

## Green Energy and Environment Sustainability

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### ABSTRACT

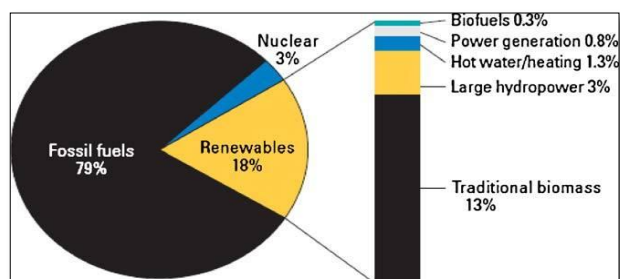
In this paper, a brief review on the sources of green energy and their sustainable in global as well as in Indian context has been presented. It shows that green energy is a basic requirement of human being but their further development and proper use is needed otherwise it may be lapsed in few decades. There are various sources of green energy have been discussed but some them are going to die or we say not in frequent use. To save them and develop efficiently there are many polices have been made at national and international.

**Keywords:** Green energy, Biofuels, Fossil fuels

### INTRODUCTION

In the recent scenario, there is a need of an alternative energy resource for which green energy is most suitable alternative around the globe. Green energy (sometimes called renewable or sustainable energy) is derived from regenerative resources of energy and do not reduce over period of time. Green energy focuses on the atmosphere cleaning by reduction of CO<sub>2</sub> emission and generates improved public health. It generates from resources which are natural like water, biomass, sunlight, landfill gas and wind [1]. Resources of green energy are very environmentally friendly as compare to the other type of energy resources which are not responsible to global warming or change in climate. Recently, green energy is the future, it generates naturally and supply continuously without any major negative collision to the atmosphere and it leads to save the future of our planet.

According to Forum of World Energy is that biofuels, gases and coal will be worn out in less than coming 10 decades. A major part (79%) of the energy from fossil fuels is consumed by humans and transport sector used 57.7% of that amount and again retreating fast [2]. The consumption of resources (natural) and the high demand of conservative energy have enforced humans to look on some other sources of energy. World's 18% final energy consumption is supplies by Green (Renewable) energy and this level is going to increase in future. The global distribution of energy consumption is shown in **Figure 1**.



**Figure 1.** Green energy contributed at worldwide final energy utilization [3].

According to Renewable Energy Policy Network for 21st Century, i.e., REN21 (2010), there are four major areas of green energy such as water and air cooling/heating, electricity generation, rural (off-grid) energy services and transportation.

According to the report REN21's (2017) found that about 19.3% renewable contributed to worldwide energy utilization by the humans and in 2015-2016 production of electricity is 24.5%. The rate of energy utilization is divided

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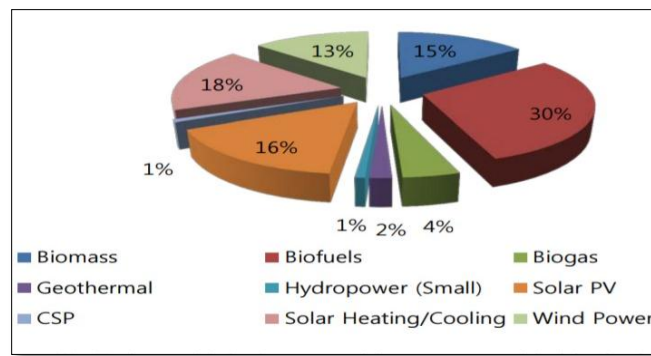
as (Table 1):

**Table 1.** Rate of energy utilization from different sources.

| Percentage of Energy | Sources  |
|----------------------|--|
| 8.9%                 | Customary biomass  |
| 3.9%                 | Hydro electricity  |
| 4.2%                 | Heat Energy through solar heat, geothermal and biomass     |
| 2.2%                 | Electrical energy from biomass, solar, wind and geothermal |

The united states and china are highly marketing in wind, solar and biofuels and in hydro portions [4] due to this around 7.7 million jobs are generated in the field of solar photovoltaic development [5] at the end of the 2015 around half of the total electricity is generated which was renewable

[6]. In some countries the employment rate is decreases like in Spain and Germany [7]. On the basis of GSR 2012 report the estimate job distribution is in the field of green energy is shown in **Figure 2** and about 30% jobs are possible in this sector which is the highest among the others.



