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A Review of Renewable Energy Prospective Universally

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ABSTRACT
The use of fossil fuels as energy is now broadly accepted as unsustainable due to depleting resources and also due to the accumulation of greenhouse gases in the environment. To resolve this problem use of renewable energy is now in focus, renewable energy plays a crucial role in dealing with energy security, eco-friendliness and climate change issues at global and national level. Renewable energy continued to grow strongly in 2012 in both OECD and non-OECD countries. This paper reviews the global growth of renewable energy and present renewable energy status in India, with the main focus on algal biofuel and its future prospects in India.

Introduction

Energy is one of the most important and fundamental parts of our universe. Every day we use energy to do work. Energy lights our cities, Energy powers our vehicles, trains, planes and rockets. Energy warms our homes, cooks our food, Energy powers machinery in factories and tractors on a farm etc.

Global energy demand is increasing with time, industrialized countries and developing countries such as India and China have high energy demand for their rapid economic growth. Currently combustion of fossil fuels can full fill the global energy demand but this is resulting problems such as supply insecurity, air pollution, environmental degradation, and climate change and price volatility. With a projected world population of 10 billion by the year of 2050, the increasing global energy demand will drive a more rapid depletion of the world fossil fuel reserves. Which may results tightening of energy supplies in the future and this will results in an upsurge of fuel and electricity prices.

To address these depletions use of renewable energy is the best way. Renewable energy “Energy that cannot be exhausted and is constantly renewed known as renewable energy; Renewable energy is generated from natural resources that are continuously replenished. This includes sunlight, wind, geothermal heat, water, tides, and various forms of biomass [1]. Can reduce the dependency on exhaustible sources of fossil fuels Renewable energy plays a crucial role in dealing with energy security, eco-friendliness and climate change issues at global and national levels [2]. The use of renewable energy is not new idea, it is well known from thousands of years ago and so on. Prior to the development of coal in the mid-19th century, nearly all energy used was renewable. Use of biomass for fire was one of the oldest known renewable energy source, dates from 790,000 years ago [3]. Wind energy is second oldest renewable energy source used for drive ships over water. This practice can be traced back some 7000 years, to ships on the Nile [4]. Moving into the time of recorded history, the primary sources of traditional renewable energy were human labour, water power, and animal power, wind power, in grain crushing windmills, and firewood, a traditional biomass. By 1873, use of solar energy comes in more practice and gradually in some prompted experiments it takes place of coal [5]. Development of solar engines continued until the outbreak of World War I. In 1911 the importance of solar energy was recognized by a Scientific American article: in the far distant future, natural fuels having been exhausted [solar power] will remain as the only means of existence of the human race [6]. In 1956 the theory of peak oil was published [7]. In the 1970s environmentalists promoted the development of renewable energy both as a replacement for the eventual depletion of oil, as well as for an escape from dependence on oil, and the first electricity generating wind turbines appeared. Solar had long been used for heating and cooling, but solar panels were too costly to build solar farms until 1980 [8]. Development of renewable energy surge with time to time and finally, now it contributes about 16% of global final energy consumption comes from renewable resources. (Figure 1) [9].

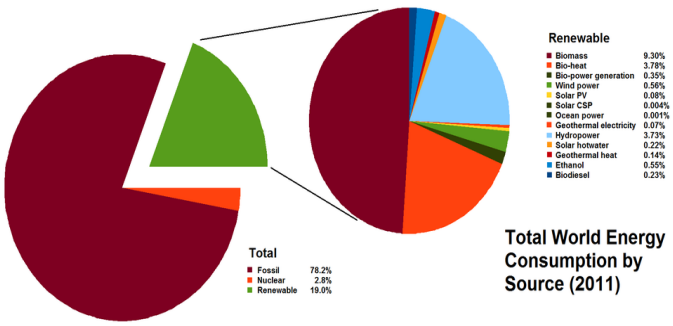

Figure 1. Total world renewable energy consumption

In which 3.7% from hydroelectricity, and 10% of all energy from traditional biomass mainly used for heating. New renewables such as small hydro, modern biomass, wind, solar, geothermal, and biofuels accounted for another 3% and are growing rapidly [10]. In electricity generation 16% of electricity coming from hydroelectricity, 19% from renewable and 3% from new renewables [11]. Renewable energy can replaces conventional fuels by electricity generation, hot water/space heating, motor fuels, and rural (off-grid) energy services, at least 30 nations around the world already have renewable energy contributing more than 20% of energy supply [12]. In 2011, India was the fourth largest energy consumer in the world after the United States, China, and Russia. India's economy grew at an annual rate of approximately 7 percent since 2000 and proved

