



**Sudan University for Science & Technology College of**

**Graduate Studies Department of General Physics**



## **Renewable Energy Advantages and Disadvantages**

وا  ساوى للطاقات ا  تجدة  
ا  اسن

A thesis submitted to the Sudan University of Science and  
Technology in fulfillment of MSC in General Physics

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## ***DEDICATION***

*Dedicate this research ..*

*TO flash of light in my life...and my lovely father*

*AbdelgaderMoh. Osman*

*To my mother and a professor of generations*

*ALawiaAhmed Salim*

*To my sisters and my brother ... To  
my friends and my colleagues ..*

*To all my professors at all stages..*

*And to all who supported me ...*

*And others loved them*

*Areeg*

## **Acknowledgement,,,**

Thanks first and foremost to **God** who guided me to accomplish this search..

Thanks to **my family**, which was a strong supporter and has been credited in arriving for this stage..

I deeply thank to advisor **Dr. Sawsan Ahmad ELhour**i , which oversaw the research it may all my cordiality, respect and appreciation...

Thanks for all professors Sudan University of Science and Technology, and especially thank the Masters Physics Department..

And also thank all those who supported me and encouraged me and helped me in the output of this research in its current form and I hope to obtain the consent of everyone...

**Researcher**

## **Abstract**

As the critical problem of global pollution ( greenhouse gas , global warming ) raises from fossil fuels and other non-renewable sources; Renewable energy was the only solution.

It is an environmentally friendly source. Although it is a very interesting alternative energy yet it is not the key to play role to take place of the traditional fossil energy ; that is due to high cost as well as environmental aspects and detailed economic difficulties in the construction of these plants.

## المستخلص

تصاعدت وتأزمت مشكلة التلوث الكوني (غابات ازسامة اونبهاث حريرا ) بين الاسيستخدم المتصاعد للويود الاحفويير ومصادر الطاقة الاخري غير المتجددة . لذلك كانت الطاقة المتجددة هي الحل الوحيد .

الطاقة المتجددة مصدر بيئي صديق هوي تلعبرود أساسي بسططيع نأ يحل مديل الطابئة التقليدية الاحفويير ، لكن لا تستطيع الطاقة المتجددة نأ تحل مديل المشكلة تماما ذوايك نسبية لكلفتها العالبة علاوة علي العوائق المتعلقة بالمناخ اولبيئة وتعقيدتا اقتصادية في إنشاء مولد تامن هذا النوع .

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# Chapter One

## 1.1 Introduction

Energy plays a major role in economic activity and is considered an important indicator of the growth and development and the progress of nations and prosperity, where we find that the countries most energy-consuming is the advanced and developing countries, and where the industry is booming in the biggest developing nations, in general, energy resources, renewable resources such as solar, wind, water and other untapped after broadly, and other non-renewable, such as coal, natural gas, oil and energy non-renewable are causing climate change, which resulted in the escalation of the gases, increasing environmental pollution and causing the expansion of the ozone hole, and also coal production requires the use of forest resources resulting in scarcity and shortage of farmland.

These changes have tended attention to the exploitation of energy from renewable sources and develop, because it is clean energy and preserve the environment and available, we live in an ocean of energy, nature operates around us without stopping to give us huge amounts of alternative and renewable energy, that man can not be used for only a small fraction of them, the most powerful generators at all is the sun. And then water watershed alone is able to be produced from hydroelectric power as many as 80% of the total energy consumed by humans. Wind energy can produce electricity produced twice as much water today, and if we use tidal energy to generate power provided us with half our energy needs, as well as energy produced from biomass is one of the cheaper and simpler alternative energy resources. All these productive if used properly these energies and high technology.



## **1.2 Research Problem**

It is known that energy is the only engine in this era energy is fossil consist principally of excessive dependence and higher consumption for energy sources of non-renewable up almost 90%, which is exposed to the rapid entry into force of the sources, in addition to being energy sources contaminated carry a lot of environmental risks, as well as the tendency of some countries to use nuclear energy as the best solution to get out of the current energy crisis. In fact this trend is dangerous for the world because nuclear power has very serious environmental returns.

The study also proved that the renewable energy, despite the diversity of sources and spread in various regions of the world, they are yet to be exploited on a large scale, contributing only about 10%.

But in spite of alternative and renewable energy advantages, but there are some difficulties faced by their use, they are not always available upon request, and requires a relatively large initial investment to set up compared with conventional power plants, and also the lack of researchers and specialized technical personnel of the operation, monitoring and maintenance of these control hand established units.

## **1.3 Literature Review**

### **1.3.1 Opportunities and challenges for renewable energy policy in China**

**Zhang Peidong, Yang Yanli, Shijin, , ZhengYonghong, Wang Lisheng, & Li Xinrong**

Renewable energy is the inevitable choice for sustainable economic growth, for the harmonious coexistence of human and environment as well as for the

sustainable development. Government support is the key and initial power for developing renewable energy. In this article, an overall review has been conducted on renewable energy development policy (including laws and regulations, economic encouragement, technical research and development, industrialized support and government model projects, etc.) in China. On this basis, a systematic analysis has been conducted on the disadvantages of renewable energy development policy. On the point of long-term effective system for renewable energy development, a series of policy advice has been offered, such as strengthening the policy coordination, enhancing regional policy innovation, echoing with clean development mechanism, implementing process management, constructing market investment and financing system. It is expected that the above advices could be helpful to ever-improvement of renewable energy development policy.

### **1.3.2 A literature review of wind forecasting technology in the world**

**Yuan-Kang Wu, Member** ( IEEE, National Penghu University, Taiwan), **Jing-Shan Hong** (Meteorological Information Center, Central Weather Bureau, Taiwan)

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Large intermittent generations have grown the influence on the grid security, system operation, and market economics. Although wind energy may not be dispatched, the cost impacts of wind can be substantially reduced if the wind energy can be scheduled using accurate wind forecasting. In other words, the improvement of the performance of wind power forecasting tool has significant technology and economic impact on the system operation with increased wind

power penetration. Forecasting has been a vital part of business planning in today's competitive environment, especially in areas characterized by a high concentration of wind generation and a limited capacity of network. The target of this paper is to present a critical literature review and an up-to-date bibliography on wind forecasting technologies over the world. Various forecasting aspects concerning the wind speed and power have been highlighted. These technologies based on numeric weather prediction (NWP) methods, statistical methods, methods based upon artificial neural networks (ANNs), and hybrid forecasting approaches will be discussed. Furthermore, the difference between wind speed and power forecasting, the lead time of forecasting, and the further research will also be discussed in this paper.

### **1.3.3 Status of micro-hydrokinetic river technology in rural applications**

**Herman Jacobus Vermaak, Kanzumba Kusakana, , Sandile Philip Koko**(  
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University of Technology, Free State Bloemfontein, South Africa Received 21  
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Apparently, most hydrokinetic literatures mainly concentrate on large-scale technologies such as waves, tides and ocean current applications. This could be one of the reasons delaying the utilization of small-scale hydrokinetic river technology in rural areas. This paper therefore critically reviews the current status of micro-hydrokinetic river (MHR) technology for rural applications. Relevant research literatures based on developments, applications, design, operation as well as different MHR technologies involved in rural electrification projects have been reviewed. After conducting these reviews it has become clear that one of the key barriers hindering the employment of MHR technology in rural areas with access to flowing water is the lack of research demonstrating the

technical, economic and environmental benefits of this technology compared to other rural electrification techniques. Studies that look towards the long-term perspective of techno-economic analysis inclusive of capital, maintenance and running costs computations need to be carried out promoting the interest in utilizing this technology. This paper will aid researchers to identify areas that need to improve as well as encourage public bodies to implement proper energy policies regarding the MHR technology usage in rural areas. It will also create awareness among site owners, investors, project developers and decision makers regarding the potential benefits of using this technology in rural areas especially in countries with little or no elevation.

#### **1.4 Objectives of the Study**

The study of this subject discussed trying to learn about renewable energies, what are the alternative and renewable energy, and why we call alternative energy or renewable energy? And to identify the types and extent of its importance and the pros and evening of these energies together and beauties and evening each power separately, which was one of the most important goals of research.

And also try to identify the extent of the ability of renewable energies on substitutes place oil.

#### **1.5 Presentation of the thesis**

Mark the first chapter Introduction ,Chapter two talked about the types of energies,Chapter three dealt with the advantages and disadvantages of renewable energy,

Chapter fourcame under the energies used in Sudan, Chapter five addressed the Conclusion and Recommendations.

## **Chapter Two**

### **Types of Renewable Energy**

#### **2.1 Introduction**

Energy is a key component of the universe, and is one of the forms of existence. Energy, usually derived from natural sources and other non-natural, so it is divided into two main types:

Renewable energy, which depends on natural resources, and non-renewable, and it relies on non-natural sources, although it was formed over time and under the influence of a combination of factors.

