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GREEN ENERGY AND RENEWABLE ENERGY SOURCES

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Abstract: Energy is the property of objects which can be converted into different forms or can be transferred to other objects but cannot be created or destroyed. Green energy is the energy that is produced in such a way as to minimize its negative impact on the environment. It is a renewable source of energy. Sources of green energy such as solar, wind, geothermal and hydro energy are developed and promoted as alternative source that make little or no contribution to climate change. In this paper the author seeks to explore how green energy is useful for the future aspect of the world. And current application of this emerging technology, like generating electricity for various purposes, heating and cooling of water and more.

Keywords: Green Energy, different types of sources, advantages, applications

I. INTRODUCTION

The idea of green energy is introduced in November 2006 as renewable energy standard offer program. That offer was in short called asSOP or RESOP. It introduced a 20-year feed in tariffs for hydro, wind, solar (PV) and biomass projects. The Ontario Green Energy Act (GEA), officially the Green

Energy and Green Economy Act 2009 was introduced in the Ontario Legislature on February 23, 2009, to expand renewable energy production and encourage energy conservation [1]. The word 'Green' make our mind to think about a world without pollution and eco friendly. So, the green energy reflects the idea about generation of energy from natural resources like sunlight, wind, rain, tides, plant, algae, geothermal heat, etc. having no or less impact on the environment and can be renewed. These energy resources are renewable, meaning they're naturally replenished.

There are two types of sources of energy in the world: renewable energy sources and non-renewable energy sources.

Renewable energy sources are generated directly from nature for example, from the sun, rain, wind, tides, and it is possible to generate it over and over whenever it is needed. Renewable energy sources are abundant and are definitely the cleanest energy sources in Earth. Many types of Renewable energy sources are solar energy, biomass energy, wind energy, tidal energy, hydro energy, and geothermal energy. For instance, it is possible to use the energy from the sun and that is converted into electricity. Geothermal, wind, tides, and biomass energy from plants can also be used in different forms like Wind is harnessed from Earth's natural weather patterns. Hydropower comes from flowing rivers and from reservoirs. Solar energy comes from the Sun's light and radiation. Geothermal energy comes from the heat produced by the Earth underneath the ground. The advantages of Renewable energy are that wind, sun, ocean, and geothermal energy is in abundance and completely free of charge. The renewable energy sources have very low or zero carbon emissions, so they are environmentally friendly. Another advantage is, it is not necessary to rely on any country to supply renewable energy sources, unlike its non-renewable counterparts.

Non-renewable sources are not environmentally friendly and can have serious affect on our health. Most energy that is used in the world today is generated from non-renewable energy sources. These energy sources can be re-generated over a short period of time. Natural gas and oil are derived from ancient plant or animal remains or fossils. These remains are what we have been left with after millions of years of fluctuation in pressure and temperature. Non-renewable energy sources include oil, coal, natural gas, and nuclear energy. The advantage of non-renewable energy sources is it is ready, cheap, and easy to use. The non-renewable energy converts one non-renewable energy type to another. The major disadvantage of non-renewable energy sources is that they are finite and will expire sometime in the future. This will make the prices of these non-renewable energy sources increase dramatically. They also cause severe environmental changes and are in a large way responsible for climate change and global warming. Non-renewable energy sources can have a serious impact on human health, as they are certainly not environmentally friendly.

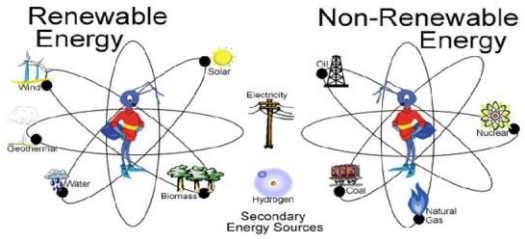

Fig.1: Diagram of Renewable and Non-Renewable Energy

Thus, in this paper we discuss about different types of green energies, its advantages and applications.

