid and integrated with the grid is taken as study.



The World currently relies heavily on Fossil fuel (coal, oil (and Natural gas

Fossil fuel is:

- **Non-renewable (finite resources).**
- **Becoming too expensive.**
- **Have a high impact on environment.**

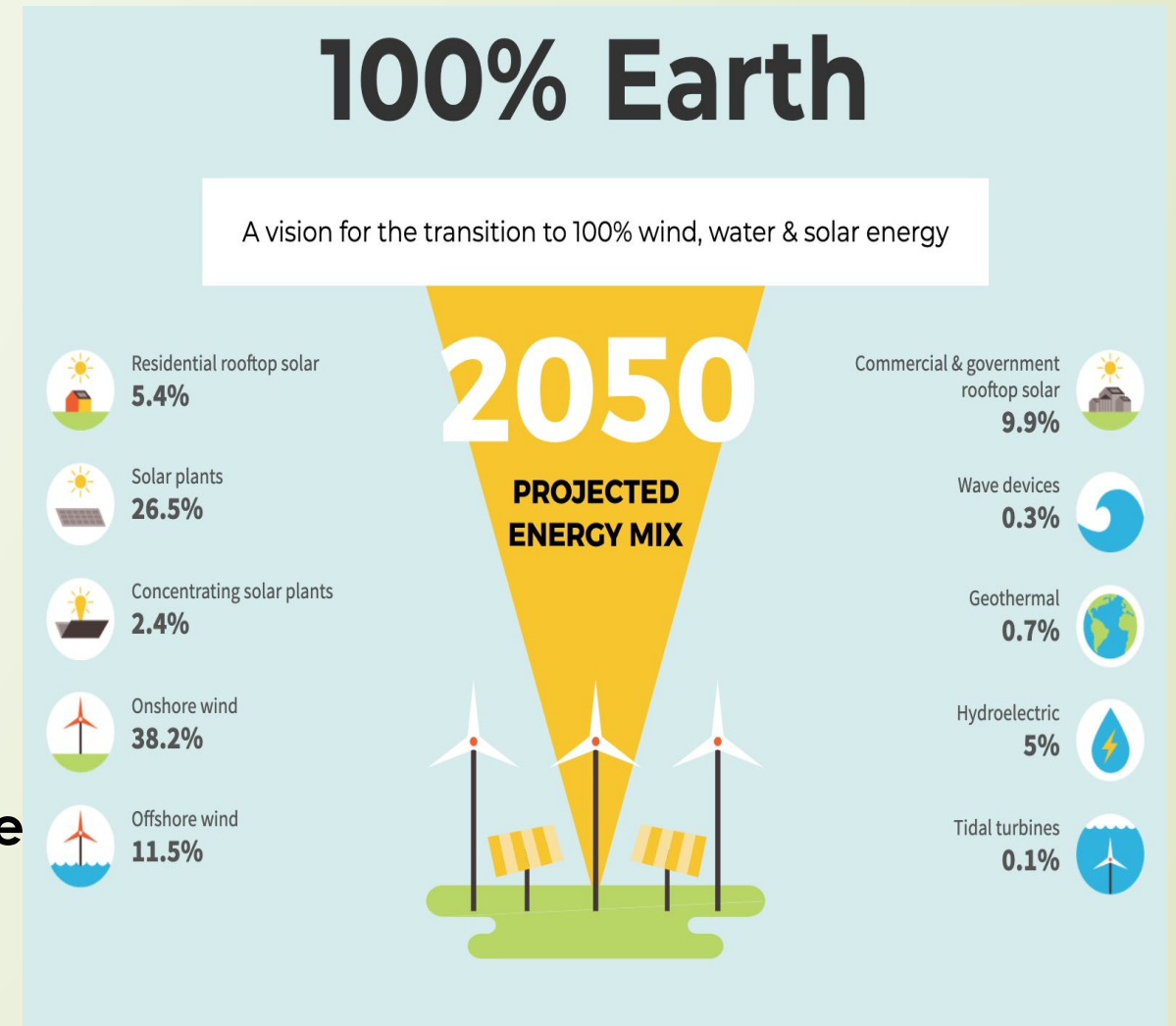
Renewable energies resources are:

- **Clean.**
- **Non-depleted.**
- **Have very small impact on environment**



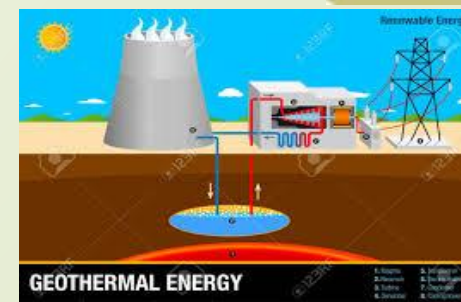
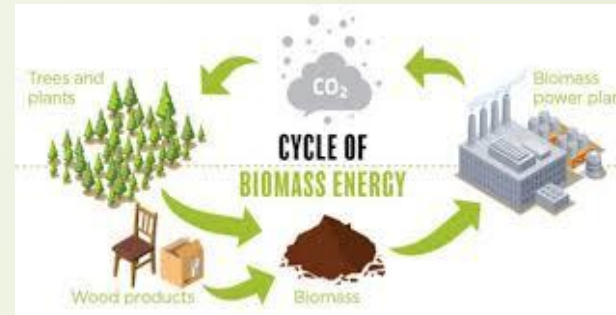
?What Is Renewable Energy

- Renewable energy is energy that has been derived from earth's natural resources that are not finite or exhaustible, such as wind and sunlight. Renewable energy is an alternative to the traditional energy that relies on fossil fuels, and it tends to be much less harmful to the environment.



Types of Renewable Energy resources

- ❑ Solar Energy
- ❑ Wind Energy
- ❑ Biomass Energy
- ❑ Fuel Cell
- ❑ Hydropower Energy
- ❑ Wave Energy
- ❑ Geothermal Energy



Solar Energy

- ❑ Is derived by capturing radiant energy from sunlight and converting it into heat, electricity, or hot water. Photovoltaic (PV) systems can convert direct sunlight into electricity using solar cells.



Types of Solar Systems

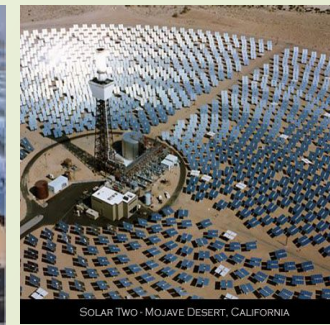
□ PV (Photovoltaic)

- 1) Thin Film
- 2) Polycrystalline
- 3) Monocrystalline



□ CSP (Concentrated Solar Power)

- 1) Parabolic Trough
- 2) Solar Towers
- 3) Dish Reflectors



Wind Energy

- ❑ Wind farms capture the energy of wind flow by using turbines and converting it into electricity.
- ❑ There are several forms of systems used to convert wind energy and each vary.
- ❑ Commercial grade wind-powered generating systems can power many different organizations, while single-wind turbines are used to help supplement pre-existing energy organizations.
- ❑ Another form is utility-scale wind farms, which are purchased by contract or wholesale.
- ❑ Technically, wind energy is a form of solar energy. The phenomenon we call “wind” is caused by the differences in temperature in the atmosphere combined with the rotation of Earth and the geography of the planet