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relatively resilient to the 2008 global financial crisis. India was the 10th largest economy in the world in 2011, as measured by nominal gross domestic product (GDP). India's energy basket has a mix of all the resources available including renewables. The largest energy source is coal, followed by petroleum and traditional biomass (e.g., burning firewood and waste).

At present India's coal dependence is borne out from the fact that 54 % of the total installed electricity. Other renewables such as wind, geothermal, solar, and hydroelectricity represent a 2 percent share of the Indian fuel mix. Nuclear holds a one percent share [13]. As known Indian is a place with ideal environment and sufficient amount of biomass suitable for production of renewable energy. From few years a drastic change is seen in the growth of renewable energy specially wind power, solar power but biofuel production is still not on the track. Here, we will deliberate about renewable energy growth especially about algae biofuel in India and all over the world and its future in India.

Overview of Global Renewable power capacities

Globally, renewable energy continued to grow strongly in 2012 in both OECD and non-OECD countries.

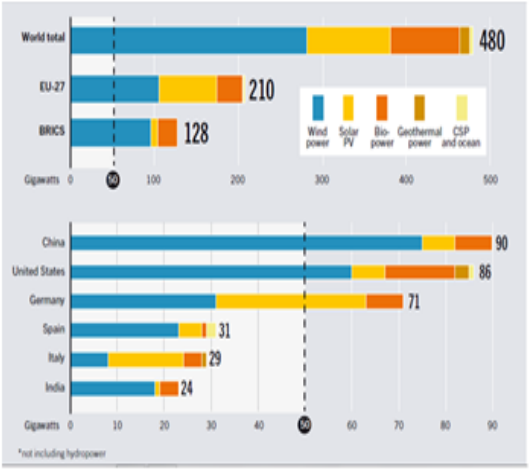

Figure 2. Renewable power capacities in world, EU-27, BRICS, and top six countries

During 2012 renewable power capacity of India was About 4.2 GW, including 0.7 GW of hydropower and 3.5 GW of other renewables (mostly wind), at the end of the year total exceeding 66 GW [14]. Renewables accounted for more than 31% of total installed capacity, with non-hydro renewables representing over 11% (24 GW) [15]. The BRICSi nations accounted for 36% of total global renewable power capacity and almost 27% of non-hydro renewable capacity by the end of 2012. While Russia has a large capacity of hydropower, virtually all of the BRICS' non-hydro capacity is in Brazil, India, and particularly China. South Africa is also starting to gain momentum, with significant wind and CSP capacity under construction by year's end. At the end of 2012 European Union (EU) had the most non-hydro capacity with 44% of the global total. More than half of all electric capacity added by Renewables in the EU during the 2000–2012 period mostly from solar PV and wind. In 2011, renewables met 20.6% of the region's electricity consumption (up from 20% in 2010) and 13.4% of gross final energy consumption (compared to 12.5% in 2010) [16].

In the AEO2013 Reference case, renewable generation increases from 524 billion kilowatt-hours in 2011 to 858 billion kilowatt-hours in 2040, growing by an average of 1.7 percent per year. There are main three renewable energy sources like wind, solar, and biomass account for most of the growth, as shown in below;