II. GREEN ENERGY

Green energy comes from natural sources such as sunlight, wind, rain, tides, plants, algae and geothermal heat. These energy resources are renewable, meaning they're naturally replenished. The different types of renewable energy technologies include:

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Solar energy, Marine energy, Wind energy, Hydropower, Bio-energy, Geothermal energy etc.

Fig.2: Diagram of Green Energy

There are various renewable energy technologies, which include hybrid and related technologies. These are effectively used for:

- Storing energy generated through renewable energy
- For predicting renewable energy supply
- Assisting in efficient delivery of energy generated by means of renewable energy technologies to energy consumers

A. CONCEPT

Our Traditional energy sources, such as fossil fuels have a big role in creating the effect of global warming and climate change to the earth and this makes us to create a subway to overcome these problems by introducing the concept of Green Energy. The primary goal of developing green sources of energy is to generate power and also to minimize both waste and pollution, so that we can reduce the impact of energy production on environment. Scientist who favoured the use of green energy said that we can reduce the rate of climate change by using such sources. In contrast to fossil fuel sources these sources are renewable. The concept of Green Energy most often considered when it comes to the issues such as cogeneration, heating and electricity. These sources can be purchased by the consumers or businesses as a means to support to support living which is environmentally friendly, by reducing bad impacts of energy production. Today energy certificate or renewable energy certificate can be purchased to support the use of green practices. It is estimated that more than 35 million European homes and 1 million American homes are currently using Green Certificates that symbolizes their use of Green Energy.
Ultimately, green energy is clean energy.

B. THE NEED OF GREEN ENERGY

Green energy is produced from renewable sources and produces very less impact on our environment. So, in order to protect Mother Nature from pollution and to ensure the supply of energy continuously we should start using green energy for industrial as well as domestic purpose. To limiting global warming and protecting ecosystems by reducing CO2 emissions through energy efficiency and renewable Energy, Green Energy Technology is essential. As temperatures rise, agricultural output will fall, damage from floods and storms will increase, (tropical) diseases will become more prevalent and access to water will become more of a problem for more and more people. The cost to our environment is greater and loss is irreversible. The Earth's flora and fauna will suffer both directly from higher temperatures and indirectly through the damage to their habitats. Ecosystems will disappear. Even small temperature increases will cause coral bleaching and threaten some amphibians. Temperature rises of 3° or 4°C and more will lead to major extinctions around the globe [2].

C. USES OF GREEN ENERGY

There are many options of using renewable energy at residential or commercial spaces.

Most common form of renewable energy comes from sunlight or solar energy. One can get solar panels installed in residential and commercial spaces where sunlight is available in plenty.

Other places where wind is in abundance may raise wind turbines to generate renewable energy. The energy thus gotten can be used for pumping water and or for charging sailboat battery.

Biomass is another very popular renewable energy source. It is used for producing electricity and also used as a transportation fuel. The use of biomass as a renewable form of energy is commonly known as bio-energy.

Geothermal energy on the other hand, taps the internal heat of the Earth for a variety of uses, including cooling and heating of buildings and electric power production.

Marine energy is yet another very important renewable form of energy. It comes from a variety of sources including tidal energy and energy generated from the ocean's waves, driven from both tides and winds.

III. TYPES OF GREEN ENERGIES

1. SOLAR ENERGY

Sun is a huge source of solar energy which provides energy to all the living creatures on earth. It is renewable and clean source which produce almost about 10,000 times more energy than earth can produce in 21st century. We can use this solar energy as green energy as it is the most suitable renewable energy source which is giving us energy directly and indirectly such as hydro, wind, etc. and having the least impact on the environment as it not taking part in increasing the carbon dioxide and does not lead to global warming in any way.

It can be converted into useful energy directly using various technologies grouped under two fundamental categories:

(i). Solar Photovoltaic (PV): Solar energy is directly converted into electricity by using photovoltaic cells. This technology is relatively new, as the solar cell was only first successfully developed in 1975. Solar cells use light energy from the sun to generate electricity through the photoelectric effect. They are arranged in such away so that they can capture as sunlight as possible.

