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CONFERENCE PAPER

RECENT TRENDS IN RENEWABLE ENERGY TECHNOLOGIES: A COMPREHENSIVE REVIEW

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Abstract

Sustainable development can be guaranteed by adopting revolutionary technologies and making efficient use of natural resources. Everyone is focused on using renewable energy sources to address the worldwide power crisis. India is currently producing a significant amount of renew able energy. Now energy is a crucial factor and prerequisite for the advancement of human civilization and economy.Exploring alternative, unconventional, or renewable energy sources is therefore imperative in order to reduce reliance on fossil fuels and to preserve Mother Earth for the coming generations. This includes energy from sun, wind, hydropo wer, geothermal, and biomass sources. Solar power uses solar thermal collectors or photovoltaic cells to harvest energy from the sun. Wind power converts wind energy from kinetic to electrical form by using wind turbines. Hydropower is the process of utilizing the energy of fluid motion to generate electricity. Organic materials are used to make biomass energy. The renewable power generation system offers a once-in-a-lifetime chance to boost economic growth, achieve climate goals and improves human well-being in addition to creating new jobs. Because of this, renewable energy is becoming more and more significa nt and its applicability has increased significantly as worries regarding energy security have become more prevalent. The latest developments in renewable energy in India are examined in this paper.

Introduction:-

With 17.7% of the global population, India is the second most populous nation. With the growing population, India's energy consumption has risen to fourth position in the global market.

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As the use of fossil fuels declines, pollution increases, contributing to global warming, and energy demand increases, the development of renewable energy has become the only viable option. It is the sole eco-friendly and sustainable energy source.India was only to establish the Ministry of New and Renewable Energy (MNRE) in the early 1980s, and public sector initiatives like the Indian Solar Energy Industry are the reason for the growth of the solar energy sector in India. Hydroelectricity, which is not covered by the MNRE, is handled by the Ministry of Power.In wind energy sector, India has a very good development as compared to other countries. Around 20 manufacturers are producing more than 50 international quality wind turbines models and selling to foreign countries. Wind or solar PV is currently cost effective when paired with four-hour battery storage solutions. It is also tax free as compared to other conventional energy sources in India.

RENEWABLE ENERGY : INDIAN SCENARIO

The government's objective is to produce 175 gigawatts of renewable power by the end of 2024, with ambitions to rise to 500 gigawatts by 2030. This is the most effective renewable energy growth strategy in the world. By 2024, India would be ranked third in the attractiveness of renewable energy countries.India's solar energy production has grown to be a major contributor to the country's grid-connected power generation capacity over the years. As it becomes an increasingly important factor in the country's energy requirements and a major player in energy security. It also helps the government to achieve its goal of sustainable growth. The country's solar potential is estimated by the National Institute of Solar Energy to be 748 GW, considering that solar PV modules will cover 3% of the waste land area. Under the automatic route, renewable energy generating and distribution projects can get up to 100 % FDI, according to the rules of The Electricity Act, 2003 [5].

India has set targets to attain net-zero emissions of carbon by 2070, 50% cumulative installations of renewable energy by 2030, and less than 45% reduction in the nation's economic carbon intensity within end this decade.India aims to produce five million tons of renewable hydrogen by 2030. India has set a goal to produce 8 GW of green hydrogen annually by 2025, according to projections.

As of 31st December 2021, the total installed capacity of India is 151.4 GW. The breakups of following renewable energies are as follows in Table I.

Table I. Contribution of different Renewable Energy Sources

Name of the energy	Solar Power	Small hydro power	Wind Power	Large hydro power	Bio Power
Contribution of RE in GW	49.84	4.89	40.21	46.32	10.72

The National Solar Mission (NSM) is one of the main Missions of India's National Action Plan on Climate Change, which has given solar energy a central role. In order to solve the nation's energy security concerns and advance ecological sustainability, the Indian government initiated the NSM.India will also play a significant role in the global effort to address climate change concerns. The Mission's objective is to develop the legal framework for solar energy's quick spread throughout the country, positioning India as a leader in the field [1]. Power purchasers' outstanding payment dues are rapidly increasing due to a lack of purchasing power and the expansion of renewable electricity producing capacity. Table II shows the physical progress of total installed RE capacities of India as on Feb 2022

Table II. Installed RE Capacity (CAPACITIES IN MW) as on Feb 2022 in India [1]

Name of Power	Achievements (Apr2021-Feb 2022)	Cumulative Achievements (as on 31.03.2021)	Cumulative Achievements (as on 28.02.2022)
SPV Systems (Off-grid)	329.4	1150.66	1480.05
Waste to Energy(off-grid)	18.48	218.95	237.43
Solar Power - Roof Top	2036.35	4439.74	6476.09

Biomass(non-bagasse) Cogeneration	0	772.05	772.05
Small Hydro Power	54.75	4786.81	4839.9
Biomass (Bagasse) Cogeneration)	30	9373.87	9403.56
Solar Power - Ground Mounted	7176.01	35645.63	42821.63
Waste to Power	45.5	168.64	214.14
Wind Power	882.73	39247.05	40129.78
Total	10573.22	95803.4	106374.63

India ranks third in the world for energy usage [2,4].Fig.1 shows a comparative analysis of technology specific rank among 3 leading countries i.e. India, USA and China.

