Review on Green Energy

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***Abstract*— Energy can be converted into different forms or can be transferred from one object to another object but it can neither be created nor ne destroyed. The energy produced from the renewable sources such as sun, wind, water, tides etc. so that it can control the usage of non-renewable sources of energy is known as green energy. This review article approaches the current scenario of the world regarding the use of energies and the future advancements, advantages, disadvantages of green energy along with the various in economic and ecological fields are discussed.**

***Index Terms:* Green energy, environment, applications, green employment.**

I.INTRODUCTION

The term 'Green' makes us think about a pollution-free and eco-friendly world. Considering carbon dioxide as the major component of greenhouse gases, reducing carbon emissions has become a global concern. In November 2006, the Renewable Energy Standard Offer Programme (SOP) was launched by the Ontario Power Authority which introduced the idea of green energy. In this offer A 20 year tariff feed was introduced for hydro, solar, biomass and wind projects. Many countries have started to use renewable energy sources for power generation purpose. Also, many tax policies and renewable portfolio standards are being employed by governments for generation of renewable energy along with implementation of energy use efficiency for energy saving purposes. For stimulating the growth of renewable energy technologies, there are three primary motivators— 1. Energy security, 2. Economic impacts and 3. CO_2 emission reduction. Green energy reflects the idea about energy generation from resources like sunlight, wind, plant, rain, tides, geothermal heat, algae, etc. which are natural having no or negligible negative effects on the environment and are renewable naturally [1-3].

The world is fast becoming a global village due to the increasing daily requirement of energy by all population across the world while the earth in its form cannot change. The need for energy and its related services to satisfy human social and economic development, welfare and health is increasing. Returning to renewable to help mitigate climate change is an excellent approach which needs to be sustainable in order to meet energy demand of future generations [2]. The study reviewed the opportunities associated with renewable energy sources which include: Energy Security, Energy Access, Social and Economic development, Climate Change Mitigation, and reduction of environmental and health impacts. Despite these opportunities, there are challenges that hinder the sustainability of renewable energy sources towards climate change mitigation. These challenges include Market failures, lack of information, access to raw materials for future renewable resource deployment, and our daily carbon footprint. The study suggested some measures and policy recommendations which when considered would help achieve the goal of renewable energy thus to reduce emissions, mitigate climate change and provide a clean environment as well as clean energy for all and future generations.

Renewable energy sources have negligible or no carbon emissions, hence they are eco-friendly. Also, supply renewable energy sources are not dependent on other countries, unlike its non-renewable counterparts. Most Non-renewable sources have serious effects on the environment and hence are not environment-friendly. Though, even in today's world, most of the energy that is being used is generated from non-renewable energy sources which include oil, coal, nuclear energy, and natural gas. But the amount of non-renewable energy sources is finite as they take millions of years to form and cannot be replenished in a short span of time. They are

responsible for environmental changes as well as climate change and global warming. They can also have hazardous impacts on human health.

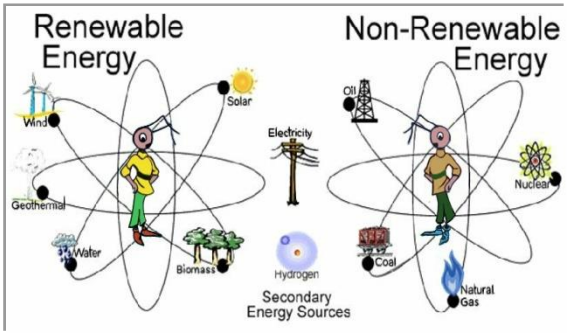

Fig. 1. Diagram of Renewable and Non-Renewable Energy

While discussing about clean technologies, two primary concepts of energy technologies are there: 1. Energy supply technologies: The technologies that referto alternative sources of renewable energy (e.g., wind and solar power), and 2. Energy efficiency technologies: The technologies that are hired to enhance energy use efficiency, (e.g., virtual power plants (VPP), combined heat and power (CHP) and smart meters) [4]. It should be highlighted that the energy sector transformation and using renewable energy sources as a replacement to conventional energy is a path towards progress associated with technological changes and forming markets. A sustainability analysis is required for the application of any renewable energy, which is dependent on three major factors: environmental effects, externalities costs, and economics and financing. Each one of these factors plays a major role on the application of renewable energies[5]; therefore,to assure that no social, environmental or economic problems arise, a detailed research must be done before promising communities to different kinds of renewable energies.