And all kinds of this energy require the existence of mechanisms, tools, and techniques for special drawn.

#### **2.2 Renewable Energy**

Is a kind of energy types inexhaustible not run out, and call it refers to it whenever nearing completion exist again, and be a source of natural resources, such as wind, water, and sun, the most important thing distinguishes it is clean and environmentally friendly energy, they do not leave harmful gases such as carbon dioxide, does not adversely affect the surrounding environment, as they do not play a role of an impact on the level of temperature and global warming, renewable energy sources are considered completely contradictory with the sources of non-renewable ; such as natural gas, and nuclear fuel; despite maligned by renewable energy from the high cost and the unavailability of mechanisms and techniques sufficiently, they start working on their development and their development and use in a number of countries[1].

## 2.3 The reasons of used Renewable Energy

Today we primarily use fossil fuels to heat and power our homes , fuel our cars and for all Industrial uses . It's convenient to use coal, oil, and natural gas for meeting our energy needs, but we have a limited supply of these fuels on the Earth. We're using them much more rapidly than they are being created. Eventually, they will run out, and because of safety concerns and waste disposal problems , In the mean time, the nation's energy needs are expected to grow by 33% percent during the next 20 years. Renewable energy can help fill the gap Even if we had an unlimited supply of fossil fuels, using renewable energy is better for the environment. We often call renewable energy technologies "clean" or "green" because they produce few if any pollutants. Burning fossil fuels, however, sends greenhouse gases into the atmosphere, trapping the sun's heat , climate change and cause a Greenhouse effect. Climate scientists generally agree that the Earth's average temperature has risen in the past century. If this trend continues, sea levels will rise, and scientists predict that floods, heat waves, droughts, and other extreme weather conditions could occur more often [1].

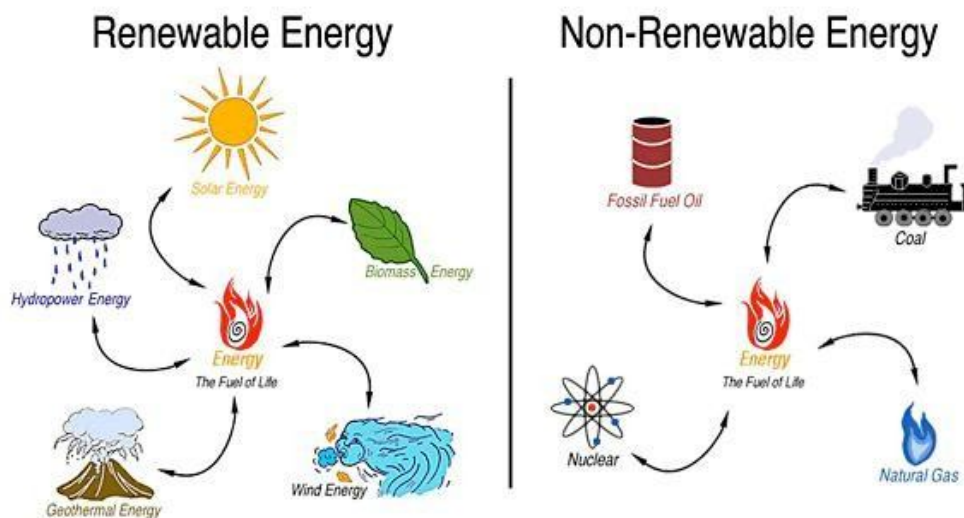


Figure (2.1) type of energy.

## **2.4 Types of Renewable Energy**

Renewable energy comes from several sources, and have different types, it can be divided into several categories:

**2.4.1 Solar Energy:** The radiation from the sun and carry it with them from the heat and the light source of solar energy; and can take advantage of the sun in thermal energy and mechanical and electrical generating, either electrical power can be generated by solar power using heat engines, and panels photovoltaic cells, transformers PV.

### **2.4.1.1 The photoelectric effect**

This effect can be defined as the generation of an electrical potential between the ends of the semi-conductor process when they fall upon radiation leads to ionization voltage are inside the barrier-based semiconductor.

The photoelectric effect is characterized by a driving force electrical subjective and ability to provide electric power for pregnancy and continuity when radiation continued falling. The effort can be created in the barrier inside the semiconductor beyond the means of the ratio of solar cells are two ways; one effort that is made up when deposition of a thin layer of transparent conductive metal on the semiconductor.

The second method is known as bilateral link (PN-Junction), Which consists of the addition of impurities giving n-type semiconductor on its inclusions of type P or adding impurities from p-type to n-type [9].

### **2.4.1.2 PN-Junction**

Link PN, (where N: negative and Positive), is a semi-conductor negative and positive semi-conductor has been and It was connected; In normal electrical conductors (copper wire, for example), the electron which is located in the conduction band is responsible for the delivery of electricity. So-

called conduction holder in the case of copper wire. In semiconductors, there are two types holder for electricity, electron in the conduction band and also the so-called electron hole, which is located in the valence band. There are two types of conduction holder in the semiconductor, not one, where the electrons and voids the transfer of power; While in electrical insulators gap in the valence band is be carriers of cargo and do not move. Semi-negative connector have free electrons can carry the conduction, and semiconductor positive has free gaps can in turn carry the conduction as well. And when some of the connect them of both carriers to transport conduction; Transmission gaps generates negative ions in the region (P) and the movement of electrons generates positive ions in the region (N) on both sides of the forum and this voltage is called the barrier Physical teams composed (Barrier potential) on both sides of the forum generator room electrically opposite to the movement vectors shipment and grow this area until it becomes enough to stop this transition would receive the balance[9].

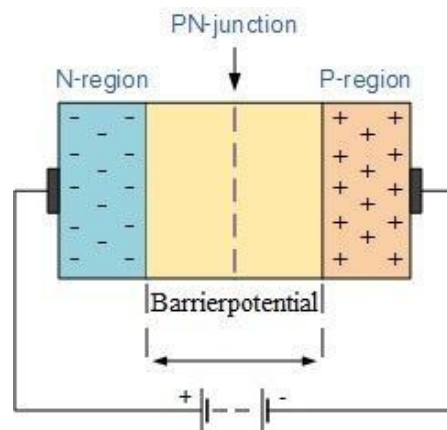


Figure (2.2) PN-Junction.

### 2.4.1.3 Types of solar cells

**1. cell made of mono silicon crystallization:** (mono crystalline), which is a cell cut from crystallizing silicon single and efficiency of this type of cells from 11 to



16%, which means that the absorption of the cells from the next radiation from the sun, which measuring 1000 watts per square meter and so on a sunny day near the equator that is, per square meter of these cells absorb solar radiation such efficiency produces between 110 to 160 watts.

**2. Many cells crystallization (multi crystalline):** which is a chip of silicon scraped off of the crystals silicon cylindrical then chemically treated in furnaces to increase the electrical properties and then the cell surfaces covered in anti reflection so that cells absorb sunlight very efficiently, and the efficiency of this type of 9 to 13%.

**3. Thin film cells (amorphous):** silicon material that are deposited in the form of thin layers on the surfaces of glass or plastic Therefore, this cell manufacturing technology is easy, but their efficiency is less than 3% to 6%, and prices are also lower. It is suitable for applications from 40 watts to less[1].



Figure (2.3) solar cell mono-crystal of silicon

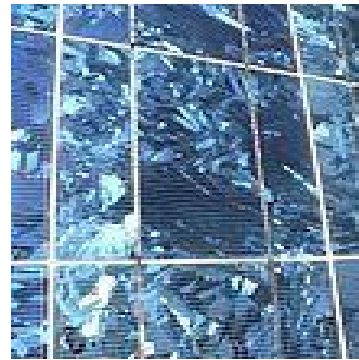


Figure (2.4) solar cell multi crystalline

#### 2.4.1.2 Solar thermal power plants

Solar thermal power plants use the sun's rays to heat a fluid to high temperatures. The fluid is then circulated through pipes so that it can transfer its heat to water

and produce steam. The steam is converted into mechanical energy in a turbine which is then converted into electricity by a conventional generator. Solar thermal power generation works essentially the same as power generation using fossil fuels, but instead of using steam produced from the combustion of fossil fuels, the steam is produced by heat collected from sunlight. Solar thermal technologies use concentrator systems to achieve the high temperatures needed to heat fluid[1].

**2.4.2. Bio-Energy:** bio-energy so-called biomass; and that is an organic working on solar radiation storage material, and then converted into chemical energy derived . Biomass contains stored energy , because plants absorb energy from the sun through the process of photosynthesis.

Many different kinds of biomass such as wood chips ,corn ,and some type of garbage , are used to produce electricity .Some types of biomass can be converted into liquid fuels called biofuels that can power cars , rucks and tractors. Leftover food products like vegetable oils and animal fats can create biodiesel , while corn , sugarcane and other plants can be fermented to produce ethanol. In biomass power plants , wood waste or other waste is burned to produce steam that runs a turbine to make electricity or provides heat .