Photovoltaic modules are the components of the PV system which are arranged in a way so that we can use them in some particular applications. While the majority of initial system capital cost may be attributed to the PV array, it is the "balance of the system" components that most affect reliability, efficiency and safety of the overall installation. Using Photovoltaic modules, the sunlight

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converted into direct current (DC). This direct current is then converted to alternating current (AC) through an inverter and adjusted to meet the power characteristics of the utility grid or the load.

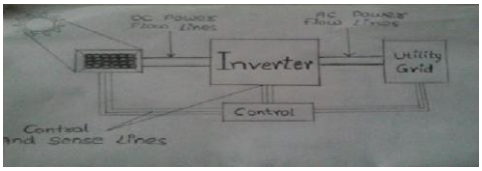

Fig.3: Simplified schematic diagram for a grid-connected PV system

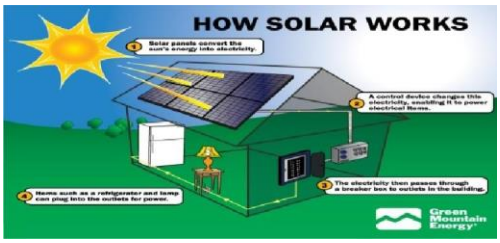

Fig.4: Use of Solar Panel

Solar Thermal: Solar Thermal refers to the utilization of the heat energy from the sun. Firstly, solar radiation can be absorbed in solar "collectors" to provide solar space or water heating at relatively low temperatures. In large-scale applications, solar radiation can be concentrated by parabolic mirrors to provide high temperatures, which may then be used either for direct heating purposes or to generate electricity. For example: via a conventional heat engine.

In solar thermal power plants, we concentrate the solar radiations on a small area to produce high temperature output. The steam which is produced through this heat is then allowed to fall on turbine- generator to produce electricity. This system is hybridized and sometimes also used as a storage system so to use it when sunlight is not available. Common solar thermal power systems include:

(ii) a. Parabolic Trough Systems

In Parabolic Trough system a mirror is used which is parabolic trough-shaped, in order to focus sunlight on a receiver tube. This is carrying a heat transfer fluid generally oil or water. This fluid is then heated up and pumped through heat exchangers to produce steam. This heat is then used to run turbine-generators to produce electricity. This Parabolic trough technology is currently the most proven solar thermal electric technology. This system usually aligned on a north – south axis, and rotated to track the Sun as it moves across the sky each day. This system is the most developed and mature CSP Technology. Optimal capacity size is 150 – 250 MW. This is enough to power 44,000 homes [3].

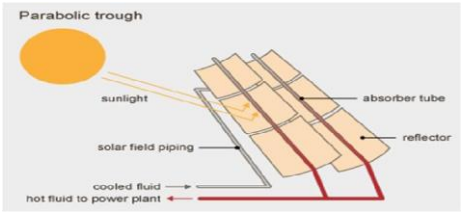

Fig.5: Parabolic Through System

(ii) b. Solar Tower Systems

Tower systems mainly consist of three main components: ground heliostats, a tower, and a central receiver at the top of the tower. The heliostats are used to capture solar radiation from the sun and re-direct it to the central receiver. A heliostat rotates in two dimensions, east and west, and north and south. Each heliostat is programmed through a computer to follow the sun and to maximize the total power output. The first commercial solar tower system was built by Abengoa Solar of Spain and is referred to as PS10 at the Solucar Platform in the Spanish province of Seville. The operation was started in March, 2007 and is still continue [4].

