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RESEARCH ON THE FINANCIAL ASPECTS OF SOLAR POWER PROJECTS IN THE RENEWABLE ENERGY INDUSTRY

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Abstract: The usage of energy on a global scale is only going up from year to year. Both nonrenewable fossil fuels and renewable sources of energy, such as the sun, the wind, biomass, and hydropower, may be used to generate electricity. These days, fossil fuels are the primary contributors to the creation of electricity all around the globe. The increasing depletion of fossil fuels has major unintended effects, one of which is an increased threat to the environment posed by climate change. A greater awareness of the risks to the environment and the need for a sustainable energy supply have both contributed to the emergence of the discussion on the increased use of renewable energy sources.

Keywords: Financial aspects, solar power projects, renewable energy industry.

Introduction

Global energy consumption is only rising year after year. Energy may be produced from both non-renewable fossil fuels and renewable sources like solar, wind, biomass, hydro, etc. Nowadays, the main sources of power production worldwide are fossil fuels. The rapid depletion of fossil fuels has serious negative consequences, such as increased environmental risk from climate change. The debate over using renewable energy more and more has arisen as a result of rising environmental risk awareness and the necessity for a sustainable energy supply.

Several nations are seriously considering raising the share of renewable energy in power production. Although poor nations are primarily motivated by economic considerations, developed nations are eager in renewable energy production for environmental reasons. Changing the renewable power portfolio right now is one option for addressing the environmental risk brought on by rising energy demand[1].

Now, there is a serious energy crisis that is defined by:

- A global energy shortage and a population that is constantly expanding.
- While conventional technologies are seen to be economically feasible, further use of them would cause a rapid depletion of available resources and serious environmental issues including climate change.
- RE is abundant and environmentally beneficial, but there are several challenges to using it to a substantial degree, particularly in poor nations, in terms of funding, technical expertise, and appropriate legislative backing.

Different public goals are being established, and efforts are being made to advance numerous new plans. For instance, the European Association has set a goal for 2020 of using at least 20% of energy that is safe for the environment.[2]

Data demonstrates unequivocally that interest in RE has grown significantly over the past few years. In 2004, there was USD 46.6 billion in interest in real estate, but this amount has increased to USD 286

[1] Abulfotuh, F. (2007) Energy efficiency and renewable technologies: the way to sustainable energyfuture. Desalination, 209(1), 275-282.

[2] Noothout, P., de Jager, D., Tesnière, L., van Rooijen, S., Karypidis, N., Brückmann, R., Jirouš, F., Breitschopf, B., Angelopoulos, D., Doukas, H. and LEI, I.K. (2016). The impact of risks in renewable energy investments and the role of smart policies. DiaCore project final report work package, 3. Retrieved on 31.03.2016 from www.ecosys.com: www.ecofys.com/files/files/diacore-2016-**impact-of-risk**-in-res-**investments**.pdf:

billion in 2015, which is frequently equal to the value in 2004[3]. Future predictions for doable power prospects are also exceptionally excellent. It is expected that by 2050, the amount of hard and fast piece of realistic will be roughly half in the full scale power region, according to IEA's (2008) "Blue Aide" Circumstance Projections.

According to a further prediction made by Green Accord Worldwide in 2008[4], by the year 2050, practical power will account for roughly 77% of full-scale power age. On numerous occasions, they have predicted that power creation by sun-based advancement will increase relative to 2005 levels. Sincerely, there are plans to completely power the world with wind, solar, and hydro power by the year 2030. The fact that there is so much potential for harm-free power development is in some ways highlighted by the vast number of projections.

Renewable Energy

Renewable is just energy derived from many sustainable materials, like the sun, wind, hydropower, biomass, etc. The sun is the source of energy for a number of non-solar sources, including geothermal and tidal, wind, hydropower, and biofuels (sunlight).

The term "renewable energy" may also refer to any naturally occurring, theoretically limitless source of energy, such as biomass, the sun, wind, tidal, wave, and hydro power, which is not generated using fossil or nuclear fuel. This meaning is apparently more inclusive.

Green Power is, in essence, a kind of renewable energy.

Standard forms of renewable energy The bulk of renewable energy comes from the sun, either directly or indirectly, as was already said. Common renewable energy sources include the following:

1. Solar Energy: Sun-derived energy is what we refer to as solar energy. The phrase "that provides the energy that can't be directly attributed to solar light and the heat it creates" is used to describe it[5]. It is well known that the solar system has hundreds of times more energy potential than the whole human species could ever use in a year.