**Biofuels:** Biofuels sustained strong oil is considered a competitor, it also plays a role in providing derived from alternative energy sources, and more plants used in the sustainable production of biofuels healthy supply, sugar cane, algae.

We have used biomass energy or bio energy - the energy from organic matter - for thousands of years, ever since people started burning wood to cook food or to keep warm.

And today, wood is still our largest biomass energy resource. But many other sources of biomass can now be used, including plants, residues from agriculture

or forestry, and the organic component of municipal and industrial wastes. Even the fumes from landfills can be used as a biomass energy source. The use of biomass energy has the potential to greatly reduce our greenhouse gas emissions. Biomass generates about the same amount of carbon dioxide as fossil fuels, but every time a new plant grows, carbon dioxide is actually removed from the atmosphere. The net emission of carbon dioxide will be zero as long as plants continue to be replenished for biomass energy purposes. These energy crops, such as fast-growing trees and grasses, are called biomass feedstocks. The use of biomass feedstocks can also help increase profits for the agricultural industry.

Corn can be harvested to produce ethanol, unlike other renewable energy sources; biomass can be converted directly into liquid fuels - biofuels - for our transportation needs (cars, trucks, buses, airplanes, and trains). The two most common types of biofuels are ethanol and biodiesel.

Ethanol is an alcohol. It is made by fermenting any biomass high in carbohydrates (starches, sugars, or celluloses) through a process similar to brewing beer. Ethanol is mostly used as a fuel additive to cut down a vehicle's carbon monoxide and emissions. But flexible-fuel vehicles, which run on mixtures of gasoline and up to 85% ethanol, are now available.

Biodiesel is made by combining alcohol (usually methanol) with vegetable oil, animal fat, or recycled cooking greases. It can be used as an additive to reduce vehicle emissions or in its pure form as a renewable alternative fuel for diesel engines.

Other biofuels include methanol and reformulated gasoline components. Methanol, commonly called wood alcohol, is currently produced from natural gas, but could also be produced from biomass. There are a number of ways to convert biomass to methanol. Gasification involves vaporizing the biomass at

high temperatures, then removing impurities from the hot gas and passing it through a catalyst, which converts it into methanol. Most reformulated gasoline components produced from biomass are pollution-reducing fuel additives[1].

**2.4.3 Wind Power:** In past windmills have been used for pumping water or grinding grain. Today, the windmill's modern equivalent - a wind turbine - can use the wind's energy to generate electricity. Human resort to rely on wind turbines to extract energy from wind, electric power generation ones, as wind power is used to produce mechanical energy in so-called windmills .Wind consider is a form of solar energy and nearly 2% percent of the sunlight that falls on the Earth's surface light turns into kinetic energy of the wind. This is a huge amount of energy can be utilized to produce electrical energy. Wind turbines, like windmills, are mounted on a tower to capture the most energy. At 100 feet (30 meters) or more aboveground, they can take advantage of the faster and less turbulent wind. Turbines catch the wind's energy with their propeller-like blades. Usually, two or three blades are mounted on a shaft to form a rotor . Wind turbines can be used as stand-alone applications, or they can be connected to a utility power grid or even combined with a photovoltaic (solar cell) system. For utility-scale sources of wind energy, a large number of wind turbines are usually built close together to form a wind plant. Several electricity providers today use wind plants to supply power to their customers . Stand-alone wind turbines are typically used for water pumping or communications. However, homeowners, farmers, and ranchers in windy areas can also use wind turbines as a way to cut their electric bills . Small wind systems also have potential as distributed energy resources. Distributed energy resources refer to a variety of small, modular power-generating technologies that can be combined to improve the operation of the electricity delivery system[2].

**2.4.3.1 Wind Turbine :** is device that converts kinetic energy from the wind into electrical power.

Wind energy is the kinetic energy of the moving air .The kinetic energy of a mass (m) with the velocity (v) is:--

$$E_{KIN} = \frac{1}{2} m v^2$$

The air mass (m) can be determined from the air density ( $\rho$ ) and the air volume (V) according to :

$$m = \rho V$$

Then ,

$$E_{Kin, wind} = \frac{1}{2} V \rho v^2$$

### **2.4.3.2 The basic elements of wind turbine**

- Rotary turbines derive wind into rotational energy rotational energy to the generator delivers column.
- Structure of the engine and is a cover containing:
  - box gears: increases the speed of the generator rotor and the center column.
  - Generator: using rotational energy from the column to generate electricity using electromagnetic
  - Electronic control unit: turbine stops the control system in the event of a malfunction and controls to deviation.
  - Deviation control device: rotor moves to stand downwind.
  - Brakes: stop rotation of the column if there is excess capacity or system failure
- Tower: supports rotor and engine structure and elevates the entire installation to rise above
- Electronics: bring electricity from the generator down through the tower and controls many elements of the turbine safety[1].

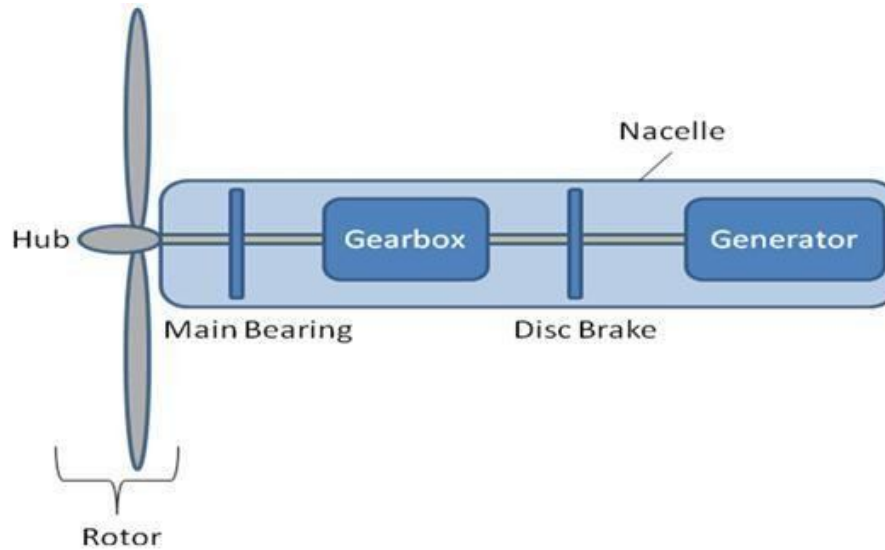


Figure (2.5) basic elements of wind turbine.

**2.4.3.3 Wind Turbine Design:** Design depends on the orientation axis of rotation in a vertical or horizontal to the ground, so that the turbine blades spin around this axis, as this design is aimed at repositioning gearbox and the generator when the turbine tower base which facilitates maintenance operations and connections, and also depend on the number of blades and design of the blades into account include:

- Blade Length.
- Blade Weight.
- Blade Number.
- Blade Pitch.
- Blade Shape.
- Blade Materials[1].

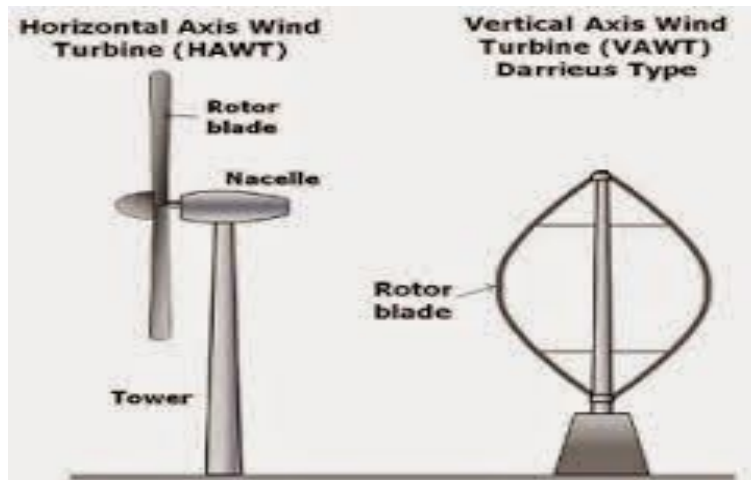


Figure (2.6) Type of wind turbine: Horizontal axis & Vertical axis.

**2.4.4 Hydropower:** The term hydroelectric term comprehensive electricity and water together, and uses this type of energy in the exploitation of hydro power to generate electricity, is very clean energy, with a wide spread. In exploiting this energy process is completely rely on the potential of water energy, or the energy situation and turn it into kinetic energy through the water fall and allowing free from top to bottom, to be run generating turbines begins the electrical generator to rotate, and therefore works on electric power production. Flowing water creates energy that can be captured and turned into electricity. This is called hydroelectric power or hydropower.