Wind power plant designs

Vertical rotor shaft

Horizontal rotor shaft

Savonius rotor



Darrieus rotor



H rotor



Propeller rotor



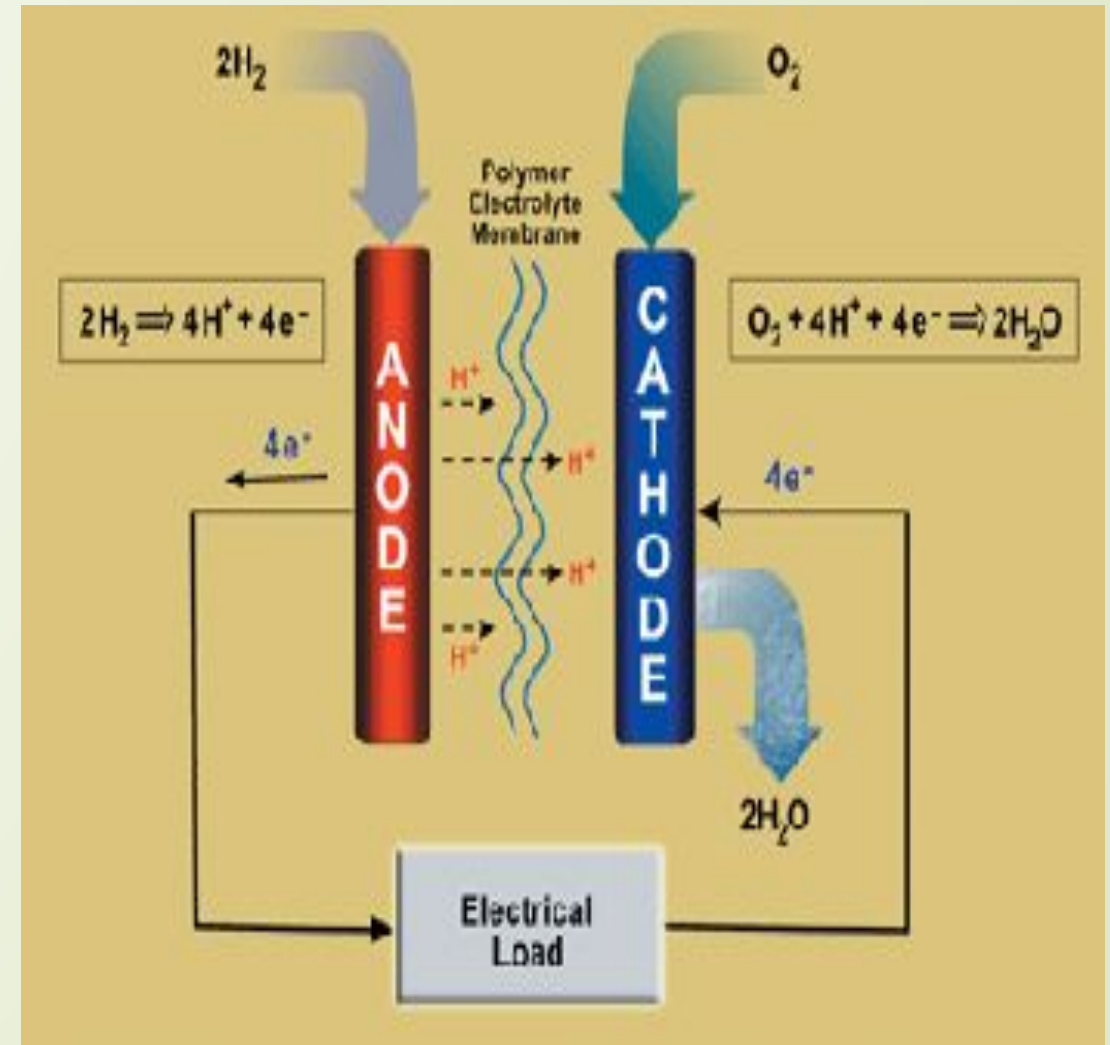
Biomass Energy

- ❑ Bioenergy is a renewable energy derived from biomass. Biomass is organic matter that comes from recently living plants and organisms.
- ❑ Using wood in your fireplace is an example of biomass that most people are familiar with.
- ❑ There are various methods used to generate energy using biomass.
- ❑ This can be done by burning biomass, or harnessing methane gas which is produced by the natural decomposition of organic materials in ponds or even landfills.



Fuel Cell

- fuel cell is an electrochemical energy conversion device. It produces electricity from external supplies of fuel (on the anode side) and oxidant (on the side).
- These react in the presence of an electrolyte.
- Generally, the reactants flow in and reaction products flow out while the electrolyte remains in the Fuel cell.
- cells cathode and operate virtually continuously if the necessary flows are maintained.