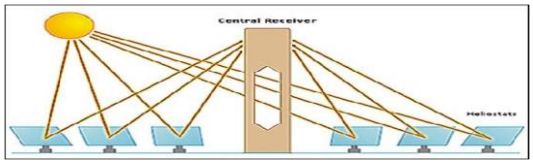

Fig.6: Solar Tower System Source:

(ii) c. A dish/Stirling system:

The dish/Stirling system is a source of renewable energy that generates power by using parabolically arranged mirrors to reflect sunlight onto a small thermal receiver, thereby heating a gas chamber connected to a piston and drive shaft. The drive shaft powers a generator which produces electricity to be distributed to a grid. Mainly this system consists of a parabolic dish concentrator, a thermal receiver and a Stirling engine located at the focus of the dish. The parabolic dish concentrator tracks the sunlight and focuses it into a cavity receiver where it is absorbed and transferred to a Stirling Engine. Stirling Engines are the most popular and widely used because they are having high thermal to mechanical efficiencies. They also provide potential for long time and low maintenance operations.

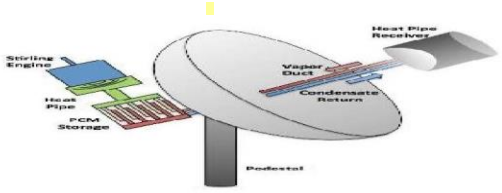

Fig.7: A dish/Stirling system Source

Dish/Stirling engines are modular in design. In Dish/Stirling engines each system is a self-contained power generator.

2. HYDRO ENERGY

Hydro energy is considered renewable because the energy from the sun powers the global hydrologic cycle. It is a power which is derived from water cycle, a continuous process of falling and fast running water to generate electricity.

Hydroelectric power is an established form of renewable energy that already provides a major source of electricity, approximately 19% of the world's electricity [5]. The majority of hydroelectric power harnessed in the world today is produced from large-scale schemes.

In addition, there is further scope for development of small-scale hydroelectric projects since:

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1. Large scale schemes can produce hundreds of mega watts and also involve construction of large dams to provide a sufficient head to the turbine;

2. Small scale schemes have less capacity and so have small dams and less impact on environment;

3. Micro scale schemes produce power in kilowatt and are used in small villages and individual houses.

Fig.8: Hydropower Plant Parts

3. GEOTHERMAL ENERGY

The term 'geo' means 'the earth' and 'thermal' means 'the heat' so geothermal means the energy which is generated in the form of heat which generates from the radioactive decay of materials inside the earth. It is the renewable and sustainable source of energy. The first geothermal power plant was built in Larderello. Magma which is produced from the radioactive decay of uranium and potassium below the earth crust produces lots of heat. The US National Renewable Energy Laboratory (NREL) found out that hot dry rock resources can provide about 4 million MW of capacity, which is more than all the electricity today US is using. If we compare geothermal in both the cases of size and consistency it can play an indispensible role in a cleaner, more sustainable power system.

(i). Geothermal Resources:

Four types of geothermal resources are hydrothermal, geopressured, hot dry rock and magma. Currently, only hydrothermal resources are in use commercially and other technologies are still under development. There are three basic components of hydrothermal resources: a heat source (magma), an aquifer (container of water), and an impermeable cap rock that seals the aquifer. To tap out the geothermal energy, aquifers are drilled and hot water and steam is extracted out.

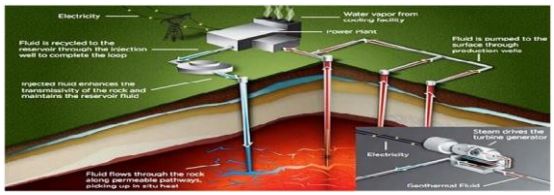

Fig.9: Geothermal Resources

(ii). Geothermal Technology

Geothermal energy can be used in generation of electricity or directly in space heating, water heating, greenhouse heating, aquaculture, laundries and industrial processes.

Geothermal systems are mainly subdivided into two production facilities-mechanical and disposal system. Firstly, the hot water and steam are delivered to the surface through bore holes and wells, then mechanical system which includes pipe, heat exchanger, pump and controls transport the energy for different applications. Then a disposal system receives and stores the cool fluid in storage ponds or injection wells. Geothermal energy is used either as heat source or a heat sink.