The most common type of hydroelectric power plant uses a dam on a river to store water in a reservoir. Water released from the reservoir flows through a turbine, spinning it, which in turn activates a generator to produce electricity. But hydroelectric power doesn't necessarily require a large dam. Some hydroelectric power plants just use a small canal to channel the river water through a turbine.

Another type of hydroelectric power plant - called a pumped storage plant - can even store power. The power is sent from a power grid into the electric

generators. The generators then spin the turbines backward, which causes the turbines to pump water from a river or lower reservoir to an upper reservoir, where the power is stored. To use the power, the water is released from the upper reservoir back down into the river or lower reservoir. This spins the turbines forward, activating the generators to produce electricity.

**2.4.4.1 Weirs:** Are structures consisting of an obstruction, such as a dam or bulkhead placed across the open channel with a specially shaped opening or notch. There are several different types of weirs. A weir may be a simple metal plate with a V-notch cut into it, or it may be a concrete and steel structure across the bed of a river. A weir that causes a large change of water level behind it, as compared to the error inherent in the depth measurement method, will give an accurate indication of the flow rate.

Common weir constructions are the

- (i) Rectangular weir.
- (ii) Triangular (v-notch) weir.
- (iii) Broad crested weir[4].



Figure (2.7) weir.

The most important forms of exploitation of hydropower following:

1. **Tidal power:** Is a form of Hydropower that converts that energy of tides



into useful forms of power , mainly electricity . Although not yet widely used tidal power has potential for future electricity generation.

Tides are more predictable than wind and solar energy. Among sources of renewable energy, tidal power has traditionally suffered from relatively high cost and limited availability of sites with sufficiently high tidal ranges or flow velocities, thus constricting its total availability; However, many recent technological developments and improvements, both in design and turbine technology , indicate that the total availability of tidal power may be much higher[4].

**2. Wave power:**Is the transport of energy by ocean surface wave and the capture of that energy to do useful work. A machine able to exploit wave power is generally known as a Wave Energy Converter (WEC). Energy output determined by wave height ,wave speed ,wave length and water density.

Types of main Wave Energy Converter :

1. Attenuator.
2. Point absorber.
3. Oscillating Wave Surge Converter.
4. Oscillating Water Column.
5. Overtopping (Terminator device).
6. Submerged Pressure Differential.
7. Bulge Wave.
8. Rotating Mass.

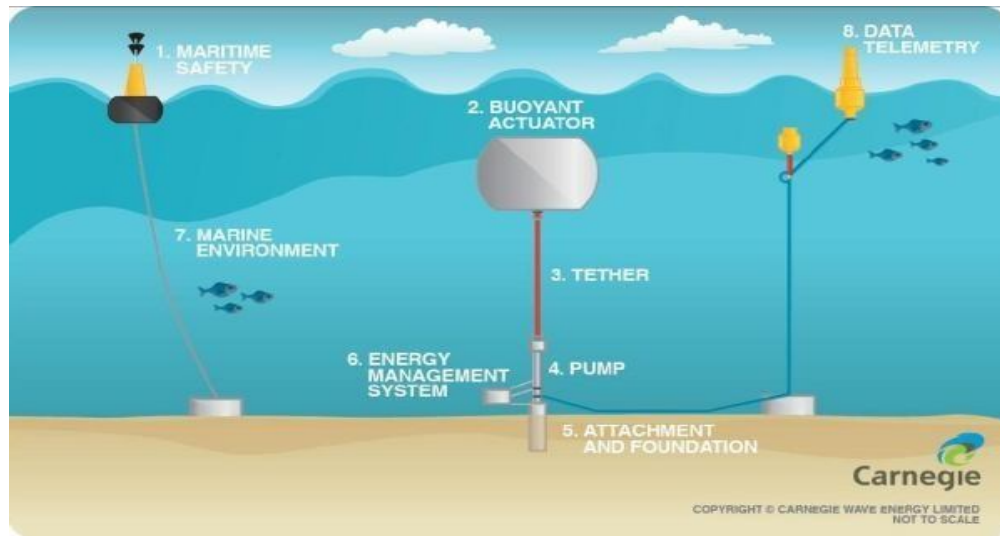


Figure (2.8) Type of Wave Energy Converter.

**2.4.5 Geothermal energy:** Geothermal energy which are also called thermal underground energy is extracted this type of energy from the earth, and is one of the eco-friendly species, due to the cleanliness and renewal, and characterized by high temperature, and growing up as the depth increased in the underground, and relied upon heavily in the generation of voltage, this process and the need to access the depths of the underground, and through the drill pipe, can be tapped and harnessed for energy.

Geothermal energy is the heat from the Earth. It's clean and sustainable. Resources of geothermal energy range from the shallow ground to hot water and hot rock found a few miles beneath the Earth's surface, and down even deeper to the extremely high temperatures of molten rock called magma.

Geothermal heat pumps can tap into this resource to heat and cool buildings. A geothermal heat pump system consists of a heat pump, an air delivery system (ductwork), and a heat exchanger-a system of pipes buried in the shallow ground near the building. In the winter, the heat pump removes heat from the heat

exchanger and pumps it into the indoor air delivery system. In the summer, the process is reversed, and the heat pump moves heat from the indoor air into the heat exchanger. The heat removed from the indoor air during the summer can also be used to provide a free source of hot water.

Most geothermal reservoirs of hot water are located in the western states. Wells can be drilled into underground reservoirs for the generation of electricity. Some geothermal power plants use the steam from a reservoir to power a turbine/generator, while others use the hot water to boil a working fluid that vaporizes and then turns a turbine. Hot water near the surface of Earth can be used directly for heat. Direct-use applications include heating buildings, growing plants in greenhouses, drying crops, heating water at fish farms, and several industrial processes such as pasteurizing milk.

Hot dry rock resources occur at depths of 3 to 5 miles everywhere beneath the Earth's surface and at lesser depths in certain areas. Access to these resources involves injecting cold water down one well, circulating it through hot fractured rock, and drawing off the heated water from another well. Currently, there are no commercial applications of this technology. Existing technology also does not yet allow recovery of heat directly from magma, the very deep and most powerful resource of geothermal energy.

The most important of these heat sources:

- (i) Radioactivity.
- (ii) Geo-thermal energy.
- (iii) Thermal power of geologic hot rocks.

Many technologies have been developed to take advantage of geothermal energy - the technologies for the following geothermal applications:

- Geothermal Electricity Production: Generating electricity from the earth's heat.

- Geothermal Direct Use:Producing heat directly from hot water within the earth.
- Geothermal Heat Pumps :Using the shallow ground to heat and cool buildings[1].

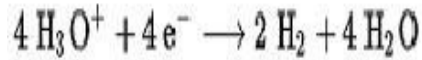
**2.4.6 Hydrogen gas:**Hydrogen is the simplest element. An atom of hydrogen consists of only one proton and one electron. It's also the most plentiful element in the universe. Despite its simplicity and abundance, hydrogen doesn't occur naturally as a gas on the Earth - it's always combined with other elements. for example, is a combination of hydrogen and oxygen (H<sub>2</sub>O) it outputs reaction water ,it's can be useful.

Hydrogen gas can be considered one of the renewable energy sources that can be exploited in electric power generation, through its union with oxygen by fuel cells, which do not cause pollution in the environment.

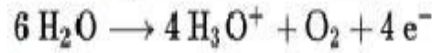
Hydrogen is also found in many organic compounds, notably the hydrocarbons that make up many of our fuels, such as gasoline, natural gas, methanol, and propane. Hydrogen can be separated from hydrocarbons through the application of heat - a process known as reforming. Currently, most hydrogen is made this way from natural gas. An electrical current can also be used to separate water into its components of oxygen and hydrogen. This process is known as electrolysis.

Electrolysis of water is an electrolysis of water molecules( H<sub>2</sub>O) process of separating into its components namely (O<sub>2</sub>)Hydrogen oxygen, by passing an electrical current in the aqueous medium.

Electrolysis on the cathode :



Electrolysis on the anode :



The total interaction:

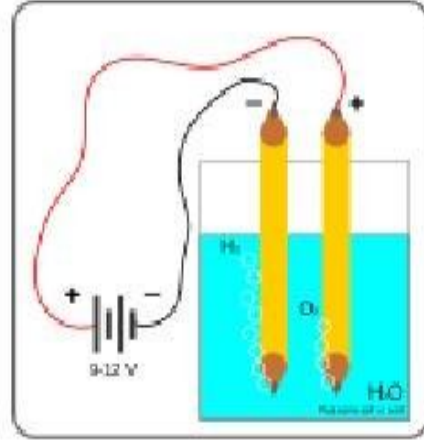
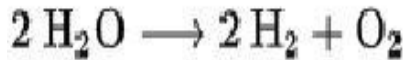


Figure (2.9) electrolysis of water.