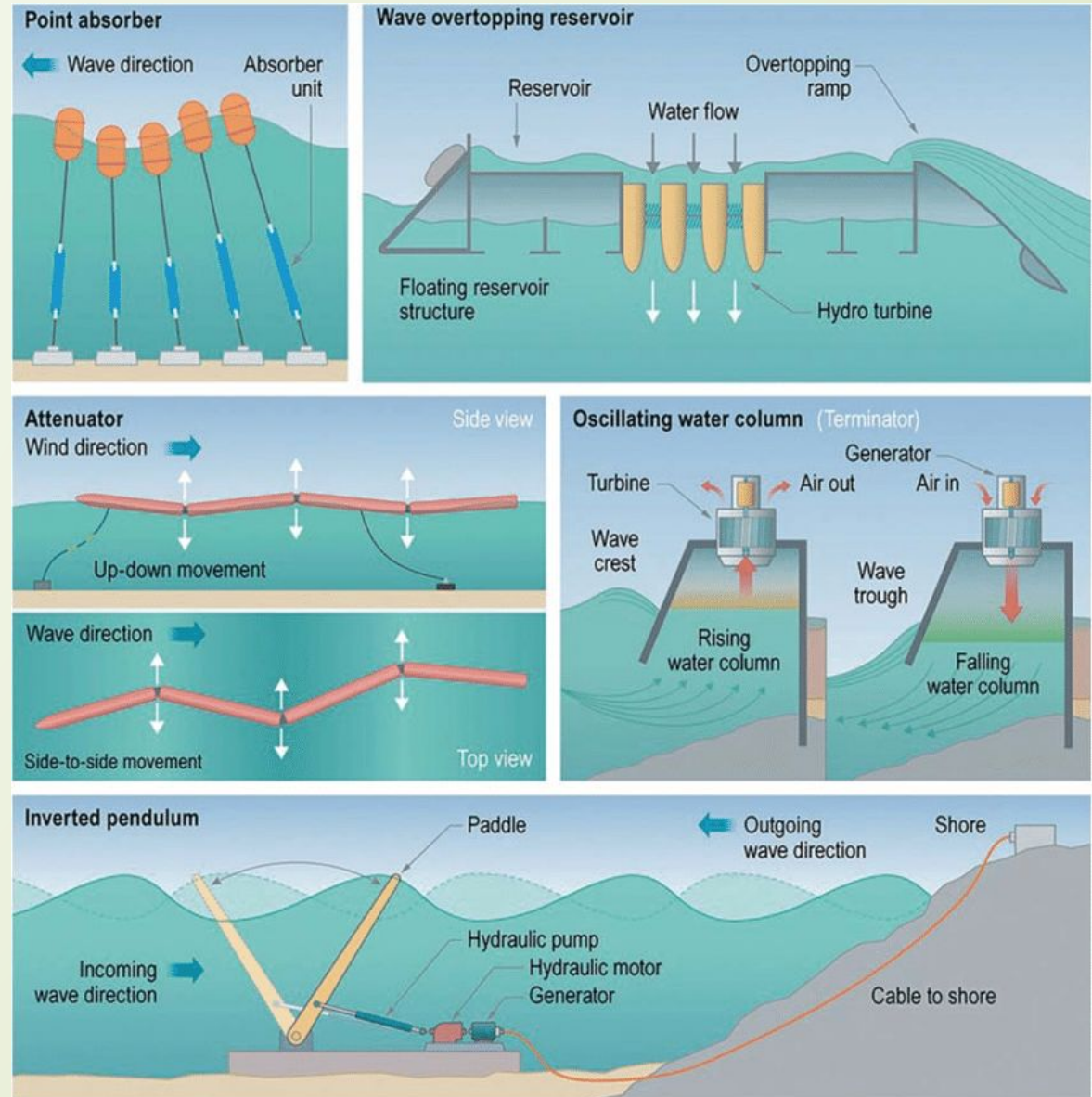
Hydropower Energy

- ❑ Dams are what people most associate when it comes to hydroelectric power.
- ❑ Water flows through the dam's turbines to produce electricity, known as pumped-storage hydropower.
- ❑ Run-of-river hydropower uses a channel to funnel water through rather than powering it through a dam.