II.SUSTAINABILITY OF RENEWABLE RESOURCES

Renewable energy sources refill themselves naturally without being exhausted completely. The world's growing energy need, alongside increasing population led to the continual use of fossil fuel-based energy sources (Coal, Oil and Gas) which became problematic by creating several challenges such as: depletion of fossil fuel reserves, greenhouse gas emissions and other environmental concerns, geopolitical and military conflicts, and the continual fuel price fluctuations. These problems will create unsustainable situations which will eventually result in potentially irreversible threat to human societies (UNFCC, 2015). Reliable energy supply is essential in all economies for heating, lighting, industrial equipment, transport, etc. (International Energy Agency, 2014).

Despite the outstanding returns of renewable energy sources, certain limitation exists such as: the cutoff in the generation of energy due to seasonal variations as most renewable energy resources depends of weather and climatic conditions, that is why its uses requires intricate design, planning and regulated optimization methods.

III. CLIMATE CHANGE AND IT'S EFFECTS ON RENEWABLE ENERGY

The term "climate change" is presently of great interest to the world at large, in economic, scientific and political discussions. since the evolution of the world climate has been changing continuously. What seems a matter of concern is the speed of change in past few years which can be a threatening situation for the earth. From (1979–2014),the growth rate of carbon dioxide has found to have increased. According to Earth System Research Laboratory reported in 2015, the rate of carbon dioxide averaging about 1.4 ppm per year before 1995 and 2.0 ppm per year thereafter. The United Nations Framework Convention on Climate Change describes climate change as being related directly or indirectly to human activities that brings changes to the composition of the atmosphere which in turn shows inconsistency in climate observed over a certain time period [5-6]. For more than a decade, the objective of keeping global warming below 2°C has been a key focus of international climate debate. Since 1850, the global use of fossil fuels has increased and it dominates energy supply which leads to a rapid growth in carbon dioxide emissions which is toxic for the atmosphere. By the end of 2010, data confirmed that consumption of fossil fuels resulted for the majority of global anthropogenic greenhouse gas (GHG) emissions, where concentrations had increased to over 390 ppm (39%) above pre industrial levels (Edenhofer et al., 2011). Renewable

technologies are clean sources of energy, the optimal use of which decreases environmental effects, produces less secondary waste and are sustainable depending upon the current and future economic and social needs. Renewable energy technologies provide an exceptional opportunity for reduction of greenhouse gas emission and global warming through substituting conventional energy sources.

IV. RENEWABLE ENERGY SUPPLY TECHNOLOGIES

Supply of renewable energy is increasing continuously. During the recent years, a large amount of investment has been made for the advancement of technology which has enabled countries to produce renewable energy more cost efficiently. It is estimated that the number of countries producing above 100 megawatts (MW) of renewable energy will increase significantly by the next few years. Due to some negative and irreversible externalities rising with conventional energy production, it is necessary to promote and develop renewable energy supply technologies. These technologies may not be comparable with conventional fuels if considered in terms of production and usage cost, but they could be comparable if we consider their environmental and social effects. Also, the economies of scale could play a key role in reducing the unit production cost. Transmission and distribution costs, as well as technologies, do not vary much among the conventional and renewable energies.

A. *HYDRO POWER*

Hydropower is a clean and renewable energy source. Considering the economic, technical and environmental benefits of hydropower, most countries give priority to its development. For example, China has the richest hydro resources on the planet with a total theoretical hydropower potential of 694GW. Developing hydropower is of great importance to alleviate the energy crisis and environmental pollution resulting from the rapid economic growth of China and other countries in the 21st century. [4] Hydropower is generated using the mechanical energy of flowing water by forcing it through piping called a penstock, which then turns a generator in order to produce electricity.

