

Renewable Energy Revolution: Mapping Global Trends and Future Directions

Aman Khan¹, Vishant Kumar Meena^{1,*}, Gaurav Jain²

Abstract

For the objective of creating energy plans, setting baselines for objectives, tracking the adoption and performance of policy measures, and luring investment, it is important to have access to fast, accurate, and reliable data on renewable energy. Practical and forward-thinking energy plans are built on a foundation of sound data. This study offers a thorough examination of worldwide trends in renewable energy, taking into account the state of affairs at the moment, emerging technologies, existing frameworks for regulation, and anticipated future advancements. It emphasizes how vital renewable energy is to reducing global warming, improving energy security, and promoting sustainable development. Focus topics include solar, wind, hydro, and bioenergy, along with insights into market dynamics and regional alterations. In addition, the essay discusses the opportunities and challenges of moving toward a sustainable energy future. The report emphasizes how crucial it is for government regulations, investor dynamics, and developments in technology to propel the renewable energy industry. In spite of obstacles like undefined regulations and limited infrastructure, renewable energy has a bright future ahead of it, with significant growth anticipated and lots of room to develop. According to the study's findings, renewable energy will be essential to the world's energy transition and to the growth of sustainable energy sources in the future.

Keywords: Wind energy, biomass, ocean energy, geothermal, global warming

INTRODUCTION

An estimated 19% of the world's final consumption of energy. came from renewable sources in 2012; (i), and this percentage grew significantly in 2013; (ii) Of this overall proportion in 2012, contemporary renewable energy options accounted for around 10%, while traditional biomass; (iii) which is presently mostly utilized for cooking and heating in remote and rural parts of developing nations, contributed for about 9%. Even though the amount of contemporary renewable energy grew, the overall percentage of traditional and modern renewable energy was around the same as in 2011. This is due to the fact that both a gradual shift away from conventional biomass and an ongoing increase in the world's overall energy consumption are moderating the fast expansion of new renewable energy [1].

*Author for Correspondence

Vishant Kumar Meena
E-mail: vk.sharma@poornima.org

¹Student, Department of Electrical Engineering, Poomima College of Engineering, Jaipur, Rajasthan, India

²Professor, Department of Electrical Engineering, Poomima College of Engineering, Jaipur, Rajasthan, India

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Four main industries have observed an increase in the usage of modern renewable energy: power production, transportation fuels, heating and cooling, and rural/off-grid energy services. In 2012, the proportion of contemporary renewable energy sources to total final energy usage was as follows: 3.8% were produced by hydropower, 1.2% by other renewable power sources, 4.2% by thermal energy, and 0.8% by transport biofuels. Most renewable

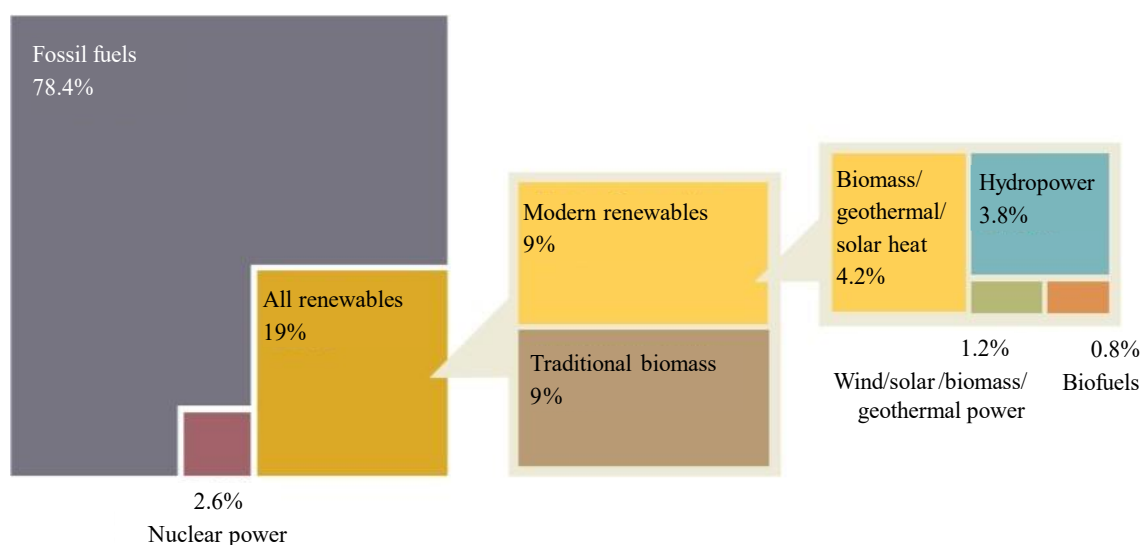


Figure 1. Estimated renewable energy share.

energy technologies saw fast growth in installed capacity and output between 2009 and 2013, especially in the power segment [2].