Wave Energy

- ❑ Waves are generated by the wind as it blows across the sea surface. Energy is transferred from the wind to the waves.
- ❑ Wave energy is sometimes confused with tidal energy, which is quite different.
- ❑ Waves travel vast distances across oceans at great speed. The longer and stronger the wind blows over the sea surface, the higher, longer, faster and more powerful the sea is.



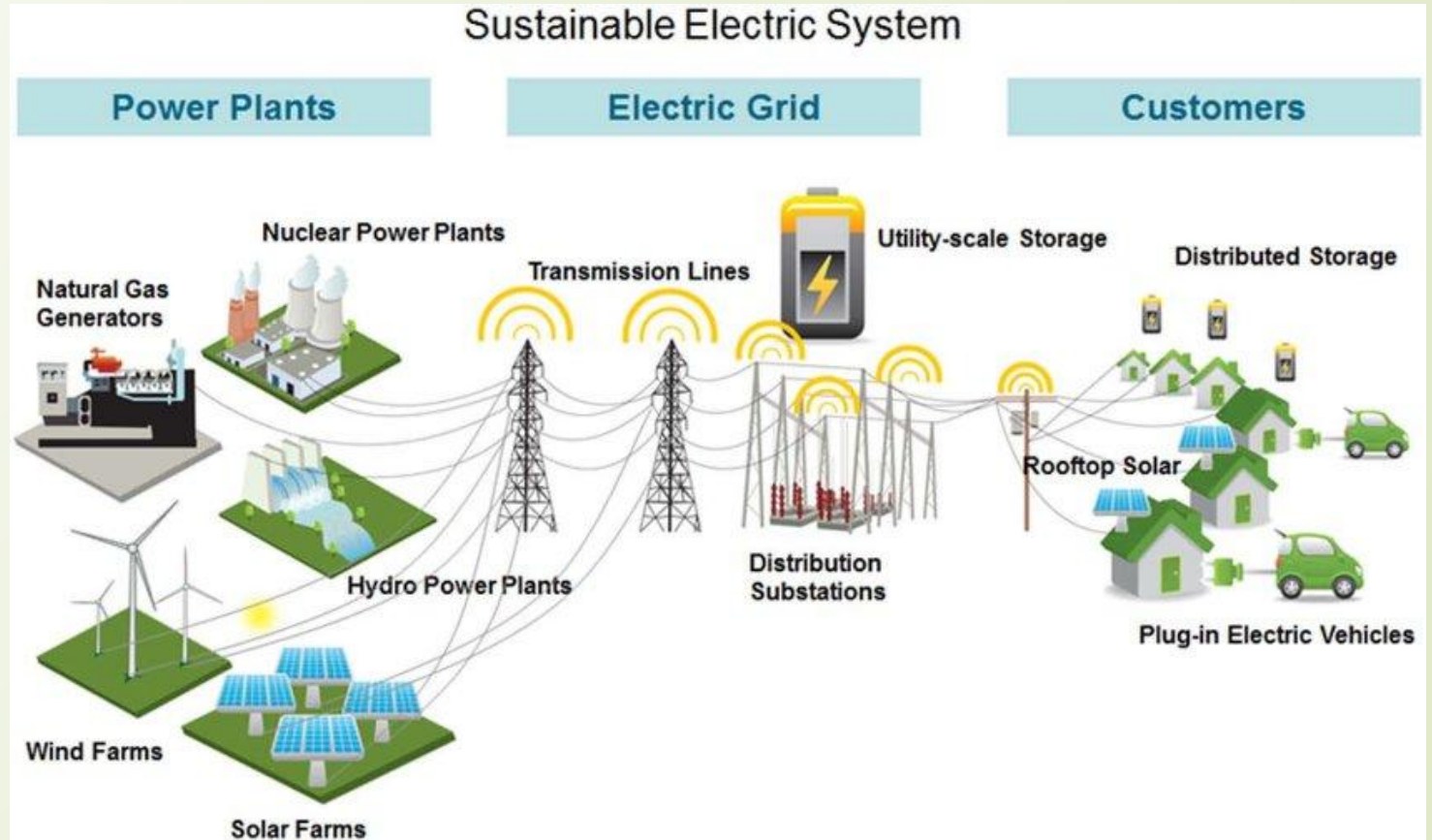
Geothermal Energy

- ❑ Geothermal heat is heat that is trapped beneath the earth's crust from the formation of the Earth 4.5 billion years ago and from radioactive decay.
- ❑ Sometimes large amounts of this heat escapes naturally, but all at once, resulting in familiar occurrences, such as volcanic eruptions and geysers.
- ❑ This heat can be captured and used to produce geothermal energy by using steam that comes from the heated water pumping below the surface, which then rises to the top and can be used to operate a turbine.