In Geothermal energy there are a number of technologies available, dry steam, flash steam, binary cycle systems, and hot dry rock and resources used in these are at high temperature.

a. Dry Steam Technology

The dry steam power plant is suitable where the geothermal steam is not mixed with water. Production wells are drilled down to the aquifer and the superheated, pressurized steam is brought to the surface at high speeds, and passed through a steam turbine to generate electricity.

Fig.10: Dry Stream Power Plant

Source:http:

Then cooling towers are use to vent out the waste heat. As the efficiency of dry steam plants are affected due to gases such as CO2 and H2S so it is reduced to 30% only. Commercially available range is from 35 to 120 MW.

b. Flash Steam Technology

Single flash steam technology is used where the hydrothermal resource is in a liquid form. The fluid is pumped and sprayed into a flash tank, which is at a much lower pressure than the fluid which causes the hydrothermal fluid to vaporize into steam. Then this steam is then passed to a turbine which is coupled to a generator to generate electricity.

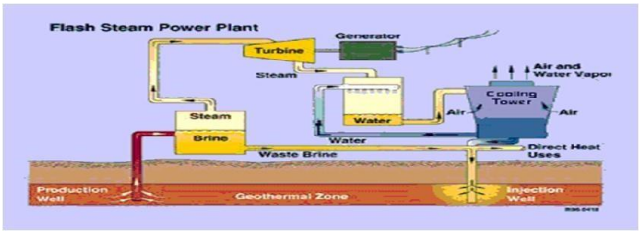

Fig.11: Flash Steam Power Plant

Most of the geothermal fluid is not flashed so it is reinjected into the reservoir or can be used in direct heat applications. But if the fluid is at high temperature, then it is passed to second tank which is then flashed into steam to generate electricity again. This will increase output power.

c. Binary Cycle Power Plant:

Binary cycle power plants are used where the resources are insufficiently hot to produce steam and contain many chemical impurities. Or we can use the fluid remaining in the flash steam power plants in binary cycle power plant. In binary cycle process first, the fluid is passed through a heat exchanger, then the

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secondary fluid such as isobutane or pentane having lower boiling point than water is vaporized and then passed to turbine to generate electricity. Then the remaining fluid is reinjected into the ground.

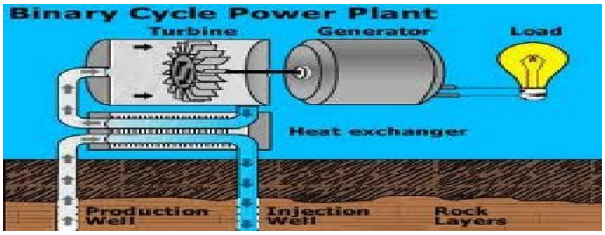

Fig.12: Binary Cycle Power Plan

4. Wind Energy

The energy which is generated by the flow of wind using wind turbines is called wind energy. It is a renewable source of energy which can be use as an alternative to fossil fuels. Wind energy is a clean energy which does not create pollution or releasing any harmful gases i.e. greenhouse gases. That's why it is considered as one of the sources of green energy. Wind is actually a form of solar energy; winds are caused by the heating of atmosphere by the sun, the rotation of the earth and the earth's surface irregularities. Wind turbines are usually installed in large land farms. Wind power capacity increases to 369.553 MW by Dec. 2014 and rapidly growing the total wind energy production, reached around 4% of total electricity usage [6]. Generally, all the large wind turbines have same structure consist of a horizontal axis wind turbine having upwind rotor with three blades. In a wind farm, each turbine is interconnected with a medium voltage power collection system and communication network. Today in wind turbines we use the combination of variable speed generators and partial or full-scale power converter between the turbine generator and the collector system. A wind turbine is a device that converts kinetic energy from the wind into electrical power.