Table 1. Renewable energy sources and their use (Panwar et al., 2011)

Energy sources	*Energy conversion and usage options*
Hydropower	*Power generation*
Modern biomass	*Heat and power generation, pyrolysis, gasification, digestion*
Geothermal	*Urban heating, power generation, hydrothermal, hot dry rock*
Solar	*Solar home systems, solar dryers, solar cookers*
Direct solar	*Photovoltaic, thermal power generation, water heaters*
Wind	*Power generation, wind generators, windmills, water pump*
Wave and tide	*Numerous design, barrage, tidal stream*

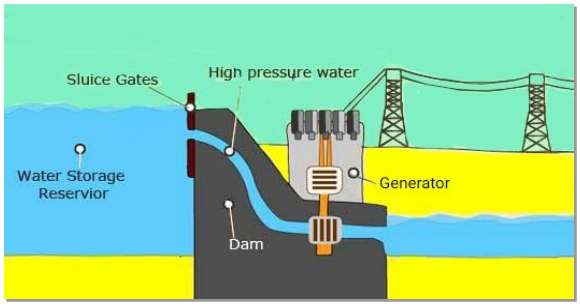

Fig. 2. Generation of Hydro Energy

Waterpower also consists of wave and tidal energy, which are both in the infant stage of research, as scientists try to discover how to harness the energy produced from movement of the ocean. [5] Hydropower has several advantages over most other sources generating electrical power. These include a high level of reliability, proven technology, high efficiency, very low operating and maintenance costs, and the ability to easily adjust to load changes. Generally many hydropower plants are located in conjunction with reservoirs, which provide water, flood control, and recreation benefits for the community. In addition, hydropower does not produce waste products that cause acid rain, and greenhouse gases [7]. Disadvantages of hydropower include high initial costs of facilities; dependence on precipitation (no control over amount of water available); changes in stream regimens (can affect fish, plants, and wildlife by changing stream levels, flow patterns, and temperature); inundation of land and wildlife habitat (creation of reservoir); and displacement of people living in the reservoir area.

The primary energy is provided by gravity and the height the water falls down on to the turbine. The potential energy of the stored water is the mass of the water, the gravity factor (g = 9.81 ms−2) and the head defined as the difference between the dam level and the tail water level. The reservoir level to some extent changes downwards when water is released and accordingly influences electricity production. Turbines are constructed for an optional flow of water (Førsund, 2015). Hydropower discharges practically no particulate pollution, can upgrade quickly, and it is capable of storing energy for many hours (Hamann, 2015). Figure (1) shows the general trend of worldwide hydro electricity consumption from 1965 to 2011.

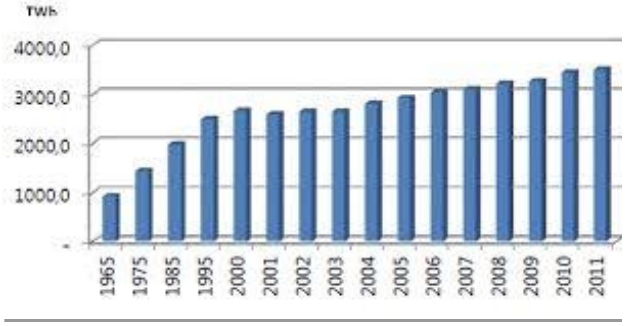

Fig. 3. Worldwide hydro electricity consumption, 1965-2011 (in TWh)

There are three kinds of hydropower generation plants: (i) run-of-river, where the power is generated by the flow of a river, (ii) reservoir, where the power is generated by the release of stored water, and (iii) pumped storage, where stored water is backed up into the reservoir in - 1000,0 2000,0 3000,0 4000,0 1965 1975 1985 1995 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 0,0 500,0 1000,0 1500,0 2000,0 2500,0 3000,0 OECD non-OECD 6 order to be pumped again. Small scale hydropower stations are typically of the run-of-river type. Wirl (1989) examined conventional standards to evaluate hydropower plant projects and argued that the conventional cost-benefit analysis is not applicable to evaluate the expansion of plants. Wirl believed that the actual cost of hydropower plants is underestimated because of negative environmental externalities and positive dynamic spillover effects. Sinha (1992) estimated a model for a hypothetical site to simulate performance and economic aspects of combined wind/hydro/diesel power plants with pumped storage. His model constitutes a wind energy conversion system, a mini/micro hydro plant, a diesel generator and a pump. The results show that pumped storage doesn't have a significant effect when wind and water systems are applied. However, it could be used in sites without natural inflows. Gagnon (1997) discussed GHG emissions from hydropower plants and shows that hydropower is a good alternative compared to fossil fuel power plants in most cases. Based on the results, a typical GHG emission factor is 15g CO2 equivalent/kWh, an amount which is 30-60 times less than conventional fossil fuel power plants. Paish (2002) argued that the main advantages for small-scale hydropower include a more concentrated energy resource than wind or solar, predictability, on demand availability, limited maintenance, long-lasting technology, lack of fuel, and no environmental impact.