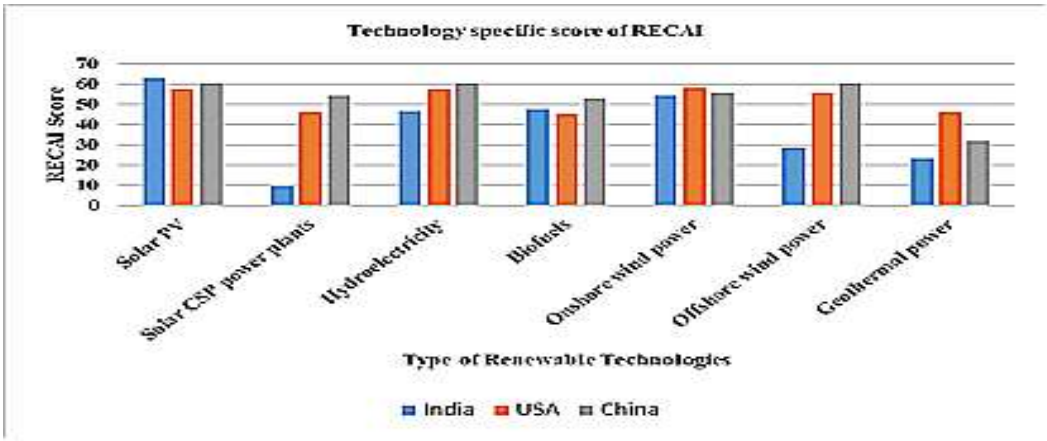

Fig.1 Rank of India in renewable energy technology.

The National Solar Mission set an off-grid solar PV application objective of 2000 MWp. The Mission established a target of 200 MWp for Phase I from 2010 to 2013, which was met with 253 MWp, and a target of 500 MWp for Phase II from 2013 to 2017, which was met with 713 MWp. The program for off-grid and autonomous solar PV processes displays the current status of installationsby application in Table III below. The updated installed capacity status of renewable energy as of February 2023 is as presented in fig.2.

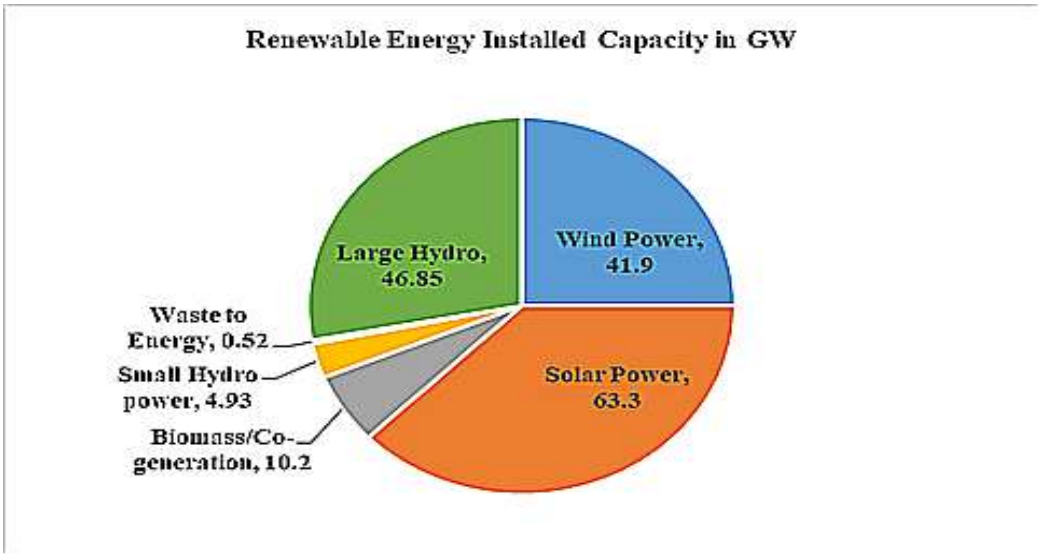

Fig.2 Renewable energy installed capacity in India as of feb.2023

Table III. Application wise solar PV installations [1]

Solar System installed	Solar Lamps	Solar Pumps	Solar Street Lights	Solar Home Lighting Systems	Solar Power Plants/Packs
No of systems installed	65,17,180	2,37,120	6,71,832	17,15,639	212

GOVERNMENT OF INDIA INCENTIVES AND SUPPORT

Laws and Policies

Legislation and policies have been implemented by the Indian government to promote the utilization of renewable energy. The Power Act of 2003 encourages the use of cogeneration and renewable energy sources to generate electricity. This Act has hastened the development of renewable energy in the country. Section 63 of the Electricity Act of 2003 outlines the rules for competitive procurement as follows:

- The tariff shall be accepted by the Appropriate Commission if it was determined through a transparent bidding process in accordance with the Central Government's criteria.
- According to the 2005 National Power Policy, the percentage of electricity generated by non-conventional sources must increase, and distribution companies must obtain electricity through a competitive process.
- Tariff Policy 2006 states that, based on the resources available in the area and their effect on retail rates and the Appropriate Commission shall establish a minimum share for the purchase of energy from non-conventional sources.

Government Support and mission

To boost the construction of solar capacity in India, the Indian government is granting a subsidy of Rs 15,050 crore. This capital subsidy for solar projects will assist many cities and municipalities. The bundling strategy would be used to build solar power plants valued roughly Rs. 90,000 crore. Independent power producers (IPPs) and large public sector undertakings (PSUs) will also invest (IPPs). Many state administrations have also developed solar policies to encourage the usage of solar energy [3].

CONCLUSION:-

The study highlighted the advantages of renewable energy sources, including energy access, security, and decrease of negative effects on the environment and human health.The viability of sources of clean energy and their capacity to slow climate change are challenged in many ways.The seventh and thirteenth objectives of sustainable development are to guarantee that all people have access to affordable, dependable, sustainable andcombating the consequences of climate change by using modern energywould also be addressed if the necessary steps were taken to ensure the long-term viability of renewable energy resources.

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