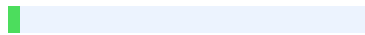




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An overview of India's current state and potential for renewable energy

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Abstract: The ability or capacity to work is called energy. Renewable energy sources are unconventional and have a low impact on the environment. Modern technology can be directly replaced by renewable energy technology. By replacing fossil fuels with renewable energy, we can conserve more energy and improve the environment. With the increased emergence of environmental issues over the past two to three decades, renewable energy technology has great potential to improve environmental circumstances. We must shift to other energy sources because as the world's population grows, so does its daily energy use. This study examines how the evolution of the energy mix has changed in connection to a nation's degree of development while taking various forms of renewable energy into account.

The Indian government is actively working on several large-scale sustainable power projects and strongly advocating for the usage of clean energy sources. This article provides a thorough discussion of the relationship between renewable energy and sustainable development, as well as its future prospects. According to the predicted results, the main drivers of renewable energy consumption are economic growth, energy efficiency, carbon emissions, and renewable energy output. In order to promote the use of renewable energy sources, this report also recommends increasing funding for the production of renewable energy, the energy efficiency industry, and ecologically linked technology innovation.

Keywords: Sustainable development, environment, fossil fuels and renewable energy.

1. Introduction

Across the globe, different countries have varying energy requirements. In comparison to developing nations, industrialised nations require more energy. Renewable energy sources are of utmost concern to modern society due to their lack of pollution, ease of availability, low cost, and abundance on the planet. In renewable energy technology, natural energy sources such as solar radiation, wind, tidal, biomass, and geothermal energy must be used. It is environmentally friendly to use these energy sources. There are several renewable energy sources shown in Fig. 1. For the past 20 years, clean energy sources remain the main cause of concern for people seeking sustainable development. The realisation of sustainable development is facilitated by a variety of variables.

One of the major drivers of economic development is the energy sector; there is a direct correlation between rising economic growth and rising energy consumption. The amount of renewable energy resources varies throughout the various countries. The developing nations also have more in common with applied renewable energy technology, excluding employment opportunities. People rely more on fossil fuels for energy in the current environment. In general, it is expensive and detrimental to the environment. Since there is typically a finite supply of fossil fuels, attention must be paid to alternative energy sources. There are many innovative and interesting suggestions for building sustainable homes. These include using non-toxic and renewable building materials, reusing grey water for irrigation or flushing, and using solar energy to warm and charge electric automobiles.

Fig. 1. Various resources of renewable energy sectors

The PV market in India is anticipated to rebound quickly in 2021, whilst robust policy support for distributed solar PV applications is fueling generation gains in Brazil and Vietnam. Global solar photovoltaic electricity generation is predicted **9** to rise by 145 TWh,

or over 18%, to reach 1000 TWh by 2021. We anticipate considerable growth in hydropower generation in 2021 as a result of both new capacity additions from significant Chinese projects and an economic rebound. Thanks to incentives, the rise of bioenergy will be driven by energy from waste electricity plants in Asia. The percentage of renewable energy in the mix of energy sources should reach a record-breaking 30% in 2021 as a result of increases in the production of electricity from all renewable sources.

2. Renewable energy sources

An alternative to traditional energy, which is dependent on fossil fuels, is renewable energy, which is typically far less damaging to the environment. The selection of a greener energy solution presents numerous options to positively benefit the environment. With energy offsets, the energy gives customers the choice to select green energy solutions that lessen their environmental impact. To lessen your effect right now, add only green to your natural gas or electricity plan. As innovation drives down costs and begins to fulfill the promise of a clean energy future, renewable power is experiencing an upward trend. Figure 2 depicts the world's diverse sources of renewable energy.

Fig.2. Various sources of renewable energy sections in the world

Solar energy

Solar energy is solar radiation energy, which includes both radiation and heat. Solar heating, photovoltaic energy, solarthermal energy, and artificial photosynthesis are all included in this technology. It is one of the most significant forms of renewable energy and may be classified as either active or passive solar energy. Photovoltaic systems, concentrated solar electricity, and solar water heating are examples of active systems. The passive solar strategies are depicted in Fig. 3(A), and they comprise building orientation, thermal biomass, and natural air circulation. The planet received 174,000 TW (terawatts) of solar energy, which was absorbed by the land surface, seas, rivers, and so on.