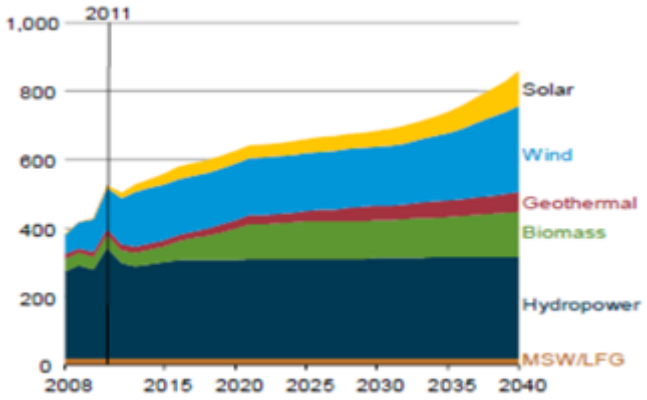

Figure 3. According to annual energy out look 2013 an estimate growth of different renewables

Wind power generation

Global wind power installations increased by 44,799 in 2012, bringing total installed capacity up to 282,587 MW, a 18.7% increase on the 238,050 MW installed at the end of 2011[17].

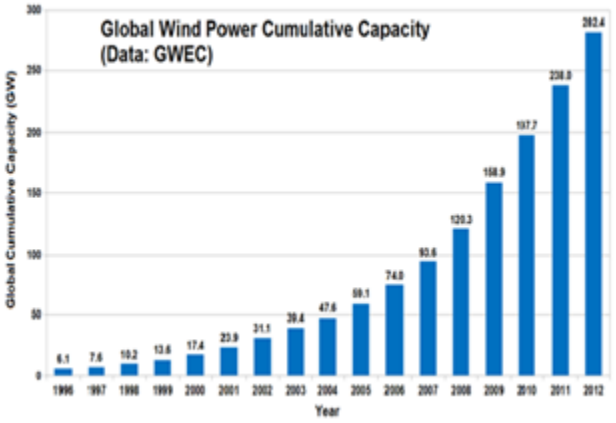

Figure 4. Global wind power cumulative capacity

U.S. wind industry built 5115 MW of wind power in 2010, which was about half of 2009's record pace, according to the American Wind Energy Association (AWEA). However, AWEA said U.S. industry entered 2011 with more than 5600 MW under construction. During 2010-2011 more than half of all new wind power was added outside of the traditional markets of Europe and North America, mainly driven by the continuing boom in China which accounted 300MW in 2000 and nearly half of all of the installations at 18,000 MW in 2011. China now has 75,324 MW of wind power installed [18]. Several countries have achieved relatively high levels of wind power penetration, such as:

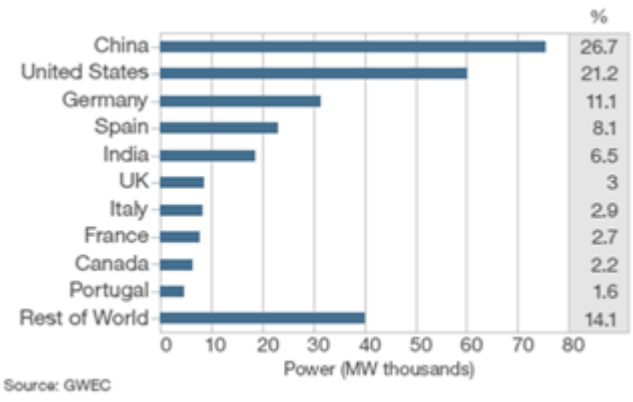

Figure 5. Installed wind power capacity

The development of wind power in India began in the 1990s, and has significantly increased in the last few years. According to initial estimates, India's wind power potential was assessed at around 20,000MW. It has been re-assessed at 48,561MW in 2011 with Karnataka, Gujarat, and Andhra Pradesh as the leading states. Assuming 1% of land availability for wind power generation in potential areas. Domestic policy support for wind power has led India to become the country with the fifth largest installed wind power capacity in the world [19].

Solar PV generation

The total annual solar radiation falling on the earth is more than 7500 times the world's total annual primary energy consumption of 450 EJ. The annual solar radiation reaching the earth's surface, approximately 3,400,000 EJ, is an order of magnitude greater than all the estimated non-renewable energy resources, including fossil fuels and nuclear. However, 80% of the present worldwide energy use is based on fossil fuels

The solar photovoltaic (PV) market saw another strong year, with total global operating capacity reaching the 100 GW milestones in 2012 [20].