Of all the energy tools, solar photovoltaic (PV) had the quickest rates of capacity expansion throughout this time, while wind had the largest additions to power capacity. Although there is a dearth of reliable data for many heating methods and fuels, the usage of present-day renewable energy for heating and cooling has increased significantly. Despite high oil prices, the output of biofuels for the transportation sector decreased from 2010 to 2012, although it resumed in 2013 [3]. The markets and industries for renewable energy are maturing and are facing a variety of new and varied problems alongside the numerous possibilities (Figure 1).

MARKET AND INDUSTRY TRENDS

Biomass

A demand for biomass in the transportation and power industries grew steadily. In 2013, the total primary energy use for biomass was estimated to be 57 EJ, involving conventional biomass accounting for over 60% of the total and contemporary biodiesel (solid, gaseous, and liquid fuels) making up the remaining portion. Biomass heat capacity has now expanded by about 1% to an estimated 296 GWth, with most of its utilization going toward cooling. Global biopower capacity rose to 88 GW, an estimated 5 GW more. The annual output of biopower, including that produced in combined heat and electricity (CHP) facilities, surpassed 400 TWh. The need for contemporary biomass is propelling a surge in world trade for solid biofuels, such as wood pellets. 2.3% of the world's transportation fuel demand was satisfied by liquid biofuels. To reach 116.6 billion liters in 2013, there was a 7.7 billion liter increase in world output [4–7].

After 2 years of decline, yearly manufacturing for hydrotreated vegetable oil (HVO) rose to 3 million liters, biodiesel by 11%, and gasoline by 6%. From its high in 2007, the total investment in new biofuel plant capacity has been declining (Figure 2).

Geothermal

In 2013, an additional 530 MW of geothermal generating capacity was brought online. When replacements are taken into account, the net gain comes to around 455 MW, raising the overall capacity to 12 GW worldwide. The two prior years' average yearly growth rate was 3%, hence this net capacity expansion of 4% is in contrast to that (2010–12). It is believed that the per year direct use of geothermal



Figure 2. Global new investment in renewable energy By region, 2004–13 (\$Bn).

energy, for space heating, thermal baths and swimming pools, and agricultural and industrial processes, exceeds 300 PJ, but growth is not particularly strong. In order to make more effective use of traditional geothermal resources, governments and businesses have kept up their pursuit of technical innovation. Meanwhile, the utilization of low-temperature fields for power and heating was growing, expanding the application of geothermal energy outside of high-temperature areas.

Hydro Power

3,750 TWh of hydropower had been generated worldwide throughout the year. 2013 saw the commissioning of over 40 GW of additional hydroelectric capacity, bringing the total capacity worldwide up to about 1,000 GW, or about 4% higher. China has added the most capacity (29 GW), with Turkey, Brazil, Vietnam, India, and Russia following suit. China's development has been the main driver of the industry's recent, comparatively stable growth. The global market for modernizing aging hydropower plants is expanding. There is a tendency in certain nations toward multi-turbine run-of-river projects and smaller reservoirs. The potential of hydropower to supplement other renewable technologies, such as variable wind and solar electricity, is now becoming more widely understood [8].

Ocean Energy

By the end of 2013, ocean energy capacity, primarily from tidal power generation, reached around 530 MW. A few trial installations were set up for continuous testing in the year in anticipation of planned commercial operations. There are signs that there may be a large increase in capacity in the near future, especially in the UK and France, because of industry emphasis and government backing. Through strategic alliances and the purchase of technology innovators, major businesses kept boosting their positions in the ocean energy industry.

Concentrating Solar Thermal Power (CSP)

2013 saw a nearly 0.9 GW (36%) increase in global CSP capacity, reaching 3.4 GW. Although the United States and Spain continued to lead the industry, demand was also moving to more isolated underdeveloped nations. Outside of the top markets, developments in China, India, and the United Arab Emirates brought capacity close to tripling. A growing number of hybrid CSP applications appeared, and thermal energy storage kept becoming more significant. Industry activities continued to spread into new areas, and the industry continued to grow significantly. However, a number of corporations closed their CSP operations due to competition from solar PV in some countries and lowered growth estimates. Larger factories nevertheless remained the norm in order to benefit from economies of scale, even if costs were kept down by better design and production practices.

Wind Power

In 2013, the wind turbine capacity increased by more than 35 GW, bringing the total to more than 318 GW. But after a number of record-breaking years, the global market fell by around 10 GW from 2012 to 2013, mostly due to a sharp decline in the US market. Asia was closing the gap and would overtake the European Union as the leading area for cumulative wind capacity in 2014. All areas saw the emergence of new markets, while Latin America saw a sizable portion of new installations for the first time. With 1.6 GW installed, offshore wind enjoyed a record year, nearly all of it in the EU. The record level, however, conceals delays brought on by ambiguous procedures, project cancellations, and downsizing. Downward pressure on pricing, heightened rivalry among turbine manufacturers, competition from low-cost gas in certain markets, decreases in policy assistance due to economic austerity, and drops in important markets remained challenges facing the energy sector.

Concurrently, declining capital costs and technology advancements raised capacity factors, making wind-generated power affordable than fossil fuel-based electrical power. Deeper water and greater distances from shore were required for the offshore industry, which led to the need for more advanced boats and new foundation designs.