B. BIOENERGY

Bio energy is a renewable energy source derived from biological sources. Bioenergy is an important source of energy, which can be used for transport using biodiesel, electricity generation, cooking and heating. Electricity from bioenergy attracts a large range of different sources, including forest byproducts such as wood residues; agricultural residues such as sugar cane waste; and animal husbandry residue such as cow dung. One advantage of biomass energy-based electricity is that fuel is often a by-product, residue or waste product from the above sources. Presently, global production of biofuels is comparatively low, but continuously increasing. The annual biodiesel consumption in the United States was 15 billion litres in 2006. It has been growing at a rate of 30–50% per year to achieve an annual target of 30 billion litres at the end of year 2012. Biomass has a large potential, which meets the goal of reducing greenhouse gases and could insure fuel supply in the future. A lot of research is being done in this area trying to quantify global biomass technology[8]. According to Hoogwijk, Faaij, Eickhout, de Vries, and Turkenburg (2005) the theoretical potential of bioenergy at the total terrestrial surface is about 3,500 EJ/year. The greater part of this potential is located in South America and Caribbean (47–221 EJ/year), sub-Saharan Africa (31– 317 EJ/year) and the Commonwealth of

Independent States (C.I.S) and Baltic states (45–199 EJ/ year). The yield of biomass and its potential varies from country to country, from medium yields in temperature to high level in sub tropic and tropic countries. With biomass, a lot of research is focusing on an environmentally acceptable and sustainable source to mitigate climate change (Demirbas, Balat, & Balat, 2009).

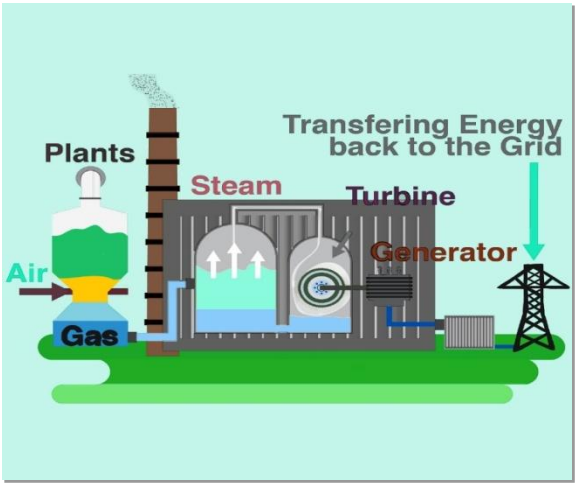

Fig.4. Generation of Bioenergy

The use of biological components (plant and animal source) to produce energy has always been a cause of worry especially to the general public and as to whether its food produce are to be used to provide fuel since there are cases of food aid needed around the world in deprived countries. Wood is still the largest biomass energy resource today, but other sources of biomass can also be used. These include food crops, grassy and woody plants, residues from agriculture or forestry, oil-rich algae, and the organic component of municipal and industrial wastes. Even the methane fume from landfills can be used as a biomass energy source. The use of biomass energy has the potential to greatly reduce greenhouse gas emissions, dependence on foreign oil, landfills, and finally supports local agricultural and forest-product industries[9]. The main biomass feed-stocks for power are paper mill residue, lumber mill scrap, and municipal waste. For biomass fuels, the most common feedstocks used today are corn grain (for ethanol) and soybeans (for biodiesel). Long-term plans include growing and using dedicated energy crops, such as fast-growing trees and grasses, and algae. These feed-stocks can grow sustainably on land that will not support intensive food crops. About 99.7% of human food is obtained from the terrestrial environment, while about 0.3% comes from the aquatic domain. Most of the suitable land for biomass production is already in use (Ajanovic, 2011). Current studies have underlined both positive and negative environmental and socio-economic effects of bioenergy. Like orthodox agriculture and forestry systems, bioenergy can worsen soil and vegetation degradation related with the overexploitation of forest, too exhaustive crop and forest residue removal, and water overuse (Koh & Ghazoul, 2008; Robertson et al., 2008).

Another benefit of biomass is its capability to convert into a range of valuable fuels, chemicals, materials, and products—much like crude oil:

1. Biofuel – Converting biomass into liquid fuels for transportation
2. Biopower - Burning biomass directly, or converting it into gaseous or liquid fuels that burn more efficiently, to generate electricity
3. Bioproducts - Converting biomass into chemicals for making plastics and other products that typically are made from petroleum.