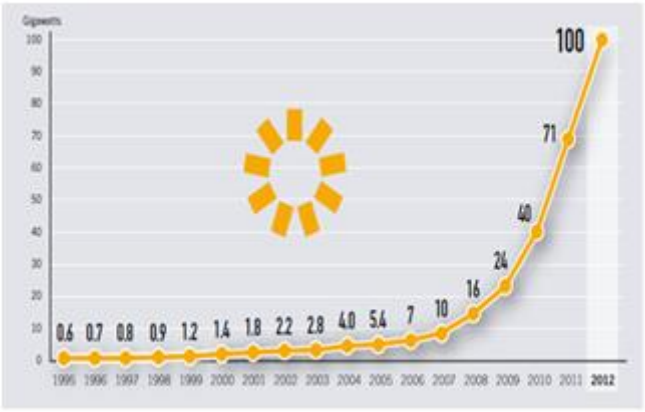

Figure 6. Solar PV global capacity, 1995-2012

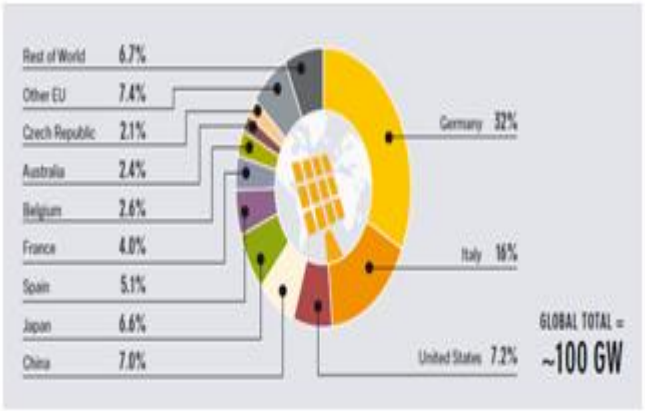

Figure 7. Solar PV global capacity, shares of top 10 countries

Europe again lead in the market, adding 16.9 GW and accounting for about 57% of newly installed capacity, (See Figure 7) Germany added a record 7.6 GW to 32.4 GW, up just slightly over the previous two years [21]. During 2012, 28 TWh Solar PV generated in Germany, up 45% over 2011 [22]. Italy reached to 16.4 GW. Other top EU markets included France (1.1 GW), Bulgaria (0.8 MW), the United Kingdom (0.9 GW), Belgium (0.6 MW) and Greece (0.9 GW) [23]. All saw total capacity increase 30%, worldwide capacity increases from 8 GW to 12.5 GW [24]. The major markets were China (3.5 GW), the United States (3.3 GW), Japan (1.7 GW), Australia (1 GW), and India (almost 1 GW) [25]. Asia (7 GW) and North America (3.6 GW) U.S. capacity was up nearly 85% in 2012 to 7.2 GW. California had a record year (>1 GW added) and was home to 35% of total U.S. capacity China doubled its capacity, ending 2012 with about 7 GW, but below expectations for the year [26]. By early 2013, about 90 plants in operation were larger than 30 MW, and some 400 had at least 10 MW of capacity. The world's 50 biggest plants reached cumulative capacity exceeding 4 GW by the end of 2012, and at least 12 countries across Europe, North America, and Asia had solar PV plants over 30 MW. More than 20 of these facilities came on line in 2012, including the world's two largest: a 250 MW thin film plant in the U.S. state of Arizona and a 214 MW plant in Gujarat, India. Several projects are planned around the world that range from 50 to 1,000 MW in scale [27].

In India, the amount of solar energy produced in India in 2007 was less than 1% of the total energy demand [28]. The grid-interactive solar power as of December 2010 was merely 10 MW [29]. Government-funded solar energy in India only accounted for approximately 6.4 MW-yr. of power as of 2005. However, India is ranked number one in terms of solar energy production per watt installed, with an insolation of 1,700 to 1,900 kilowatt hours per kilowatt peak (kWh/KWp) [30]. 25.1 MW was added in 2010 and 468.3 MW in 2011[31]. By the end of 2013 the installed grid connected photovoltaics had increased to 2.18 GW [32], and India expects to install an additional 10,000 MW by 2017 and a total of 20,000 MW by 2022 [33].