Some algae and bacteria, using sunlight as their energy source, even give off hydrogen under certain conditions.

Hydrogen is high in energy, yet an engine that burns pure hydrogen produces almost no pollution. A fuel cell combines hydrogen and oxygen to produce electricity, heat, and water. Fuel cells are often compared to batteries. Both convert the energy produced by a chemical reaction into usable electric power. However, the fuel cell will produce electricity as long as fuel (hydrogen) is supplied, never losing its charge.

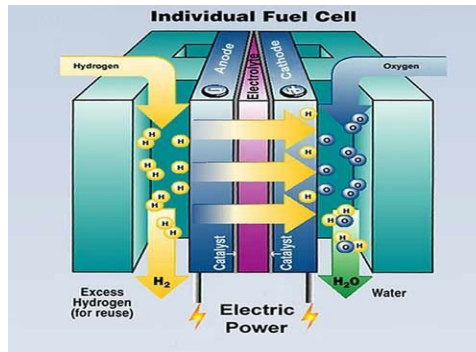


Figure (2.10) H<sub>2</sub>-Fuel Cell Vehicles.

Fuel cells are a promising technology for use as a source of heat and electricity for buildings, and as an electrical power source for electric motors propelling

vehicles. Fuel cells operate best on pure hydrogen. But fuels like natural gas, methanol, or even gasoline can be reformed to produce the hydrogen required for fuel cells. Some fuel cells even can be fueled directly with methanol, without using a reformer.

In the future, hydrogen could also join electricity as an important energy carrier. An energy carrier moves and delivers energy in a usable form to consumers. Renewable energy sources, like the sun and wind, can't produce energy all the time. But they could, for example, produce electric energy and hydrogen, which can be stored until it's needed. Hydrogen can also be transported (like electricity) to locations where it is needed[4].

## **Chapter Three**

### **Advantages and Disadvantages of Renewable Energy**

#### **3.1 Advantages of Renewable Energy**

##### **3.1.1. Renewable energy is well renewable**

This means it has infinity of sustainability and we will never run out of it. Other sources of energy like coal, oil and gas are limited and will run out some day. Renewable energy can reduce our dependence on fuels and energy from foreign governments. Strong winds, heat within earth, moving water, shining sun can provide a vast and constant energy resource supply.

##### **3.1.2. Environmental Benefits**

It is clean and results in little to no greenhouse and net carbon emissions. It will not deplete our natural resources and have minimal, if any, negative impacts on the environment, with no waste products of CO<sub>2</sub> and other, more toxic take with different sources of energy. The environmental benefits of renewable energy are innovative in that they will dramatically scale back on the amount of toxic air pollution released into the atmosphere by other methods. Enables us to protect the environment from toxic pollutions, which in turn keep people healthier.

##### **3.1.3. Reliable Energy Source**

Our dependence on fossil fuels has increased considerably in last few decades. The result is that our national security continues to be threatened by our dependence on fossil fuels which are vulnerable to political instabilities, trade disputes, wars, and high prices. This impacts more than just our national energy

policy. Also, solar and wind plants are distributed over large geographical area and weather disruptions in one area won't cut off power to an entire region.

#### **3.1.4. Economic Benefits**

Renewable energy is also cheaper and more economically sound than other sources of generated energy. It is estimated that as a result of renewable energy manufacturing, hundreds of thousands of stable jobs will be created. Thousands of jobs have already been created in numerous European countries like the United Kingdom and Germany, who have adopted measures to manufacture renewable energy. Renewable energy amenities require a less amount of maintenance, which reduces the costs. Switching to renewable energy sources also means that the future of our energy is returned back to the people: to communities, families, farmers, and individuals.

#### **3.1.5. Stabilize Energy Prices**

Switching to renewable energy sources also means steady pricing on energy. Since the cost of renewable energy is dependent on the invested money and not the increasing or decreasing or inflated cost of the natural resource, governments would only pay a small amount in comparison to the needlessly heavy pricing of the energy prices we are witnessing currently.

The United States of America has the best wind resources in the entire world. Now that wind energy is the most cost effective source of energy, and the technology of wind turbines has improved as well as the cost has gone down. This permits more manufacturing plants that are cost effective. Wind is a reliable source of electricity, as is solar power for similar reasons[5].



## **3.2 Disadvantages of Renewable Energy**

### **3.2.1. Reliability of Supply**

One shortcoming is that renewable energy relies heavily upon the weather for sources of supply: [rain](#), wind, and sunshine. In the event of weather that doesn't produce these kinds of climate conditions renewable energy sources lack the capacity to make energy. Since it may be difficult to generate the necessary energy due to the unpredictable weather patterns, we may need to reduce the amount of energy we use.

### **3.2.2. Difficult to Generate in Large Quantity**

Another disadvantage of renewable energy is that it is difficult to generate large amount of energy as those produced by coal powered plants. This means that either we need to set up more such facilities to match up with the growing demand or look out for ways to reduce our energy consumption.

### **3.2.3. Large Capital Cost**

Initial investments are quite high in case of building renewable energy plants. These plants require upfront investments to build, have high maintenance expenses and require careful planning and implementation.

### **3.2.4. Large Tracts of Land Required**

To meet up with the large quantities of electricity produced by [fossilfuels](#), large amount of solar panels and wind farms need to be set up. For this, large tracts of land is required to produce energy quantities competitive with fossil fuel burning[5].

## **3.3 Detailed Advantages and Disadvantages of Some Types of Renewable Energy**

### **3.3.1 Solar Power**

We have discussed many of the advantages and disadvantages of solar energy compared with other forms of renewable energy. While it is clear that it excels on some forms of energy, high-efficiency solar energy and the cost depends on the geography of the place is limited, however, a large number of advantages also worthy of further development and even possible adjustment of the housing.

The most important of these advantages is low cost of maintenance. Solar panels have no moving parts and requires very little maintenance beyond regular cleaning. With no moving parts to break down and replacement, and after the initial costs for the installation of the plates, and the costs of maintenance and repair are very reasonable. Solar power remains rare in many countries due to some fairly significant drawbacks:

**1. Cost :** The largest problem of using primarily solar energy is the cost involved. Despite advances in technology, solar panels remain almost prohibitively expensive. Even when the cost of the panels is ignored, the system required to store the energy for use can also be quite costly.

**2. Weather Dependent :** Although some solar energy can be collected during even the cloudiest of days, efficient solar energy collection is dependent on sunshine. Even a few cloudy days can have a large affect on an energy system, particularly once that fact that solar energy cannot be collected at night is taken into account.

**3. Geographic Limitations:** While some areas would benefit from adapting solar power, other parts of the world would receive little benefit from current solar systems. Solar panels still require direct sunlight to collect large amounts of power, and in many areas of the world there are few days that would efficiently power a system[6].



Figure (3.1) solar cell.

### 3.3.2 Biofuels

Since the term "biofuel" first entered the energy lexicon of the average consumer, there has been a steady stream of advancements to this technology. While public perceptions on biofuels may have changed over the years, quite a lot of interest in the pros and cons of this fuel source still remain. It is important for all consumers to seriously consider both the positive and negative aspects of this still-emerging technology.

**Primary Advantages and Disadvantages of Biofuels** No fuel source is completely positive or completely negative. Consumers need to weigh the pros and cons of biofuels to determine whether they feel comfortable with this resource as an alternative to traditional fuels.

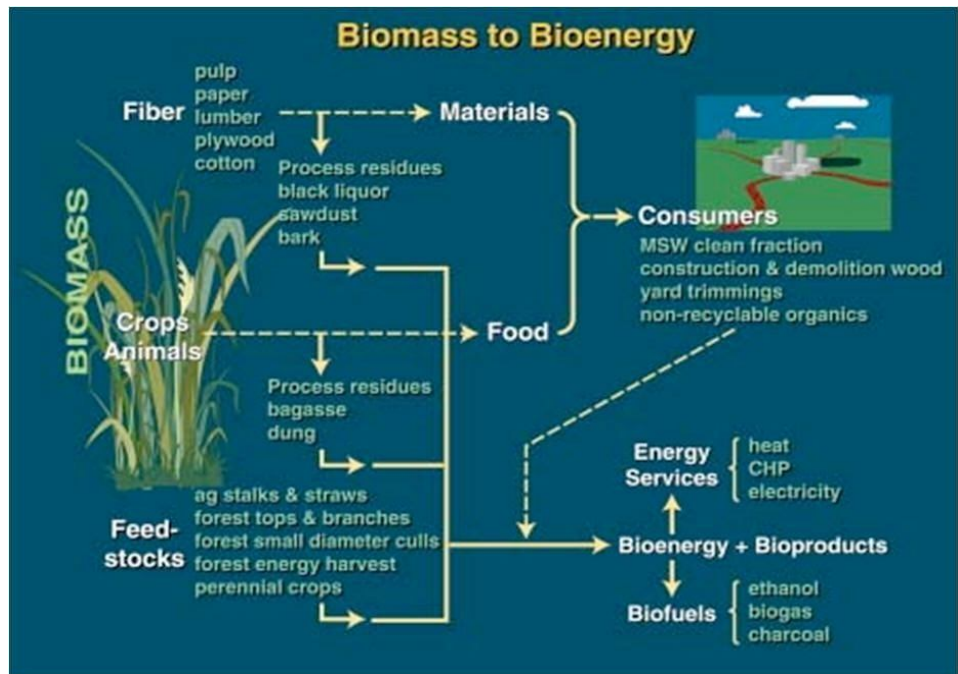


Figure (3.2) Biomass

**The most important of these advantages:**

fuel price Costs may decrease when using biofuels, Biofuel advocates frequently point out the advantages of these plant- and animal-based fuels, such as:

- 1. Cost:** Biofuels have the potential to be significantly less expensive than gasoline and other fossil fuels. This is particularly true as worldwide demand for oil increases, oil supplies dwindle, and more sources of biofuels become apparent.
- 2. Source material:** Whereas oil is a limited resource that comes from specific materials, biofuels can be manufactured from a wide range of materials including crop waste, manure, and other byproducts. This makes it an efficient step in recycling.

**3. Security:** Biofuels can be produced locally, which decreases the nation's dependence upon foreign energy. By reducing dependence on foreign fuel sources, countries can protect the integrity of their energy resources and make them safe from outside influences.

**4. Economic stimulation:** Because biofuels are produced locally, biofuel manufacturing plants can employ hundreds or thousands of workers, creating new jobs in rural areas. Biofuel production will also increase the demand for suitable biofuel crops, providing economic stimulation to the agriculture industry.

**5. Lower carbon emissions:** When biofuels are burned, they produce significantly less carbon output and fewer toxins, making them a safer alternative to preserve atmospheric quality and lower air pollution[7].

### **3.3.3 Hydropower**

Hydroelectric power is electricity generated by hydropower. Hydropower is harnessed through the gravitational force of falling or flowing water. On a worldwide standpoint, it is the most widely used form of renewable energy; Hydropower has been used for centuries by humans. The electricity is typically created when the water is passed over large mechanical turbines, the water pressure forces the turbines to turn, the mechanical energy created is then converted into electricity.

#### **3.3.3.1 Tidal energy**

Harnessing the power of the tides can be achieved by placing bi-directional turbines in the path of the tidal water flow in bays and river estuaries. To be viable, it needs a large tidal range and involves creating a barrier across the bay

or estuary to funnel the water through the turbines as the tide comes in and goes out. Although tidal energy captured in tidal ponds have been used since long time ago, there are few modern installations.

### **3.3.3.1.1 Advantages**

**1. A Very Predictable Energy Source:** Ever since the beginning of time itself, the oceans have had tides. Massive amounts of water move in extremely predictable patterns. This makes it very easy to harness the energy that these tides can generate, because we can predict their movements as far as years ahead.

**2. An Inexhaustible Source of Energy:** There will be no shortage of tides anytime soon. They are controlled by the gravitational pull between the earth, sun, and moon. This means that as long as the earth is being orbited by the moon, the tides will continue to be there producing energy.

**3. Very Low Costs To Operate:** Once the initial constructions costs are done, there are very few additional costs to keep the tidal energy plant up and running. Little maintenance is required, and minimal personnel as well.

**4 .Effective Even at Low Speeds:** Since water is much denser than air, the amount of movement needed to generate power is very low. It has been proven that tidal energy can still be harnessed even if the water is only moving at 3 feet per second.

**5. Can Last Forever:** maybe not literally forever, but a very long time! Tidal energy plants are very simple, and made of durable and simple materials that can withstand the time very well.

**6. Completely Green:** There are no carbon emissions from tidal energy plants, making it an energy source that does not negatively affect the global environment.

### **3.3.3.1.2 The Disadvantages**

**1. Effects on Marine Life:** The biggest concern regarding tidal energy is the effect that the turbines and plants will have on the marine life in the surrounding areas. The mounting of the turbines could greatly interrupt the habitats of marine life and also prevent natural movements of species.

**2. High Construction Costs:** The costs of the tricky on the water construction and the expensive equipment necessary to build a tidal energy plant can add up very quickly. These costs are usually transferred onto the tax payers.

**3. Changes In Tidal Movement:** The exact locations and intensity of the tides can vary drastically. If the tides were to shift enough from the location of the energy plant, it could be rendered useless.

**4. Difficult Sea Usage:** The tidal plant could greatly impact the access of the sea. This could affect transportation of goods and other vessels that need to travel by the ocean.

**5. Location Limits:** There are very few ocean shores that are suitable for the construction of a tidal energy plant. Research has shown that only around 20 areas in the entire world would work to harness tidal energy[10].

**3.3.3.2 Weirs energy:** Weirs are a barrier across a river designed to alter its flow characteristics. In most cases, weirs take the form of obstructions smaller than most conventional dams, pooling water behind them while also allowing it to

flow steadily over their tops. Weirs are commonly used to alter the flow of rivers to prevent flooding, measure discharge, and help render rivers navigable[1].

### **3.3.3.2.1 Advantages**

1. Once a dam is constructed, electricity can be produced at a constant rate.
2. If electricity is not needed, the sluice gates can be shut, stopping electricity generation. The water can be saved for use another time when electricity demand is high.
3. Dams are designed to last many decades and so can contribute to the generation of electricity for many years (decades).
4. The lake that forms behind the dam can be used for water sports and leisure (pleasure) activities. Often large dams become tourist attractions in their own right.
5. The lake's water can be used for irrigation purposes.
6. The buildup of water in the lake means that energy can be stored until needed, when the water is released to produce electricity.
7. When in use, electricity produced by dam systems do not produce green house gases. They do not pollute the atmosphere.

### **3.3.3.2.2 Disadvantages**

1. Dams are extremely expensive to build and must be built to a very high standard.
2. The high cost of dam construction means that they must operate for many decades to become profitable.



3. The flooding of large areas of land means that the natural environment is destroyed.

4. People living in villages and towns that are in the valley to be flooded, must move out. This means that they lose their farms and businesses. In some countries, people are forcibly removed so that hydro-power schemes can go ahead.

5. The building of large dams can cause serious geological damage.

6. Although modern planning and design of dams is good, in the past old dams have been known to be breached (the dam gives under the weight of water in the lake). This has led to deaths and flooding.

7. Dams built blocking the progress of a river in one country usually means that the water supply from the same river in the following country is out of their control. This can lead to serious problems between neighboring countries.

8. Building a large dam alters the natural water table level. For example, the building of the Aswan Dam in Egypt has altered the level of the water table. This is slowly leading to damage of many of its ancient monuments as salts and destructive minerals are deposited in the stone work from 'rising damp' caused by the changing water table level[11].

### **3.3.4 Hydrogen Fuel**

In today's society, many are talking about the advantages of hydrogen fuel and taking it into consideration as an alternative energy medium. The Hydrogen fuel to reduce the dependence on imported fuels, improve the environment, and drive economic growth by becoming more hydrogen efficient.



Figure (3.3) Hydrogen cell.

#### **3.3.4.1 Hydrogen production**

There are five ways to produce hydrogen, depending on the desired output quantity are as follows:

1. Chemical Methods.
2. Electrochemical Methods.
3. Thermal chemical Methods.
4. Chemical Methods photovoltaic.
5. Bio-chemical Methods.

#### **3.3.4.2 Advantages**

When hydrogen is burned, the only emission it makes is water vapor, so a key advantage of hydrogen is that when burned, carbon dioxide (CO<sub>2</sub>) is not produced. Clearly, hydrogen is less of a pollutant in the air because it omits little

tail pipe pollution. Hydrogen has the potential to run a fuel-cell engine with greater efficiency over an internal combustion engine.

### **3.3.4.3 Disadvantages**

While many of the advantages of hydrogen fuel are clear, the disadvantages must be noted as well. Currently, it still costs a considerable amount of money to run a hydrogen vehicle because it takes a large amount of energy to liquefy the fuel. Filling up a car with compressed hydrogen gas will probably prove to be more practical and may also reduce the distance between fills. Research shows that cars could store hydrogen in high pressure tanks like those used for compressed natural gas[8].

### **3.3.5 Geothermal Energy**

Geothermal energy is seen as the new source of power generation by digging out the heat stored inside the earth. Though not used fully due to factors such as location and high costs but in the years to come when fossil fuels would start to diminish, it will turn out to be the cheapest source of power generation. Geothermal energy suffers from its own advantages and disadvantages as described below.