The turbines which are smaller used for applications such as traffic lights signs, charging battery, etc. While large
turbines are used for the domestic power supply and the power which is of no use sell back to the utility supplier through the electrical grid. Arrays of large turbines, commonly called wind farm, are becoming an increasingly
important source of renewable energy. Many countries now started using these resources so that they can reduce them
dependence on fossil fuels. Generally, turbines are designed so that they not only work during blowing of wind but works at low wind speed too.

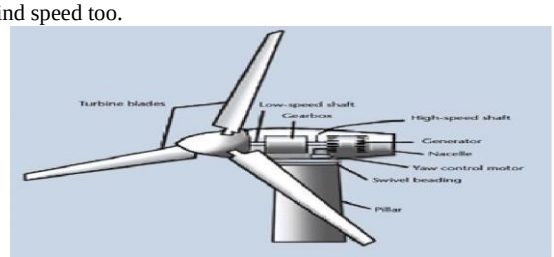

Fig.13: Wind Turbine

5. Vibration energy:

Vibration produced by a large crowd or by a large traffic on the road, vibrations of tall buildings, long bridges, vehicle systems, railroads, ocean waves can also be harvested efficiently. The vibration energy can be converted into electric energy and can be stored which can be used efficiently in giving power to many low power electronic appliances and the large vibration energy harvesting obtain 1 W to 100 kW or more [7].

When the vibration occurs about a point which is at equilibrium then this mechanical phenomenon is known as vibration energy. Everything present in the world vibrates at some frequency some at low which are detectable and some are at very high so that any human eye can't detect them. Vibration energy comes into focus from recent years. As we are now in need to find out different sources of energy which are renewable and continuous so that we can use these instead of fossil fuels. There are mainly two kind of vibration energy:

1. Free vibration: When a mechanical device is setup with an initial input and then it is free to vibrate i.e. known as free vibration. Examples for this type of vibrations is hitting a tuning fork and letting it to vibrate. In this type the mechanical systems vibrate one or more time than its natural frequency and ends up with zero frequency.

2. Forced Vibration: When time varying disturbances are applied to some mechanical systems such as load, displacement or velocity then the vibrations occur at that time are forced vibrations. The disturbances applied can be periodic, steady state, a transient or a random input type. In these the periodic disturbance can be of harmonic or non harmonic type. Example: the shaking of washing machine due to unbalancing.

Vibration energy can be converted to electricity by using transducer. And there are two transducers available for this. One is piezoelectric materials and another is electromagnetic transducer. Transducers are the device which converts different form of energy into electrical energy and hence in case of vibration mechanical energy is converted to electricity.

Piezoelectricity

Piezoelectric crystals are present in the crystalline structured form and can produce electrical energy when mechanical stress is applied on them.

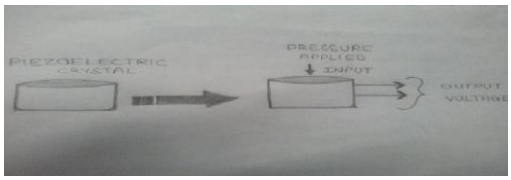

Fig.14. Principle of direct piezoelectric effect

Electromagnetic induction:

Some springs act as power generating medium, such as springs applied in the structures of buses and trucks to make their moments comfortable. There is a generation of electrical flux during the moment. When these springs move upward and downward continuously, they produce electromagnetic induction which is tuned into electricity. These types of springs are known as vibration amplification springs.

IV. ADVANTAGES OF GREEN ENERGY

1.SOLAR ENERGY

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- It is a clean source of energy which does not produce harmful gases as a co-product so have no effect on environment and human health.
- Many everyday items such as calculator and other low power consuming devices can be powered by solar energy effectively.
- It is a better source of energy for future generation as it last long forever (infinite).

2.HYDRO ENERGY

- It is one of the clean sources of energy because does not create any by-product during conversion.
- Hydroelectric power is a domestic source of energy, allowing each state to produce their own energy without being reliant on international fuel sources.
- It is reliable, affordable and vast source of energy.
- In addition to a sustainable fuel source, hydropower efforts produce a no. of benefits, such as flood control, irrigation and water supply.
- Hydro electric power plant reservoirs collect rain water, which can then be used for consumption or for irrigation.
- Hydroelectric installations bring electricity, highways, industry and commerce to communities, thus developing the economy, expanding access to health and education, also improving the quality of life.