As we know that India has perfect environment for solar energy generation, can receive solar energy equivalent to more than 5000 trillion kWh/yr. which is far more than its total annual energy consumption. The daily average global radiation is around 5kWh/m2 day with the sunshine hours ranging between 2300 and 3200 per year [34]. Solar power may be able to fulfil electricity demand with in next few years. At present solar power Growth is low in India but had a great future.

Biofuel generation

Liquid biofuels continue to make a small but growing contribution to transport fuel demand worldwide, currently providing about 3% of global road transport fuels. They also are seeing small but increasing use in the aviation and marine sectors [35]. Growth in biofuels markets, investment, and new plant construction has slowed in several countries in response to a number of factors: lower margins, spiking of commodity prices, policy uncertainty, and increased competition for feedstock.

Figure 8. Ethanol and Biodiesel global production 2000-2012

Global production of fuel ethanol in 2012 was an estimated 83.1 billion litres. (See Figure 8) Outside of the United States, global ethanol production was up more than 4%, but U.S. ethanol production dropped more than 4% to 50.4 billion litres, due partly to high corn prices resulting from the mid-year drought. By contrast, Brazil's production increased 3% to 21.6 billion litres, although investment in new sugarcane ethanol plants was very low compared with recent years [36]. Overall,

the United States accounted for 61% (63% in 2011) of global ethanol production and Brazil for 26% (25% in 2011). The other leading producers included China, Canada, and France, as in 2011. Demand continued to rise in Sweden, where around 200,000 flex-fuel vehicles are using high blends of locally produced and imported ethanol [37].

Global biodiesel production continued to increase, but at much slower rate relative to the previous several years, reaching 22.5 billion litres in 2012, compared with 22.4 billion litres in 2011. The United States was again the world's leading producer, followed by Argentina, Germany, Brazil, and France—with German and Brazilian production being approximately equal. U.S. biodiesel plants produced 3.6 billion litres in 2012, up only slightly over 2011 levels, but approaching the target set by the Environmental Protection Agency (EPA) under the federal Renewable Fuels Standard, or RFS. This standard requires 4.8 billion litres (1.28 billion gallons) of biodiesel to be included in diesel fuel markets in 2013 [38].

Europe accounted for 41% of total global biodiesel production, led by Germany, which produced an estimated 2.7 billion litres in 2012 (down 14% relative to 2011) [39]. Production declined 7% across the region and in most European countries including Spain (-32%), Portugal (-14%), and Italy (-44%) but it was up in France (18%), Poland (63%), and the United Kingdom (53%) [40]. Brazil's total annual biodiesel production from soybean oil (77–82%), beef tallow (13–17%), and cottonseed oil (2%) increased slightly to at 2.7 billion litres. Argentina passed Germany to rank second for total biodiesel production, at 2.8 billion litres [41]. Elsewhere in Latin America, three Jatropha plantations were certified in Mexico by the Roundtable on Sustainable Biofuels, and a small biodiesel plant using Jatropha oil was established in Cuba [42].

India overtook Italy in total biofuel production in 2012, increasing its ethanol production by 25% to 0.5 billion litres. China's biofuel production remained unchanged at around 2.1 billion litres of ethanol and 0.2 billion litres of biodiesel [43]. Thailand increased both its ethanol and biodiesel production to a total of 1.6 billion litres, 40% higher than in 2011 [44].

But if we talk about India Currently, biofuel production is minimal, accounting for only one percent of global production or less then it. Supporting a future bioenergy sector will likely require policy support, community and local interest, technological breakthroughs, and cost-effective feedstock production [45].

In 2008, the Government of India announced its National Biofuel Policy, which envisions meeting close to 20% of the domestic diesel demand from biofuels. This requires approximate 14, 00,000 sq.km for the cultivation of fuel-producing plants, the government has already identified 4, 00,000 sq. km land for Jatropha crop [46]. Reason of working with the because of Jatropha plant can easily be cultivated in wastelands and will also serve as an additional means of income for Indian farmers. According to former Indian President, Dr. Abdul Kalam, a strong believer in Jatropha as a biofuel, nearly half of the country's 6, 00,000 sq. km of wasteland is suitable for Jatropha cultivation [47]. Jatropha oil is cost effective, since it can be used directly after extraction, without the need for any additional refining.