PROSPECTS FOR RENEWABLE ENERGY

Compared to 2004, renewable energy technologies are now widely used worldwide for transportation, heating and cooling, and electricity generation. Recent trends indicate that this use will continue to expand. 10 years ago, those who were interested in switching from conventional fuels for environmental grounds found great attraction in renewable energy. Renewable energy sources have shown today that they are not only good for the environment but also for the economy, generating employment, assisting in the diversification of income sources, and fostering the growth of new technologies. Over the past 10 years, the proportion of nuclear power in the world's electricity output has fallen while the percentage of renewable energy has continued to rise. 10 years ago, the concept of obtaining extremely large proportions of non-hydro renewable energy seemed fairly radical, but many experts now believe it is realistic. Many municipal, regional, and national governments have committed to using only sustainable energy in one or more sectors for the coming years, all around globe.

However, there are still a lot of difficulties facing the renewable energy industry. Financial incentives for renewable energy sources continue to be greatly outweighed by massive subsidies for nuclear and fossil fuels. While most governments are still hesitant to absorb the external costs involved with the exploitation and use of fossil fuels, several nations are allocating more resources to the exploration and extraction of unconventional fossil resources. If we want to keep the rise in global temperature to 2°C, then more research and development into renewable energy sources as well as increased energy efficiency are required. Stable and stable policy frameworks are essential for this to happen.

The global switch to renewable energy will be aided by integrated policy approaches that include energy efficiency, which is seen as the low-hanging fruit on the road to sustainability. The last 10 years have helped prepare the way for this shift, but it will need a coordinated and persistent effort to complete (Figure 3). Renewable energy may continue beating expectations and promote a cleaner energy future with ever-higher goals, creative policies, and improvements in technology (Table 1).

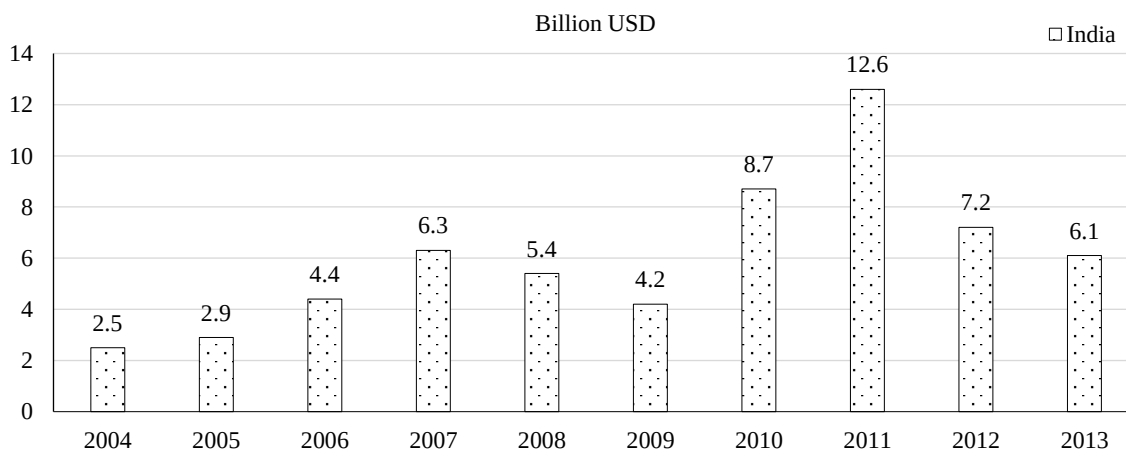


Figure 3. New Investment in Renewable Power and Fuels, By India, 2004–2013.

Table 1. Renewable energy targets of India.

Parameters		Values
India ¹	Electricity	4.3 GW added in 2014
	Electricity	30 GW added 2012–2017
	Bio-power	2.7 GW added 2012–2017
	Hydropower (small-scale)	2.1 GW added 2012–2017
	Solar PV and CSP	10 GW added 2012–2017; 20 GW grid-connected added 2010–2022; 2 GW off-grid added 2010–2020; 20 million solar lighting systems added 2010–2022
	Wind	15 GW added 2012–2017

CONCLUSION

For the second year in a row, overall expenditures in renewable energy and fuels decreased in 2013, down 14% from 2012 and 23% from the record set in 2011. It was caused by the impact of policy uncertainty in several nations as well as a significant drop in solar system pricing.

At this critical juncture, the wider renewable energy industry has the potential to fundamentally alter the energy landscape of the planet. We have examined significant trends, advancements, and forecasts in this research study that highlight the growing significance of renewable energy sources, solar, wind, hydro, and bioenergy, in reaching sustainable development objectives and reducing climate change. A clear route to a sustainable energy future is shown by worldwide advancements in renewable energy.

Through use of innovative technology, regulations that promote it, and global collaboration, renewable energy sources may be fully utilized by the globe to construct energy systems that are inclusive, robust, and sustainable. Realizing the common goal of a cleaner, greener, and more sustainable world will need cooperation between governments, businesses, and civil society as we negotiate the challenges of the energy transition.

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