Wind energy

To harness wind energy, turbines are utilised to power generators, which subsequently feed electricity into the National Grid. Despite the availability of household or 'off-grid' generating solutions, not every property is appropriate for a residential wind turbine. Find out more about wind energy on our wind power page. Wind energy is typically created from air movement using a turbine. Wind energy is converted mechanical energy from turbines into electrical energy. Another renewable energy source is wind energy. Wind energy is a kind of solar energy. Winds are created by the **6 heating of the atmosphere by the sun, the** rotation of the Earth, and imperfections in the Earth's surface. As long as the sun shines and the wind blows, the energy created may be used to transfer power across the system. The world largest wind mill is generally placed in China its present capacity is 6000 MW. The entire global wind power generation is 534.5 TWh (Pappas, 2017). Wind power installations in India reached 2.07 GW in the fiscal year (FY) 2019-20, a 31% increase over the previous fiscal year (FY 2018-19).

Fig.5. Renewable energy sources (A) solar **2 energy panel above the house and** (B) wind energy generation

Tidal energy

This energy source allows for the storage of electricity for usage at peak demand and is frequently more dependable than solar or wind power, particularly if it is tidal rather than riverine. Similar to wind energy, hydro energy may be more practical for commercial usage in some circumstances (based on kind and in comparison to other energy sources); but, much depends **10 on the type of property, it** may also be utilised for "off-grid" home generating. This is an additional hydro energy source that powers turbine generators using twice-daily tidal currents. Despite not being constant like some other hydroenergy sources, tide flow is quite dependable and, as a result, able to make up for times when the tidal

current is low. One common type of hydropower is tidal energy, which transforms oceanic energy into electrical energy. The tidal energy of Earth's oceanic tides is represented in Figure 4(A). This is one of the more affordable, accessible, and eco-friendly forms of energy.

Geothermal energy

The geothermal gradient, which is often dependent on the temperature differential between the planet's surfaces and core, is what determines the amount of geothermal energy. As seen in Fig.

4(B), the earth's interior heat is produced by radioactive decays. One of the more affordable, readily available, clean, trustworthy, and sustainable energy sources is geothermal energy.

Currently the largest thermal power plant in India is **7 the Vindhyachal Thermal Power Station in the** Singhrul district of Madhya Pradesh, which has an installed capacity of 4,760 MW. According to data from the International Geothermal Association (IGA), 24 nations worldwide produce 10,715 MW of geothermal electricity (Ruggero, 2007). Among the renewable energy sources is geothermal energy. The heat content of the earth is 1031 J. The reason why geothermal energy is renewable is that heat is constantly generated within the ground. Geothermal heat is used by people to heat houses, take baths, and produce power.

Fig.6. Renewable energy sources (A) tidal energy source and (B) geothermal energy uses for electricity generation

Biomass energy

The organic substance that remains after materials or creatures are removed is called biomass. Sunlight-stored chemical energy may be found in biomass. Plants use photosynthesis to create biomass. For heating purposes, biomass can be burned directly.

It can also be transformed into renewable liquid and gaseous fuels by different procedures. The biomass can be converted into energy-producing gases such as ethanol, biodiesel, or CH₄ gas. Global biomass production amounts to around 100 billions of tonnes per year. When biomass energy is generated, less air pollution, such as CO₂, NO_x, and particulate matter, is created than when fossil fuels are used. According to the current study, India has an estimated 750 million metric tonnes of biomass available annually. Biomass is thermochemically converted by gasification and pyrolysis. Both are thermal decomposition technologies that involve heating biomass feedstock materials at high temperatures within sealed, pressurised containers known as gasifiers. The numerous biomass energy sources are displayed in Fig. 5(A).

Hydrogen energy

This energy source is easy to use and clean. Oil, natural gas, and coal are now used to produce hydrogen gas. Gasification and rapid pyrolysis of biomass also yield hydrogen gas. As seen in Fig. 7(B), hydrogen gas is often utilised to produce power. The bulk energy content of H₂ fuel is 120.7 MJ/kg. Worldwide, hydrocarbons create 95% of the hydrogen, whereas water electrolysis produces 4% (Scott et al., 2004). Technologies based on hydrogen have seen cycles of increased hopes and then disappointment. It is anticipated that hydrogen will be a vital component of the world's energy systems in the future. As the availability of fossil fuels rises, so does environmental degradation, and hydrogen is expected to take the lead as the primary molecular energy carrier. Electricity and hydrogen are anticipated to be the two main energy carriers for the delivery of end-use services when the majority of the world's energy sources transition from being fossil fuel-based. By upgrading the heavy oils, non-fossil hydrogen will be utilised to prolong the life of the world's fossil fuels, bridging the gap between today's fossil fuel economy and hydrogen economy.