#### **3.3.5.1 Advantages**

1. **Significant Cost Saving** : Geothermal energy generally involves low running costs since it saves 80% costs over fossil fuels and no fuel is used to generate the power. Since, no fuel is require so costs for purchasing, transporting and cleaning up plants is quite low.

2. **Reduce Reliance on Fossil Fuels** : Dependence on fossil fuels decreases with the increase in the use of geothermal energy. Burning of fossil fuels releases greenhouse gases which are responsible for global warming

3. **No Pollution** : This is one of the main advantage of using geothermal energy since it does not create any pollution and help in creating clean environment. Being the renewable source of energy, geothermal energy has helped in reducing global warming and pollution. Moreover, Geothermal systems does not create any pollution as it releases some gases from deep within the earth which are not very harmful to the environment

4. **Direct Use** : Since ancient times, people having been using this source of energy for taking bath, heating homes, preparing food and today this is also used for direct heating of homes and offices. This makes geothermal energy cheaper and affordable. Although the initial investment is quite steep but in the long run with huge cost saving it proves quite useful

5. **Job creation and economic benefits** : Government of various countries are investing hugely in creation of geothermal energy which on other hand has created more jobs for the local people.

### 3.3.5.2 Disadvantages

1. **Not Widespread Source of Energy** : Since this type of energy is not widely used therefore the unavailability of equipment, staff, infrastructure. Not enough skilled manpower and availability of suitable build location pose serious problem in adopting geothermal energy globally.

2. **High Installation Costs** : To get geothermal energy, requires installation of power plants, to get steam from deep within the earth and this require skilled staff needs to be recruited and relocated to plant location. Moreover, electricity

towers, stations need to set up to move the power from geothermal plant to consumer..

3. **Suited To Particular Region** : It is only suitable for regions which have hot rocks below the earth and can produce steam over a long period of time. . Some of these regions are near hilly areas or high up in mountains.

4. **May Release Harmful Gases** : Geothermal sites may contain some poisonous gases and they can escape deep within the earth, through the holes drilled by the constructors. The geothermal plant must therefore be capable enough to contain these harmful and toxic gases.

5. **Transportation** : Geothermal Energy cannot be easily transported. Once the tapped energy is extracted, it can be only used in the surrounding areas. Other sources of energy like wood, coal or oil can be transported to residential areas but this is not a case with geothermal energy. Also, there is a fear of toxic substances getting released into the atmosphere[12].

## **Chapter Four**

### **The Renewable Energies in Sudan**

#### **4.1 Introduction**

Renewable energies are alternative solutions to provide power after the consumption of available fossil oil, coal and natural gas, and there became a great interest in energy research to develop the possibilities of exploitation, the emphasis in Sudan is on three types of renewable energies, which are solar energy and Biofuel (biogas) and the Hydropower (dams), the study proved that the rates of solar radiation in Sudan are one of the highest in the world and cover large parts of the land and for a long time.

It also has the Nile River, which is one of the longest rivers in the world, which allows the use of hydropower especially the building of Dams and Reservoirs, and if taken advantage of this energy efficiently can cover most of the needs of the Sudan, for this reason also Sudan has a large agricultural land which helped the existence of a huge animal wealth helped to use biofuel energy (and there are taking place attempts in Sudan's Kenana including projects for the production of alternative energy using Bagasse and Ethanol "Newspaper Al-Ayyam number 8671 dated 4/12/2006").

#### **4.2 Solar power**

Solar cell systems components namely :

##### **4.2.1 solar panels**

It is a collection of cells associated with each other and is considered the basic unit, which function as converting solar energy into electrical energy by taking

advantage of the properties of semiconductor materials. It varies the size of the cells and the method of connection with each other (connected in parallel or connected respectively or in a respectively and in parallel together) Depending on the amount of energy that must be met is measured in watts.



Figure (4.1) Integrated and simple solar system

#### 4.2.2 Charger Controllers

The process follows the effort of regulate panels and reduced to the value of effort storage system

And pregnancy nutrition across transferred from the storage system or from solar panels directly.

#### 4.2.3 Batteries

It is in charge of the unit for energy storage and discharged when needed ,i.e that it has a dual function, there are many types of batteries, but the majority of used batteries with solar systems are of the quality of DNA panels Lead Lead-Acid, and the majority of batteries used for this purpose to be in the range of 12 volts

or 24 volts. To deal with the battery you need to know two variables you'll at least out of the three variables are the electric voltage is measured in volts (Volts) and current is measured in amperes (Amps) and power is measured in watts (Watts), and can be connected to the batteries, such as the same method of connecting solar cells to get the effort values and different stream.

And it is pointing to the number of battery amperes per hour (Ah) capacity of the battery and called Battery Capacity.

#### **4.2.4 Power Inverters**

The importance of that point when you need to use those cells to generate electricity high variable able to run large electrical and electronic devices in homes or factories. Here, we use devices called reflectors (Inverters), which converts direct current, whether 12 volts or 24 volts or any other value to the current high variant (110V AC or 220V AC) for the operation of devices that operate on the current variable and hardware heavy, the last stage and without it will not there is a real value for solar panels, and is measured by the strength of this device in watts[15].



Figure (4.2) type Inverter.



**Table (4.1)The model prices of P.V systems in 2013 in selected countries (U\$):**

\$/watt	Australia	China	France	Germany	Italia	Japan	U.K	U.S.A
<b>Residential</b>	1.8	1.5	4.1	2.4	2.8	4.2	2.8	4.9
<b>Trade</b>	1.7	1.4	2.7	1.8	1.9	3.6	2.4	4.5
<b>On a service-wide</b>	2.0	1.4	2.2	1.4	1.5	2.9	1.9	3.3

### 4.3 Biogas

It is called biogas name on the mixture resulting from the fermentation of organic waste gases (animal, agricultural, human) underground isolation from the air by anaerobic Bacteria without human intervention is to create conditions for the work of Bacteria. Biogas mixture of Methane(CH<sub>4</sub>) and Carbon dioxide (CO<sub>2</sub>) either Hydrogen sulfide ( H<sub>2</sub>S) is from impurities Methane ratio range in the mixture between 50-75% depending on the type of waste the user and efficiency of fermentation and provide appropriate conditions for Bacteria Methane to carry out vital functions and proportional to Carbon dioxide inversely with Methane as of between 20-25% range the rest of the ratio of gases such as Hydrogen(H<sub>2</sub>) and Hydrogen Sulfide(H<sub>2</sub>S) , Nitrogen(N<sub>2</sub>) ratio between 5-10%.

Methane is odorless and color, taste and proportion to the presence of small amounts of other gases may be accompanied by very light smell stuck organic compounds and sulfur compounds. We find that the cubic meter of biogas gives the 5500 - 6500 kilo calorie and temperature up to 1400° C as the methane soluble in water is very weak, as estimated 0.3% at a temperature of 20 ° C[14].

### **4.3.1 Waste to produce biogas types**

There are three sections to the types of waste:

#### **1. Agricultural waste**

Stalks cane of sugar - corn - wheat - sesame, as well as the water grasses herbs Nile.

#### **2. Animal waste**

Animal dung and residues of poultry and birds and waste Adamite.

#### **3. Industrial waste**

Molasses and waste factories and vegetables slaughterhouses and other...

### **4.3.2 Biogas types of units**

There are different types of biogas units used for the production of gas and organic fertilizer, biogas units of four main parts comprise:

1. Fermented.
2. Gas tank.
3. Basin entering the waste.
4. Basin out waste (organic fertilizer).

### **4.3.3 The most important factors that build upon scientific applications to take advantage of anaerobic fermentation technology:**

#### **4.3.3.1 Organic raw materials**

The decomposition of organic materials compound process is done through a series of Redox processes and the resulting two gases Hydrogen and Carbon dioxide and some acids.

**Becktiria:** have an important role in the fermentation process of some types of Becktiria have the ability to Hydrogen gas and some Fatty Acid production .



#### **4.3.3.2 Feed rate**

The Feed rate means the rate by adding the raw material for organic fermented and often calculated on the dry matter added kilogram per cubic meter of space fermentation per day (Kg / m<sup>3</sup>/ Day). In the case of adding the liquid waste treatment (like water sanitation ) is measured by the degree of concentration of organic materials, including so-called Bio-Oxygen Demand (BOD), the Chemical Oxygen Demand (COD).

Feed rate depends on the type and nature of the organic material used and the usability of the decomposition temperature and time of retention and the amount of gas to be produced [14].

#### **4.3.3.3 Time of Retention**

Is the time spent by organic material inside the fermented decomposition of organic matter and the escalation gas process biogas from waste may continue for several months but must specify the time frame to get through as much of the energy in the form of biogas and often ranges from the time of confinement for many animal waste common use to 30- 45 day.