3.WIND ENERGY

- It is a clean fuel source does not pollute air. Wind turbines do not produce atmospheric emissions that cause acid rain or green house gases.
- It is renewable source of energy require less cost.
- Land around wind turbines can be used for other users e.g. farming.
- In combination with solar energy, they can be used to provide reliable as well as steady supply of electricity.

4.GEOTHERMAL ENERGY:

- It is a cheaper and affordable source of energy used for bath, heating homes and offices, preparing food, etc.
- By using geothermal sources of energy present generations of human will not endanger the capability of future generation to use their old resources to the same amount.
- This is also cost effective, reliable, sustainable and environment friendly.
- Due to its low emissions geothermal energy is considered to have excellent potential for mitigation of global warming.

5.VIBRATION ENERGY

1. Vibration energy harvesting replaces the batteries in medical implants which is beneficial for the environment as these batteries contain toxic heavy metals. 2. We can use vibration energy to reduce the noise in environment which is mainly happening in industries or due to air craft's etc by vibration damping and vibration isolation.

V. APPLICATIONS OF GREEN ENERGY

1. Use in calculators, road signs, satellites, etc. as solar energy.
2. Passive space heating by solar energy.

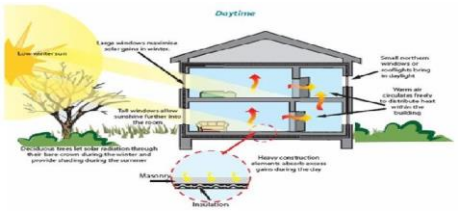

Fig.15: Passive space heating by solar energy

3. Warm up and keeping the food fresh by solar energy.

Fig.16: Solar Fridge

4. Water your plants with solar powered irrigation.
5. for hydrogen fuel production.

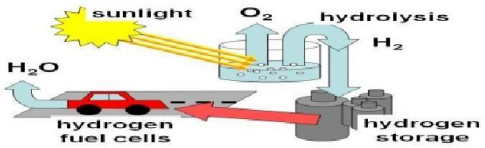

Fig.17: Hydrogen Fuel Production Source

6. Parabolic concentrating solar cookers.

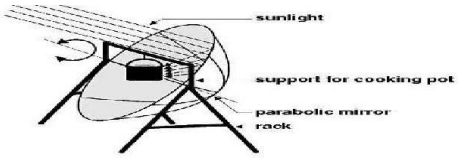

Fig.18: Solar Parabolic Cooker Source

7.Wind and solar power vehicles.

Fig.19: Wind Solar Powered Car

8.Wind /kite-power cargo ships.

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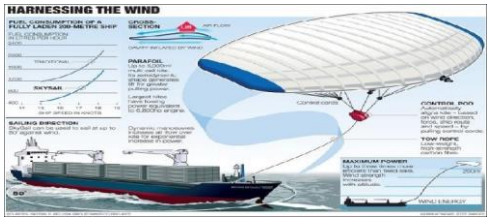

Fig.20: Wind /kite-power cargo ships.

9. Wind powered sorts like wind surfing, kite flying, kite surfing, hang gliding, Para sailing, wind skiing and more.

Fig.21: Wind Kites

10. Wind powered water pumps.

11. In farming like in fish farms in form of geothermal energy.

Fig.22: Geothermal Energy in Farming Source

12. Use in industries to dry fruits, vegetables, wood, wool to extract gold and silver from ore

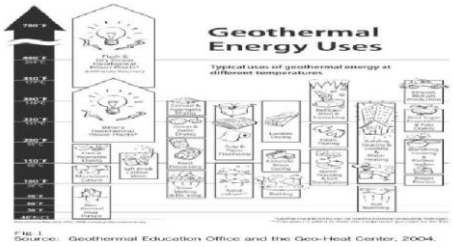

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Fig.23: Uses of Geothermal Energy

Fig.24: Geothermal Energy in Green Houses Source

13. Use to heat sidewalks and roads in order to prevent freezing in winters.

Fig.25: Geothermal Bike lanes Source

Building technologies: Some wireless sensors are made for the structural monitoring and safety systems of the building when there is power cut.