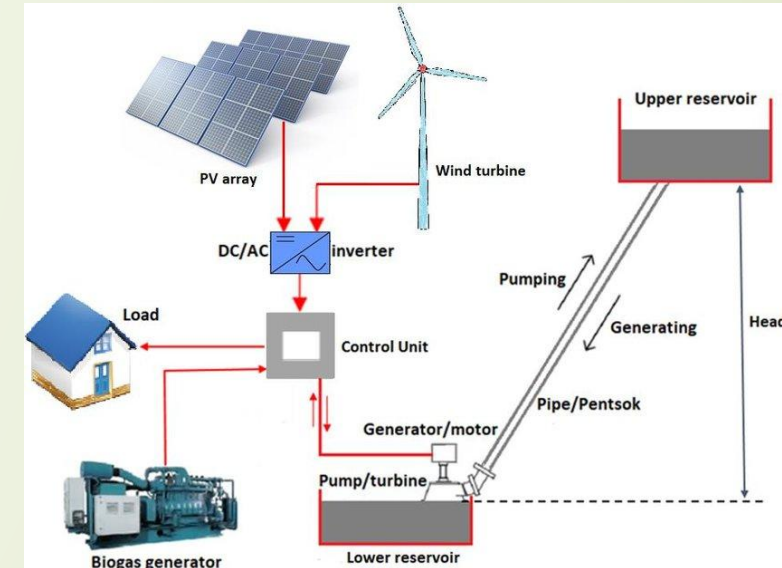
Hybrid Power System

- The goal is to achieve a reliable and efficient operation of the microgrid, and successfully managing the power inside it.
- In order to achieve this, a representative model of the power system is essential.
- A valid, flexible and reliable model provides the basis for assessing the operation of a system and offering a good quality service to the people.



Research Objectives and Methodology

- The main objective of this study is to model and simulate the HRES off grid and integrated with the grid. This study covers the following objectives:
- 1-Discuss the modeling of the selected renewable energy systems.
- 2-simulation of different renewable energy systems.
- 3-Simulation of standalone hybrid renewable energy systems.