**Table (4.2) Gas production rates of some of the animal waste:**

Type of waste	The percentage converted organic material %	Gas production for the organic matter rate Kg /m <sup>3</sup>
Cow dung	30	0.8
Poultry waste	60	0.6

## **4.4 Hydropower Weirs (Dam)**

### **4.4.1 The concept of the Dam**

The dam is to create a geometric takes place above a valley or low in order to reserve the water. The dams of the oldest the water plants known to human. They are usually classified according to forms and materials used in their construction, and the goals that were for constructed. The common types of dams are that arise from one type of material ,use multiple types of basic building materials in the establishment of dams, particularly the dirt, concrete and stone, but other materials such as brick, wood, metal and asphalt, plastic, rubber, etc. They are used on a very small scale .It can also be categorized dam storage dams for water supply, irrigation, power generation, navigation and other purposes, and flood protection dams and recharge dams, dams and underground dams that pays tribute to a private and for specific purposes. It can meet the dam over the purpose of these purposes.

### **4.4.2 Goals of dams**

The work of the dams for the following purposes:

1. Irrigation and agricultural uses and Livestock Development and Fisheries
2. Reduce flooding and protect from them.
3. Electrical energy production.

#### **4.4.3 Hydro generation is considered the first choice in the energy options for the following reasons**

1. Hydropower is clean energy environmentally friendly which the first choice in all countries of the world.
2. The water dam projects produce high-energy While one turbine can generate 800 MW while the largest solar module does not exceed 10 MW and the largest energy born from the wind not exceeding 5 MW.
3. Hydro power is cheaper while the cost of production of 1 MW hydro only 1.5 \$ , the production of solar power costs 15 \$ .

#### **4.4.4 Hydro power plants components**

##### **1. Reservoir and Dam**

The dam is used to reserve water in order to increase the energy status of the amount of water retained his successor, and the greater the height of the dam increased energy situation.

##### **2. Watershed (sinkhole Leaning)**

Words of tube italics up between the top and bottom of the dam and take water from the top of the dam to the entrance of the turbine. The water goes through this tube very quickly and you can control the speed of the water through the tube by the valve at the top of the tube and another valve in the most recent of which, where the higher the valve hole I said the water speed and lower the slot valve increased water flow speed.

### 3. Turbine

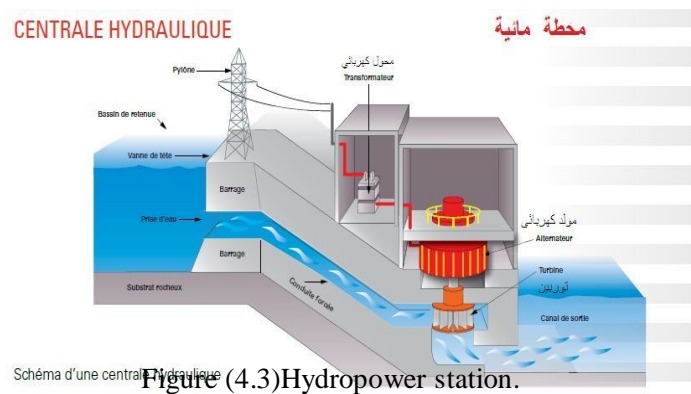
Turbine and generator are usually in the one place where riding the generator above the turbine when the valve opens at the bottom of the tube water flowing very quickly Vicu water pressure on the blades the turbine revolves turbine and operates the rotor in the generator with it and as the rotor is fed files stream continuously yields a static magnetic field and with rotor rotation turns hard magnetic field to a magnetic field of this area roundabout spinner cut hard User files, which generates a driving force, electric inducedelectromagnetic field. Theseelectromagnetic fieldlead to the passage of current in the hard User files, and thus generate electricity.

### 4. Tube drag

After that the water flowing in the works rotate the turbine must be pulled out quickly and easily so as not to hinder the rotation. So tubes placed special forms to pull out the necessary speed.

### 5. The equipment and auxiliary machines

Hydro generating stations automatic need many auxiliary machines such as pumps and gates, switches and equipment regulate the speed of rotation and others.



#### **4.4.5 Types of dams in terms of construction**

Dams can be classified according to the heights:

1. Short dam (height of up to 15 meters).
2. Dam Average (have a height of between 15 - 90 meters).
3. High Dam (increases the height of 90 meters).

#### **4.4.6 The most important parts of the dam**

1. Body of Dam
2. Spillway: It is a way to convert or to drain excess flood storage lake water to prevent it from exceeding that limit fullness, which may cause damage to the dam.
3. Storage Lake: Is any form of water storage or an artificial lake basins.

#### **4.4.7 The amount of electricity produced at hydroelectric stations on two main factors:**

1. The height of the water level in the dam compared with the level of the turbine (meter).
2. The amount of water flowing per second (in cubic meters).

The following describes the relationship that:

**Electric power (SI units) :**

$$P = \eta \rho Q g h \dots (4.3)$$

Where:

- P is power in watts.
- $\eta$  is the dimensionless efficiency of the turbine.
- $\rho$  is the density of water in kilograms per cubic meter..
- Q is the flow in cubic meters per second.
- g is the acceleration due to gravity.
- h is the height difference between inlet and outlet in meters[1].



## **Chapter Five**

### **Conclusion and Recommendations**

#### **5.1 Introduction**

It has become the world's attention is now turning to renewable energy and to increase its production of them being clean and environmentally friendly, and because oil impoverished wealth must reduce dependence upon as well as inexhaustible as the sun, wind, water, tidal and ocean thermal and geothermal, hydrogen energy is stored and biogas where he recently became used as a substitute for benzene. At this century a new century of renewable energies, especially solar energy and bioenergy in addition to Hydrogen energy.

From this research I recommend the following:

- 1- There should be a special renewable energies and be particularly at universities and scientific centers and units so that they are provided with modern laboratories and agencies that would develop this area and study the possibility of the application, and also the supervision of the Commission on the development of training programs aimed at rehabilitation and training of technicians and workers in this field body.
- 2- Support and deepen the scientific research in the fields of renewable energy and the creation of specialized databases for scholars and researchers in the field base.
- 3- Tuition artistic, technical and applied education and the creation of specialized institutes in the field of renewable energy.
- 4- The need to ensure scientific material for renewable energies within the curriculum at all grade levels.

5- Work sessions and information materials on climate change and global warming and the need for direction to clean energies environmentally friendly to raise citizens' awareness of the importance of technology and the use of new and clean energy and its role in preserving the environment.

6- Encourage domestic and foreign investment in the field of renewable energy.

7-Importance in the development of renewable energy components industry locally.

8- Exchange of experiences and transfer of technologies between the countries providing scholarships in this field, especially the successful experiences of countries such as India and Japan.

9- Need to focus on replacing traditional energy sources in industrial plants and alternative sources, especially agricultural, domestic and industrial biological pollution control and environmental protection waste.

10- Support and finance the production of renewable energy projects, especially the ones available locally (solar cells and biogas energy from agricultural products).

11- Renewable energy industries exemption from customs duties and additional components

## **5.2 Solar power**

1 - Oblige the state using solar energy in street lighting highways

2- Working age especially using solar energy in buildings on the level of planning laws and that by emphasizing the need to make use of solar energy in cities and neighborhoods, especially in the liberated areas of new planning by guiding buildings and approve the right of all housing units in the solar gain, as well as the architectural design level with the need to develop standards specify

energy-efficient buildings specifications with regard to thermal performance, which is directly related to the selection of construction materials and the use of thermal insulation materials, which reduces dependence on traditional energy and provide alternative renewable environmental and building a sound energy-saving.

3- Integrated work plan to guide wishing to set up factories investors produce solar energy systems.

4- Benefit study of the experiences of other countries in the field of solar energy production.

5- Speed up the development of solar cells and technologies industry and take advantage of available raw materials to support the industry.

### **5.3 Biogas**

1- Willingness to enter into bio-energy era as the least energy of the future cost and safest. Especially that Sudan by farmland, livestock and enormous wealth.

2- Support and encourage farmers to use agricultural wastes (especially in the cultivation of sugar cane areas) and animal in the production of energy.

### **5.4 Conclusion**

Since renewable energy is the best choice in this century Sudan is characterized by a number of sources and the Fair is characterized by brightly the sun throughout the year, which almost encourages the use of solar energy (electrical and thermal conversion), And also it contains a multi-Red Sea water sources and the River Nile ( area of State along) and this energy has been used since the time of helping to build dams have been many of them building Sennar Dam and Roseires on the Blue Nile and Tank Mount Awleia on the White Nile, and recently Marawi Dam on the River Nile in northern Sudan.

As for biomass energy are the energies that have not yet used the required level Although the Sudan is its first Agriculture, which can take advantage of agricultural waste are as great as in the State of India. If you found this energy additional attention by the government and largely it can be the first energy used in Sudan because it is the easy and available energies.

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