There are now two ways to create power from solar energy:

i. Solar Thermal
ii. Solar Photovoltaic(PV)

Energy from the sun is directed in solar energy, where the energy is subsequently utilised to create stem. A generator is then powered by this to produce electricity. It is possible to use working fluids such as water, nitrate, salt, helium, and others. Other engine types, such as steam engines and gas turbines, may be used. Large wide spaces are required for the photovoltaic energy machinery and collectors. It is predicted that 3–4 ha would be required for every Megawatt of installed capacity[6].

Solar photovoltaic technology directly transforms sunlight into electrical energy.

The basic concept behind photovoltaic (pv) technology is "a way of converting sunlight into energies using a device showing PV effect.[7]"

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[3] McCrone, A., Usher, E., Moslener, U., Gruning, C., D'Estais, F. (2016). Global Trends in RenewableEnergy Investments 2016. United Nations Environment Programme. Retrieved on 25.04.2016 from www.unep.org:http://fs-unep-centre.org/sites/default/files/publications/globaltrendsinrenewableenergyinvestment2016lowres_0.pdf.

[4] Birol, F. (2008). World energy outlook. *Paris: International Energy Agency*. Retrieved on 21.12.2014from http://www.worldenergyoutlook.org/media/weowebsite/2008-1994/weo2008.pdf:

[5] Bradford, T. (2006). Solar Revolution. The Economic Transformation of the Global Energy Industry. Cambridge, MA: The MIT Press.

[6] Sukhatme, S. P. (2011). Meeting India's future needs of electricity through renewable energy sources.Current Science (Bangalore), 101(5), 624-630.

[7] Khare,V.,Nema,S.,& Baredar,P.,(2013).Status of solar wind renewable energy in India Renewableand Sustainable Energy Reviews, 27, 1-10.

For solar PV applications, there are the following four categories[8]:
A) Off-Grid residential
B) Off-Grid non-residential
C) Shared Grid
D) Integrated Grid
The supremacy of PV technology over other RE technologies is largely attributable to its quiet operation, lack of harmful emissions, and relatively easy O&M.
2. Wind Energy: In this case, wind kinetic energy is transformed into electrical energy. The wind is produced by convection currents in the earth's atmosphere that are heated by solar radiation. Hence, even if indirectly, this kind of energy also comes from the sun. The price of wind energy is determined by the wind turbines' installation costs, capital interest rates, and the quantity of energy generated.
3. Hydro Energy: In this case, the kinetic energy of flowing water is transformed into electrical energy. Water may be used to generate energy in a variety of ways, such as by building big dams or modest hydro projects. Using the earth's water cycle allows for the creation of hydro energy.
4. Bio Energy: In this case, biomass serves as the source of energy. Technically, "biomass" refers to biological material. According to the statement, "Bio energy is made from organic matter that is obtained from trees, plants, and crops as well as from people, animals, and municipal and industrial wastes.[9]"

Meaning of RE in Indian Power Area

With an estimated 60% contribution to total power generation, coal is unmistakably the foundation of force creation in India. Around 86% of nuclear radiation comes from coal. Yet this idea of a force age that is heavily dependent on conventional energy initiatives raises a number of other difficulties. One important problem is related to retailers' fatigue. For example, it is predicted that realised coal reserves would run out within another 100 years and that realised oil reserves would be depleted within the next few years. Moreover, there are a few environmental concerns related to routine energy projects. They include changes in global temperature, ozone depletion, and other things. Ozone-depleting gases from nuclear power plants, notably CO2, SO2, and others, are being transmitted and are thought to be the cause of the Earth's rising temperatures. Thermal energy plants are a further source of force age. While they are not releasing ozone-depleting substances, the fact that atoms fuel is very dangerous and it is expensive to manage radioactive atomic waste does not change.
The hunt for a reasonable energy source is thus urgent. Supportability necessitates keeping in mind what nature safely provides.

Table 1.1, Projected Employment Scenarios for 2020,

[8] Nema, S., Nema, R. K., & Agnihotri,G. (2011). Inverter topologies and control structure in photovoltaic applications: a review. Journal of Renewable and Sustainable Energy, 3(1), 012701
[9] Meshram, J. R., & Mohan, S. (2007). Biomass power and its role in distributed power generation in India. 25 Years of Renewable Energy in India. Ministry of New and Renewable Energy, New Delhi,109-134."

	Actual number of Jobs in 2010('000)	Projected in 2020 (in '000)
Coal	1142	467
Gas oil and diesel	165	131
Nuclear	33	7
Solar	78.3	453
Wind	67	280
Biomass	825	654
Small Hydro	85	48
Total	2405	2412

The fundamental global driver of RE development is thought to be the decrease of emanations. While India is becoming more cognizant of climate change, prolonged energy security and reliable electricity supply remain the country's top priorities. The increasing reliance on imported coal and oil is also a source of concern.