Biomass with all of its benefits may cause harm for the environment, if one does not choose its crop for the production of biomass energy from the following list:

1. Energy crops that do not compete with food crops for land
2. Portions of crop residues such as wheat straw or corn stover
3. Sustainably-harvested wood and forest residues 1294 Javid Mohtasham / Energy Procedia 74 (2015) 1289 – 1297
4. Clean municipal and industrial wastes Beneficial biomass use can also be considered part of the terrestrial carbon cycle—the balanced cycling of carbon from the atmosphere into plants and then into soils and the atmosphere during plant decay.

Besides all of biomass energy advantages, there are also some downsides to it. For example biomass energy is insufficient source of energy compare to fossil fuels (ethanol vs gasoline). It could also be a great possibility for the global warming emissions associated with growing and harvesting biomass feedstock, transporting feedstock to the power plant, and burning or gasifying the feedstock. Transportation and combustion emissions are roughly

equivalent for all types of biomass. Thus, it is important to distinguish between biomass resources that are beneficial in reducing net carbon emissions, those that have an ambiguous impact, and those that increase net emissions. Another environmental impact of biomass energy is associated with land erosion because of the removal of the green vegetation. And finally land-use for the growth of the materials that are considered as biomass energy generators! Finally on the basis of the science, it is wrong to support the use of all biomass resources, with any conversion technology and for any application. It would also be unreasonable to oppose all biomass on the basis that some of the biomass resources, conversion or applications are not sustainable or beneficial! Therefore the best solution is to educate our communities to choose the best resources for generation of biomass energy.

C. SOLAR ENERGY

Solar power is the most abundant renewable resource on our planet. In spite of this abundance, only 0.04% of the basic power used by humans comes directly from solar sources because using a photovoltaic (PV) panel costs more than burning fossil fuels. Organic materials have recently been intensively studied for PV applications, not because of harvesting the sun's power more efficiently, but because power generation from organic photovoltaic (OPV) materials will cost considerably less than other PV technologies.

During the two last decades, the economic feasibility of solar power for residential, commercial and industrial consumption has been investigated by researchers. Industrial countries like Japan and Germany are looking for alternative sources of energy such as solar power due to the limited availability of natural primary energy sources. In early 1990s, Japan started to take advantage of large-scale electricity generation by solar photovoltaic (PV), and was soon followed by Germany. Currently, both countries have taken the lead in the manufacture and production of solar power technologies. More recently, China has developed an extensive solar power capacity due to cheap labor and government subsidies, in turn, decreasing the cost of solar power generation.

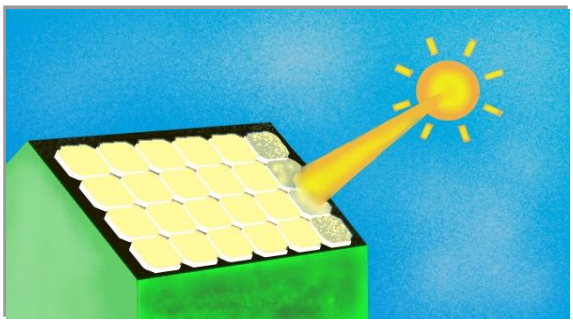

Fig.5. Solar panel and Solar Energy

Some renewable technologies, such as wind and ocean thermal, use solar energy after it has been absorbed on the earth and converted to the other forms. Solar energy technology is obtained from solar irradiance to generate electricity using photovoltaic (PV and concentrating solar power (CSP), to produce thermal energy, to meet direct lighting needs and, potentially, to produce fuels that might be used for transport and other purposes. According to the World Energy Council (2013), "the total energy from solar radiation falling on the earth was more than 7,500 times the World's total annual primary energy consumption of 450 EJ".

The cost of new photovoltaic power is dropping rapidly, and if the photovoltaic industry continues to grow and improve technologically, by 2020 the cost will be comparable to the cost of conventional power, as will the cost of solar thermal power.