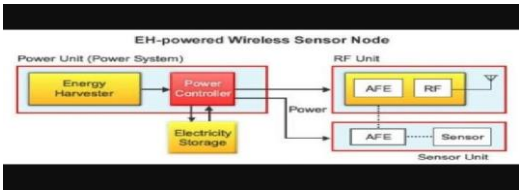

Fig.26: Wireless Sensors

14. Medical implants: Some medical devices are deployed inside human bodies for their well being. But these devices needs electricity to function properly which they get from the vibration of patient's own body movements such as heartbeats.

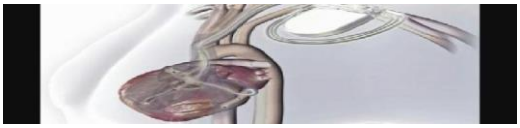

Fig.27: Medical implants Source:

15. Generating Electricity from the Weight of Cars & Pedestrians

A new technology of generating sustainable energy from flow of vehicles is introduced by the researchers in Mexico.

"This is a technology that provides sustainable energy and could be implemented at low prices, since it's a complement of already existing infrastructure: the concrete of streets and avenues," states Héctor Ricardo Macías Hernández, the developer of the system [8].

Fig.28: Generating Electricity from the Weight of Cars &Pedestrians

Mexican entrepreneurs developed a system capable of using the vehicular flow to generate electric energy [8].

An integrated ramp step which is made up of polymeric material is firstly installed which rises the street level about 5 cm. As the vehicles passes a pressure is exerted due to their weight on bellows which contains air which is expelled out through holes. Later this is compressed to produce electricity through a turbine.

17. Innovative tanks: Architect-designer invented some innovative tanks that can collect solar and water both at a time.

Fig.29: Innovative Tank Source

18. Concept of translucent battery charging from sun. A translucent lithium-ion battery that can be recharged in the sun is developed.

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Fig.30: Translucent Battery Source

20. Concept of sunny paper for charging gadget: A thinnest solar cell is introduced. It can be carried by folding in a book etc.

Fig.31: Sunny Paper for charging gadget

VI. FUTURE SCOPE

Green Energy is having a future in almost every field of the world like industrial, agricultural, Medical, domestic, etc. Scientists already have found many forms of green energy such as solar, wind, hydro, etc. and now they are working on some new forms of energy like radiation and biomass so to reduce the usage of non-renewable sources of energy as they are already depleting.

In coming years efficiency of solar panels is going to increase and it can work even in cloudy weather as researchers are already working on it. A new combined form of solar and hydro is also coming called solar/wind hybrids. This technology combines the wind turbines with solar photovoltaic (PV) panels to produce higher level of energy and the studies have found that these are nearly double efficient then the present ones [9].

Like these there are technologies which are already invented or just the concepts are given and are still developing. These inventions let us to make an environment which is using green energy completely and is eco-friendly.

VII. CONCLUSION

Through this paper we are trying to focus on need for energy which is eco- friendly and can be renewed which requires technological development to obtain the best utilization of green energy. As the resources obtained naturally has the potential to protect world and reduce dependence on non- renewable resources which are near to extinction.

Seeking from the future aspect green energy is an alternative source for power generation, provide energy in unlimited ways. The only need is to aware people for energy conservation along with environment. This is a step to generate different forms of energy in most of the field with clean source (less use of fossil fuel). Day by day the demand of clean energy is increasing; green energy will fulfil the need with more advance technological systems. But it will take some time when every single house operates their electrical appliances by using their own power producing system such as solar panels, small wind turbines etc.

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