Fig.5. Renewable energy (A) biomass energy sources and (B) hydrogen energy production

electricity

3. Renewable energy sources in India

The capacity of renewable energy in India has reached 33.8 GW, excluding big hydro. Of these renewable energy sources, 66% originates from wind, 4.59% from solar energy, and a minor amount from biomass. India possesses an abundance of renewable energy sources, which are shown in Table 1. In India, one of the main places to get wind energy is Tamil Nadu. India has 151.4 GW of installed capacity for renewable energy as of December 31, 2021. The Indian government has set goals that include reducing the country's ⁵ total projected carbon emissions by 1 billion tonnes by 2030, lowering the country's economic intensity by less than 45% by the end of the decade, achieving net-zero carbon emissions by 2070, and increasing installed capacity of renewable energy in India to 500 GW by the same year.

As shown in Table 2, development for wind power analysis in India began in the 1990s and has risen year after year. Currently, India has a 20149.50 MW wind power capacity. In addition to the 11 GW of wind energy that are now produced, the Indian government has set a target of adding 18.5 GW of renewable energy sources. Aiming to produce 1000 MW to 20,000 MW of solar power for energy production, India began ¹¹ the Jawaharlal Nehru National Solar Mission in 2009. A solar power plant's daily average generating capacity in India is 0.25 kWh/m² of usable land area, and the country can produce between 1700 and 1900 kWh of electricity per kilowatt-peak (kWh/kWp) of solar energy.

Table1 Table2 State wise wind energy generating inIndia

Sources

Total installed capacity (MW)

State wise

MWp

Windpower

22,465.03

Andhra Pradesh

279.44

Solarenergy

3063.68

Gujarat

1000.05

Smallhydropower

3990.83

Karnataka

104.22

Biomasspower

1365.20

Madhya Pradesh

673.58

Bagassepowergeneration

2800.35

Punjab
200.32
Wadetopower
107.58

Rajasthan
1199.70
Total
33,791.74

Tamil Nadu
157.98

Uttar Pradesh
71.26

Fig.6.Generation of energy from various sources in India

4. Energy conservation and energy efficiency

Energy conservation is a national priority, and in order for India to become an energy-efficient economy and society and to be competitive both domestically and globally, we must work together and put in all of our effort. The progress of society is the primary necessity for energy resources. A society cannot attain sustainable development unless

certain conditions are satisfied. Public awareness, innovative energy strategy, financing, and monitoring are all included in these factors. All assessment tools in energy modelling and appropriate ecological strategy are provided. The nation's economy benefits from using less energy through efficiency measures. Energy efficiency benefits the environment by using less energy to do specific tasks. It helps prevent detrimental effects on the important ecosystems, such as the barriers a new hydroelectric dam could put in the way of migrating salmon, and it can lessen the pollution that some forms of energy generation contribute to the air and water. Energy efficiency affects your personal finances more.

Role 8 of renewable energy sources in environmental protection

It is possible to provide energy services with nearly zero emissions of greenhouse gases and air pollutants when renewable energy sources are used to fulfil residential energy needs. According to the ministry of power report, India produced 122.10 TW of the total electricity produced, with 16.30 TW coming from renewables as of August 31, 2018. India is environmentally conscious and has made significant progress in the previous four years in the use of renewable energy.

The development of renewable energy systems will enable the completion of the most important tasks at hand, which include ensuring sustainable development of remote areas in mountain and desert zones, implementing national obligations regarding the fulfilment of international agreements related to environmental protection, improving the reliability and economy of the energy supply and organic fuels, as shown in Fig. 7, solving problems with local energy and water supply, raising the standard of living and employment of the local population. Figure 18 illustrates how the creation and execution of renewable energy projects in rural regions might reduce migration to metropolitan areas by creating job opportunities.

Fig.7. Applications of biogas plants for production of electricity

Various steps taken by governments to adopt sustainable measurement

A pivotal milestone in the global fight against climate change has been marked by India's statement that it aspires to achieve zero emissions by 2070 and to get half of its power from renewable energy sources by 2030. India is leading the way in the construction of a new economic model that might steer clear of the carbon-intensive paths that many other nations have taken in the past and serve as a model for other developing economies. The extent of change in India is astounding. Over the past 20 years, its economic development has been

among the highest in the world, bringing millions of people out of poverty. Thus, it makes sense that Prime Minister Narendra Modi has unveiled more audacious targets for 2030, such as the installation of 500 GW of renewable energy capacity, a 45% reduction in the economy's carbon intensity, and a billion tonnes of CO₂ reduction. Due to advancements in technology, consistent regulatory backing, and a thriving private sector, solar power plants are less expensive to construct than standalone units.