In a proposal to encourage Indian farmers to take up Jatropha cultivation, the government has signed a Memorandum of Understanding with bio-oils specialist D1 Mohan Bio Oils Ltd to hand out loans worth Rs1.3 billion to farmers; D1 Mohan will sponsor the purchase of the Jatropha seeds. Several Indian states are also looking into Jatropha cultivation with renewed interest, with the state governments teaming up with private players to finance and promote Jatropha-planting projects. But it is generally seen that terrestrial biofuel crops compete with conventional food crops for land area and other resources and therefore pose a threat to food security of the region [48]. So the scientists find out another option for the biofuel production is next generation biofuels.

Algal fuel caught considerable attention. Algae use enormous amount of CO2 removing from power plant emissions. Allied to this is the enormous capacity of the algae to convert CO2 into biomass, liberating via photosynthesis more oxygen for the atmosphere than forests. An additional advantage of algae is depolluted the waters by absorbing the urea expelled by these animals and at the same time increases the CO2 conversion into biomass. The algae can then be converted into various kinds of biofuel using liquefaction, pyrolysis, gasification, extraction and transesterification, fermentation, and anaerobic digestion. It also propagates rapidly. There is no competition with foodstuffs; making biofuel from algae could simultaneously resolve the soaring costs of crude oil and food along with global warming. New technologies to use various forms of nutrient laden wastewaters to generate algal biofuels with simultaneous water purification will reduce water pollution problems of rapidly urbanizing cities and help water intensive agriculture. India has several regions that have a tropical climate as well as tropical ocean areas with ocean surface temperatures of 29°C. This makes it suitable for growing algae, which can be harvested several times a year. As such, the production of algae biofuel is making progress in regions all over India [49].

Figure 10. Development of algae biofuel in various regions in India

Central Salt Marine and Chemical Research Institute (CSMCRI) in Bhavnagar on the west coast of India worked on micro algae, a fuel trial using B20 was carried out with biodiesel fuel from marine micro algae, which achieved a fuel efficiency of 12.4 km/liter (July 2012). Energy is found in Chennai on the east coast of India and Novozymes in Denmark, they have entered a partnership agreement regarding to the development and production of biofuel from seaweed in January 2012. Where

energy will develop low cost cultivation method and Novozymes will work on develop an enzyme that will convert the carbohydrates into sugar found in seaweed. The National Environmental Engineering Research Institute (NEERI) announced in February 2012 that it would join forces with Purti Power and Sugar Ltd. to construct a plant for producing industrial-grade biodiesel fuel from fresh-water micro algae at Purti's industrial district in Bela.

Conclusion

No doubt, India has marked its presence all over the world in generation of wind energy. India is counted as fifth largest country installed wind power capacity in the world. But it is assuming that only 1% of land availability for wind power generation in India this leads to limited production of wind power. Beside that India has good climate condition for solar power generation, with 2300 and 3200 sunshine hours per year. Solar power can fulfil the electricity demand of India in next few years. It shows little contribution because of high investment demand which is big challenge for solar energy growth but it can play critical role in ensuring energy security of the country.

In case of Bio-fuel, due to environmental effect on growth of Jatropha productivity the next hope is algal biofuels. Algae is the third generation biofuel and can be an ideal solution for India's impending fuel crisis, as India's long coastal region and tropical climate can facilitate the cultivation of algae in India in mass scale. Research is going on in some laboratories, institutions, universities for collection and characterization of algal strains from different ecological places; development of different production systems; improved algal strains for more oil/ lipid content and lastly, design development and fabrication of low cost and pilot scale bio-reactors for cultivation of algae for biofuels and technology.

Algae biofuels could prove particularly valuable for India. India may soon join the global race for research and development on algae biofuel and will not let go this opportunity that would enable the country to find a solution to its impending energy crisis.

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