**Figure 2.** Worldwide estimated jobs in green energy sector [8].

Green energy is widely spread in all over the green (natural) world which helps in climate change mitigation, energy preservation and economic benefits [9].

**HISTORY OF DEVELOPMENT**

The chronological evidences show that the coal is the first source of green energy than the energy of biomass was introduced in 19th century and then next was wind energy. When moving into the historical records of the green energy and it found that main (traditional) resources of green power were power of animal, human, water, fire, wind [10] and biomass. Fossil fuel was introduced in 1860’s and 70’s which was very beneficial then photovoltaic effect in solid state was found in 1885 [11]. In 1905 Max Weber focused on the fossil fuel energy in his paragraph “Die protestantische Ethik und der Geist des Kapitalismus” (bis der letzte Zentner fossilen Brennstoffs verglüht ist). At the end of the World War 1 solar engines were introduced. The significance of solar power was noticed in the article “Scientific American” in 1911 [12]. In 1960’s green revolution was noticed in extension of agriculture. In 1970’s green energy was highly promoted especially solar power but in 1980 the cost of solar panels were so high [13]. IEA 2014 focused on world energy outlook on green power

supplies will be 1,700 GW to 4,550 GW from 2014 to 2040 [14].

**RESOURCES OF GREEN ENERGY**

There are various resources of green energy some of them are described here in brief. These resources are natural and environment friendly so it is safe for human being as well as to our planet.

**Biofuels**

A fuel derived from living sources (matter), biological processes and anaerobic digestion. It is directly produced through plants and domestic wastes. In this process contemporary CO<sub>2</sub> fixation is occurred by the photosynthesis process of plant and microalgae. The main advantage of biofuel is availability. This is very helpful in controlling air pollution. Biofuels produce Biodiesel that is a type of diesel fuel produced by recycled eatery lubricants animal fats or vegetable oils. It is bio decomposable. The pure form of Biodiesel is B<sub>100</sub> and other common forms are B<sub>2</sub>, B<sub>5</sub> and B<sub>20</sub> (in which 2%, 5% and 20% biodiesel) are found.

**Biomass and bioenergy**

Living organisms’ biological material is biomass. In 2016, USA gathered the 5% energy from biomass in which

biofuels from 48% and 41% from wood based biomass [15]. Biomass Energy Center [16] reported that at present wood biomass is the largest source of green energy. Bioenergy is also a green or renewable energy derived from living sources. It generated from the area of forests or agriculture, organic wastes and municipal wastes [17]. Tester [18] said that the availability is the main advantage of biomass production means living organisms are found everywhere. There are many types of energy produced from biomass for example chemical feedstock, cooking heat, electricity, etc. [19-21].

**Hydropower**

The energy released from water is called hydropower. In this, through watermills kinetic energy of water, changes into mechanical energy or hydroelectricity. In 2016, 1064 GW or 16.4% of global electricity is generated from hydropower.

**Geothermal energy**

Heat that is stored inside the earth is help in producing geothermal energy. At present 10,000 MW over the world geothermal energy is produced. Geographical survey

reported that in India have observed existence of about 340 warm springs inside the hot nations.

**Solar energy**

The energy produces by sun light is called solar energy. China is a leading solar power generator in world with 100 GW installed capacity. In India the highest energy producer is western Rajasthan region and lowest is the north-eastern region. India indicated a good level of getting the solar power [3]. The installed capacity of India is 23 GW of 30 June, 2018 and may be extended up to eight times in future.

**Wind energy**

The power which generate through the high speed of wind is called wind power. Large numbers of wind turbines are installed at field and their mechanical energy converted into electrical energy. In 2016, 500,000 MW wind energy produced over the world.