A significant part of reaching net zero and decarbonizing the difficult-to-abate sectors will be played by green hydrogen. India wants to be a major hub for the production and export of green hydrogen worldwide. India could easily replace grey hydrogen in the fertiliser and refinery sectors by creating a market for 5 million tonnes of green hydrogen. India, a sizable developing nation home to more than 1.3 billion people, has ambitious goals for climate adaptation and mitigation that will not just change the country but the entire globe as well. Together, NITI Aayog and the IEA are determined to help India develop, industrialise, and give its people a higher standard of living without having to carbonise the country.

5. Conclusions

1 Renewable energy will account for 55% of total installed power capacity by 2030. It is

projected that by 2040, renewable energy will provide around 49% of total power, ¹² as more efficient batteries will be utilised to store electricity, further lowering the cost of solar energy by 66% compared to the present cost.

Furthermore, ² renewable energy has the potential to offer numerous job possibilities at all levels, particularly in rural regions. The Indian government intends to build a "green city" in each state, fueled by renewable energy. As a result, technological innovation dampens renewable energy usage in these economies. Interestingly, current research has demonstrated that environmental legislation and technology innovation may impact energy consumption in both developed and emerging nations.

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Data availability statement

The paper's comments are appropriately mentioned in the text, and no further data are provided.

Declaration of competing interest

The authors declare no conflict of interest. All authors of this research report have personally engaged in the study's planning, implementation, and analysis. All ³ authors of this paper have read and approved the final version submitted.

REFERENCES

1) Alper,A.,&Oguz,O.(2016).The role of renewable energy consumption in economic growth: Evidence from asymmetric causality. Renewable and Sustainable Energy Reviews,

60, 953–959.

- 2) Amjith, L. R., & Bavanish, B. (2022). A review on biomass and wind as renewable energy for sustainable environment. *Chemosphere*, 293, Article 133579.
- 3) Arora, S., & Prasad, R. (2016). An overview on dry reforming of methane: Strategies to reduce carbonaceous deactivation of catalysts. *RSC Advances*, 6, 108668–108688.
- 4) Asumadu-Sarkodie, S., & Owusu, P. A. (2016). The potential and economic viability of wind farms in Ghana. *Energy sources, PartA: Recovery, Utilization, and Environmental Effects*. <https://doi.org/10.1080/15567036.2015.1122680>
- 5) Bandyopadhyay, S. (2017). Renewable targets for India. *Clean Technologies and Environmental Policy*, 19(2), 293–294.
- 6) Bayar, Y., & Gavriletea, M. D. (2019). Energy efficiency, renewable energy, economic growth: Evidence from emerging market economies. *Quality and Quantity*, 53, 2221–2234.
- 7) Bekun, F. V., Yalçiner, K., Etokakpan, M. U., & Alola, A. A. (2020). Renewed evidence of over economic & Pollution Research, 27, 29644–29658.
- 8) Bhabha, H. J., & Prasad, N. B. (1958). The study of contribution of atomic energy to a power programmed in India. In *Second international conference on the peaceful uses of atomic energy*, Geneva, September 1958.
- 9) Bilgen, S., Kaygusuz, K., & Sari, A. (2004). Renewable energy for a clean and sustainable future. *Energy Sources, Part A: Recovery, Utilization, and Environmental Effects*, 26(12), 1119–1129.
- 10) Himri, Y., Malik, A. S., Stambouli, A. B., Himri, S., & Draoui, B. (2009). Reviews and use of the Algerian renewable energy for sustainable development. *Journal of Renewable and Sustainable Energy Reviews*, 13, 1584–1591.
- 11) Huang, J., & McElroy, M. B. (2014). Meteorologically defined limits to reduction in the variability of outputs from a coupled wind farm system in the Central US. *Journal of Renewable Energy*, 62, 331–340.
- 12) Ikhlayel, M. (2018). An integrated approach to establish waste 4 management systems for developing countries. *Journal of Cleaner Production*, 170, 119–130.

13) I_nal,V.,Addi,H.M.,Çakmak,E.N.,Torusdagç,M.,&Çalış,kan,M.(2022).Thene xus between renewable energy,CO2 emissions and economic growth: Empirical evidence from African oil-producing countries. Energy Reports, 8, 1634–1643.

14) Isaac,O.I.,&Daniel,M.(2006).Engineering mechanics of composite materials(2nded).USA:Oxford UniversityPress,2006.

15) Jinshah, B. S., Bala subramanian, K. R.,Kottala, R.,& Divakar, S. (2022). Inflof power parabolic trough collector. Renewable Energy, 181, 1046–1061. composites: Application–21723.

Sources

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