Alongside the cost reduction in power generated through conventional solar PV technologies, the advancement, and increase in efficiency, of concentrated solar power technologies in the US has further reduced the cost of electricity in the solar power industry (Gevorkian, 2012). On the other hand, there are also negative effects caused by solar technologies, such as impacts on buildings' aesthetics, routine and accidental releases of chemicals, land use, etc. (Tsoutsos et al., 2005). The solar photovoltaic market has experienced extraordinary growth over the last five years. The market has increased from 9,564 MW in 2007 to 69,371 MW in 2011. Figure 3.5 shows the trend since 1996 to 2011 based on the BP (2012) report.

D. WIND ENERGY

Like other renewable energy sources, wind energy has many advantages. It reduces greenhouse gas emissions by using turbines, which produce energy and electricity when moved by the wind, and can

reduce electricity costs. All the turbines need in order to function is wind, which is just air in natural motion, and air is everywhere [10]. Wind signifies a free, abundant, and sustainable energy that will not depreciate if we take advantage of it. We are encouraged to maximize the benefits of this resource because it can only help make our world a better, cleaner place. It will also foster domestic growth for multiple reasons. First, the native materials used to construct the turbines promote the domestic economy. Second, the turbines are a profitable investment; growth and development in the technology predict a high potential return, and increases in investment augment the country's GDP.

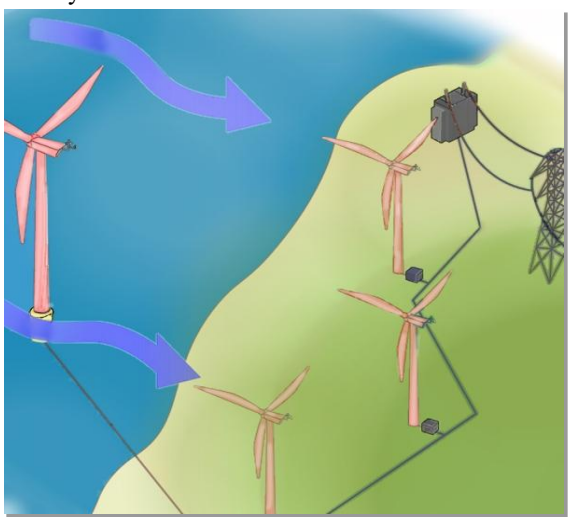

Fig.6. Generation of Wind energy by wind mills

Lastly, wind energy opens new markets and new prospects. Right now, mechanics are working to increase capacity factors so that energy can be stored for times when there isn't much wind. This project can be seen as a new economic opportunity for the US, as production of a new energy efficient generation continues. Humans cannot master nature, or else society will stagnate. Wind power is an option that works in accord with nature to promote social progress by rejecting the gloomy forecast of a world that has exhausted oils and fuels.

An investigation of the environmental impacts of wind energy production reveals a few hazards. Locating the wind turbines in or near the flyways of migrating birds and wildlife refuges may result in birds colliding with the supporting towers and rotating blades (Kellet 1990). For this reason, Clarke (1991) suggests that wind farms be located at least 300 meters (m) from nature reserves to reduce the risk to birds. The estimated 13,000 wind turbines installed in the United States have killed fewer than 300 birds per year (Kerlinger 2000). Proper siting and improved repellant technology, such as strobe lights or paint patterns, might further reduce the number of birds killed. The rotating magnets in the turbine electrical generator produce a low level of electromagnetic interference that can affect television and radio signals within 2 to 3 km of large installations (IEA 1987). Fortunately, with the widespread use of cable networks or line-of-sight microwave satellite transmission, both television and radio are unaffected by this interference. The noise caused by rotating blades is another unavoidable side effect of wind turbine operation. Beyond 2.1 km, however, the largest turbines are inaudible even downwind. At a distance of 400 m, the noise level is about 56 decibels (IEA 1987), corresponding roughly to the noise level of a home air-conditioning unit.

E. GEOTHERMAL ENERGY

The geothermal process involves trapping heat underground, then building energy that rises near the surface in the form of heat. When this heat naturally creates hot water or steam, it is harnessed and then used to turn a steam turbine to generate electricity. The Italians were the first to use geothermal energy for commercial purposes in the early 1900's. Geothermal energy is extremely kind to the environment. It offers a constant, efficient supply of clean energy with minimal impact on its surroundings. Geothermal energy, or energy derived from heat coming from the earth's interior, has many different uses. These uses can be grouped into three categories: for heating systems (and direct use), for generation of electricity, and for use in geothermal heat pumps. Besides these practical uses of geothermal energy, there are many other things that make geothermal energy a very valuable energy resource. Since the earth's core continuously produces heat with the radioactive decay of elements such as potassium and uranium, geothermal energy turns out to be a renewable, abundant, and reliable energy source. A geothermal energy plant does not make use of fuel, thus, it is both sustainable and safe for the

environment. Emissions of geothermal energy operations are low. These operations neither pollute the air nor contribute to global warming.