**GREEN ENERGY IN INDIA**

Indian Government has also taken many initiatives to increase the growth and development in green energy sector. The database from Ministry of Renewal Energy in Indian is shown in **Figure 3**.

| Renewable energy in India at a glance [7]. |   |  |   |
|--|---|--|---|
| Sl. no.                                    | Source/system   | Estimated potential                          | Achievements (as on 30 September 2008)        |
| 1  | A power from renewables                                     |  |   |
| A.   | Grid interactive renewable power                            | (MW)   | (MW)  |
| 1.   | Wind power  | 45,195                                       | 9521.80                                       |
| 2.   | Biopower (agroresidues and plantations)                     | 16,881                                       | 656.60  |
| 3.   | Bagasse cogeneration  | 5000   | 993.83  |
| 4.   | Small hydro (up to 25MW)                                    | 15,000                                       | 2220.99                                       |
| 5.   | Energy recovery from waste (MW)                             | 2700   | 55.25   |
| 6.   | Solar photovoltaic power                                    | -  | 2.12 MW                                       |
|  | Sub total (A)   | <b>84,776</b>                                | <b>13,450.59</b>                              |
| B.   | Captive/combined heat and power/distributed renewable power |  |   |
| 7.   | Biomass/cogeneration (non-bagasse)                          | -  | 136.70  |
| 8.   | Biomass gasifiers   | -  | 102.21  |
| 9.   | Energy recovery from waste                                  | -  | 31.07   |
|  | Sub total (B)   | -  | <b>269.98</b>                                 |
|  | Total (A+B)   | <b>84,776</b>                                | <b>13,720.57</b>                              |
| II   | Remote village electrification                              |  | <b>5379 villages/hamlets</b>                  |
| III  | Decentralized energy systems                                |  |   |
| 10.  | Family-type biogas plants                                   | 120 lakh                                     | 40.32 lakh                                    |
| 11.  | Solar photovoltaic systems                                  | 50 MW/km <sup>2</sup>                        | 120 MWp                                       |
|  | i. Solar street lighting systems                            | -  | 70,474 nos.                                   |
|  | ii. Home lighting systems                                   | -  | 434,692 nos.                                  |
|  | iii. Solar lanterns   | -  | 697,419 nos.                                  |
|  | iv. Solar power plant                                       | -  | 8.01 MWp                                      |
|  | v. Solar photovoltaic pumps                                 | -  | 7148 nos.                                     |
| 12.  | Solar thermal systems                                       |  | 4,78,058 nos.                                 |
|  | i. Solar water heating systems                              | 140 million m <sup>2</sup> of collector area | 2.45 million m <sup>2</sup> of collector area |
|  | ii. Solar cookers   | -  | 6.37 lakhs                                    |
| 13.  | Wind pumps  | -  | 1342 nos.                                     |
| 14.  | Aero generators/hybrid systems                              | -  | 723.00 kW                                     |
| IV   | Awareness programs  |  |   |
| 15.  | Energy parks  | -  | 516 nos.                                      |
| 16.  | Aditya Solar Shops  | -  | 269 nos.                                      |
| 17.  | Renewable Energy Clubs                                      | -  | 521 nos.                                      |
| 18.  | Distric Advisory Committees                                 | -  | 560 nos.                                      |

MW = mega-watt; m<sup>2</sup> = square meter; km<sup>2</sup> = kilowatt; MWp = mega watt peak

MNRE (www.mnre.gov.in)

**Figure 3.** Green energy in India at a glance (<http://www.mnre.gov.in>).

**ENVIRONMENTAL SUSTAINABILITY**

Environmental sustainability and social development are the most important aspect of increasing living standards and the

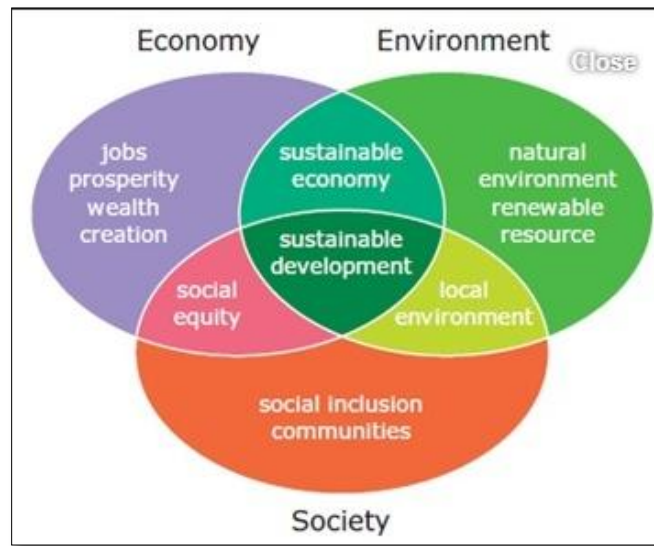
growth of economy. The pollution, biological damages, heavy waste, population growth cause climate change and green energy is also affected by these reasons. The poor