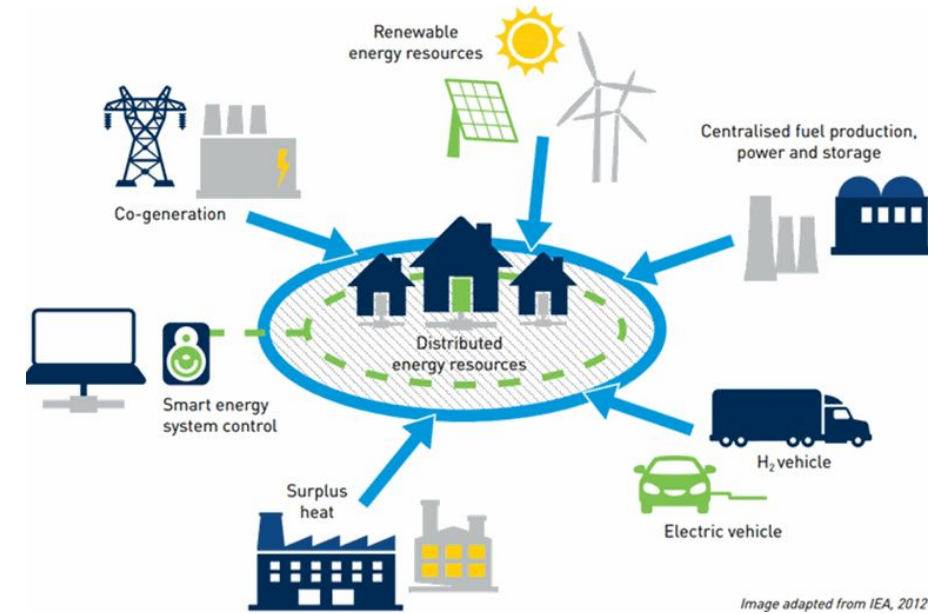
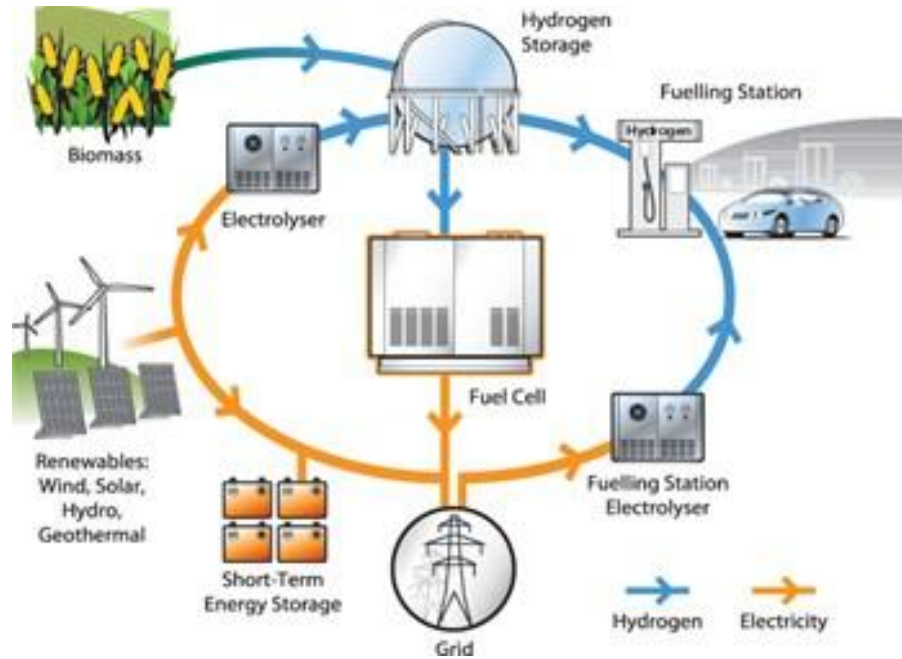


Image adapted from IEA, 2012

Research Objectives and Methodology

- ❑ 4-Simulation of hybrid renewable energy systems Connected to the grid.
- ❑ 5-Discussion and analysis of the case studies results.



Research Plan

- Survey for publications of previous research in this area.
- Study different types of renewable energy sources.
- Selection of renewable energy systems
- Discuss the modeling of the selected renewable energy systems.
- simulation of different renewable energy systems.
- Simulation of standalone hybrid renewable energy systems.
- Simulation of hybrid renewable energy systems Connected to the grid.
- Discussion and analysis of the case studies results.
- Conclusion and recommendation for future work.
- Paper writing.
- Thesis

References

- [1] M. Abd ElAziz. M. & A. M. Eltamaly, *Modeling and Simulation*, Cham, Switzerland: Springer Nature, 2018.
- [2] M. d. M. M. Díaz, "Stand-alone hybrid renewable," Barcelona, PHD Thesis 2017.
- [3] P. N. & S, "Opportunities and challenges of integrating renewable energy in smart grid system," *Energy Procedia*, vol. 34, no. 18766102, pp. 282-290, 2013.





All we need is **Sustainable Development**

Thank You