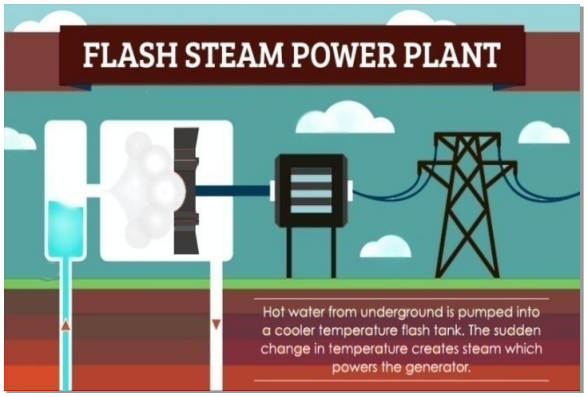

Fig. 7: Generation of Geothermal power

Renewable energies also meet the growing energy needs and allow the technological developments without damaging the future of our planet, the atmosphere and the environment. Geothermal energy, which is one of these energies, has great importance for some part of world. For example, Turkey has very rich geothermal energy resources and it is ranked fifth in the world after China, Japan, USA and Iceland; and the Turkish government support and promotion of the renewable energies has also been a major boost in the geothermal power. The drawbacks of geothermal energy power plants are its location because finding suitable locations for these power plants is not an easy task. The number of locations that can accommodate geothermal power plants is very limited. The location must have hot rocks so they can easily be drilled. Besides the rarity of suitable geothermal power plant locations, there is also the issue of safety. The concentration of geothermal energy can usually be found along plate boundaries, where volcanoes are concentrated and earthquakes are most frequent. Once in a while, geothermal energy locations run out of steam for a couple of months, during which the power plant is unable to produce electricity. Geothermal energy provides relatively smaller amount of power compared to other energy sources. Power derived from geothermal energy is difficult to transport. Thus, geothermal power plants can only provide energy to the areas surrounding them. While the steam itself can be clean and safe, it can come out with hazardous materials from underground such as hydrogen sulfide, mercury, ammonia, and arsenic. Finally geothermal energy can also cause earthquakes.

V. CONCLUSION

Energy is a requirement in our everyday life as a way of improving human development leading to economic growth and productivity. The return-to-renewables will help mitigate climate change is an excellent way but needs to be sustainable in order to ensure a sustainable future for generations to meet their energy needs. Knowledge regarding the interrelations between sustainable development and renewable energy in particular is still limited. The aim of the paper was to ascertain if renewable energy sources were sustainable and how a shift from fossil fuel-based energy sources to renewable energy sources would help reduce climate change and its impact. In this way, a creation of global opportunity through international cooperation that supports least developed and developing countries towards the accessibility of renewable energy, energy efficiency, clean energy technology and research and energy infrastructure investment will reduce the cost of renewable energy, eliminate barriers to energy efficiency (high discount rate) and promote new potentials towards climate change mitigation. It is very clear scientists are faced with a very hard job to convince public to divert their attentions toward renewable energies and forget about the convenience of working and dealing with fossil fuels on a daily basis! Having said that I know for fact all it takes to make public aware of the problems associated with fossil fuels is to present them with some statistical data about health issues as well as environmental catastrophe from some of the major big cities around the world! We should also create an environment in which usage of renewable energies becomes rewarding (i.e., tax incentive) in order to encourage people to use them. One of the best communities within the U.S. that promotes renewable energies as well as sustainable living is the City of Portland in Oregon! Portland could and should be used as a role model within the field of sustainability everywhere; because of its promotion of renewable energies for the new and existing communities, public transportation, and the famous three Rs (Recycle, Reuse and Reduce)!

Luckily based on the performance of the available renewable energy sources and findings of the U.S. Energy Information Administration public has realized the health impacts of fossil fuels as well as its impact on the environment; therefore they have slowly turned toward renewable energies. Hopefully within the next decade, the jump in the consumption of the renewable energies will be far greater than few percent.

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