energy services make worse social issues like-unemployment, poverty, inequity and ill health (diseases) so for controlling this firstly we conserve our natural resources, greenery of the earth and use different management techniques - Clean development mechanism, Green Nanotechnology, Green chemistry, Green Economy, Green Technology and Architecture and supports plantation, Energy Conservation, Energy Recycling, Power, Energy Engineering, Environmental Engineering, Energy Storage, Conversion and Grid Modernization, Bioremediation, afforestation. Environmental sustainability is mandatory to live a healthy and standard life.

Sustainable Development aims to address all the environmental, economic and socio-political problems, without compromising either one another and without jeopardizing human capability and development. It can be

seen in **Figure 4**. According to United Nations (UN) sustainable development submit held in New York on September 25-27, 2015, eight goals which were previously decided and also achieved. These are as follows:

1. To eradicate extreme poverty and hunger
2. To achieve universal primary education
3. To promote gender equality
4. To reduce child mortality
5. To improve maternal health
6. To combat HIV/AIDS, malaria, and other diseases
7. To ensure environmental sustainability
8. To develop a global partnership for development



**Figure 4.** Sustainable development parameters.

Further, seventeen goals are needed to maintain environmental sustainability which are shown in **Figure 5** and also described here one by one. The new Sustainable Development Goals (SDG) targets will be reviewed in 2030 when that will expire as stated below.

1. End poverty in all its forms everywhere.
2. End hunger, achieve food security and improved nutrition and promote sustainable agriculture.
3. Ensure healthy lives and promote well-being for all at all ages.
4. Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.
5. Achieve gender equality and empower all women and girls.
6. Ensure availability and sustainable management of water and sanitation for all.
7. Ensure access to affordable, reliable, sustainable and modern energy for all.
8. Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all.
9. Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation.
10. Reduce inequality within and among countries.
11. Make cities and human settlements inclusive, safe, resilient and sustainable.
12. Ensure sustainable consumption and production patterns.
13. Take urgent action to combat climate change and its impacts.

14. Conserve and sustainably use the oceans, seas and marine resources for sustainable development.
15. Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification and halt and reverse land degradation and halt biodiversity loss.
16. Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels.
17. Strengthen the means of implementation and revitalize the global partnership for sustainable development.



Figure 5. New sustainable development goals (SDG) of 2015.

### CURRENT ENERGY POLICIES IN INDIA

The Electricity Act 2003, National Electricity Policy 2005, National Rural Electrification Policies 2006, Tariff Policy 2006, Integrated Energy Policy Report (Planning Commission) 2006. These policies suggest that the green energy path in all over the country up to 2031-2032. These policies focus and special emphasis on the development of the green energy.

### RECENT INITIATIVES IN INDIA

Akshay Urja Shops or renewable (green) energy shops, District Advisory Committees (DACs), Energy parks, Rajiv Gandhi, Akshay Urja Newsletter (Renewable Energy Newsletter), Akshay Urja Diwas (Rajiv Gandhi Renewable Energy Day) Green (Renewable) Energy Clubs etc. take initiatives for development and preserve our green energy.

### CONCLUSION

From this chapter, we can conclude the following:

- Green energy is the recent energy alternative which can be for long which is safe and environmental friendly.
- In India as well as in world, advancement in green energy resources is on priority.
- The level of the production of green energy is continuously increasing.
- Indian Government takes many initiatives and make polices for the green energy production and development.
- At last, we can say that for environment sustainability, green energy is a key of success which should be utilized in properly.

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