So, the only choice left is to use sustainable power sources to meet the twin goals of supplying the rising energy demand for economic development and furthermore for ecological insurance. A study by the Planet Bank found that using 1 GW of clean energy may save Ghg emission by 3.3 million tonnes annually[10].

Moreover, RE may greatly reduce India's non-renewable energy import expenses.

In the current economic world, the concept of RE is essential, particularly in India where unemployed has been a significant financial issue. Here is a representation of the anticipated job environment by 2020 based on the actual professions in 2010[11].

Table 1.2: Potential from various Renewable Resources

[10] Bhatia, M. & Banerjee, S. G. (2011). Unleashing the potential of renewable energy in India. WorldBank Publications.

[11] Teske, S. (2012). Energy (r) evolution. A SUSTAINABLE INDIA ENERGY OUTLOOK.

Retrieved on 02.03.2016 from www.greenpeace.org: http://www.greenpeace.org/india/Global/india/image/2012/Energy%20Revolution%202nd%20Edition/Energy%20[R]evolution%202nd%20edition.pdf:"

Resources	Estimated Potential(MW)
Solar Power(30-50 MW/Sq Km)	748990
Wind Power (at 80 M height)	102772
Small hydro power (up to 25 MW)	19749
Bio Power (agro residue)	17,536
Bio Power(Cogeneration and bagasse)	5,000
Waste to energy	2554
Total	896602

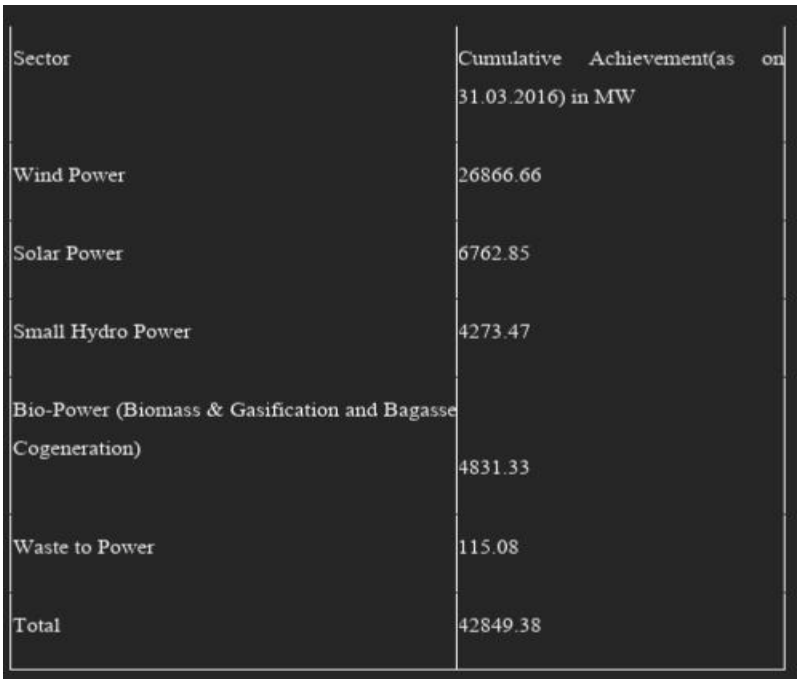
Moreover In contrast to traditional power projects, the deployment of renewable energy resources may be completed in a substantially shorter amount of time—for instance, less than three years—than that of conventional power projects (approx. 10 years). Solar PV projects are completed in much less time. The issue of India's rural electrification may be greatly helped by renewable energy. The lack of energy resources is the main cause of the development delay in rural India, which accounts for around 65% of the country's population. For this reason, RE is the only alternative, and within this, Solar is also the most practical choice.

The potential for renewable energy is enormously underutilised.

According to Press Information Ministry of India, it has been projected that there is a potential for more than 896602 MW of green sources from diverse sources, 42849.38MW stands out among these installed capacities to the end of March 2021 from a variety of sources[12]. It's obvious that there must be a lot of unrealized potential.

Table 1.3: Installed grid connected power from various renewable energy sources

[12] Central Electricity Authority (2016). Retrieved 21 .05.2016 from **www.cea.nic.in**



Sector	Cumulative Achievement(as on 31.03.2016) in MW
Wind Power	26866.66
Solar Power	6762.85
Small Hydro Power	4273.47
Bio-Power (Biomass & Gasification and Bagasse Cogeneration)	4831.33
Waste to Power	115.08
Total	42849.38

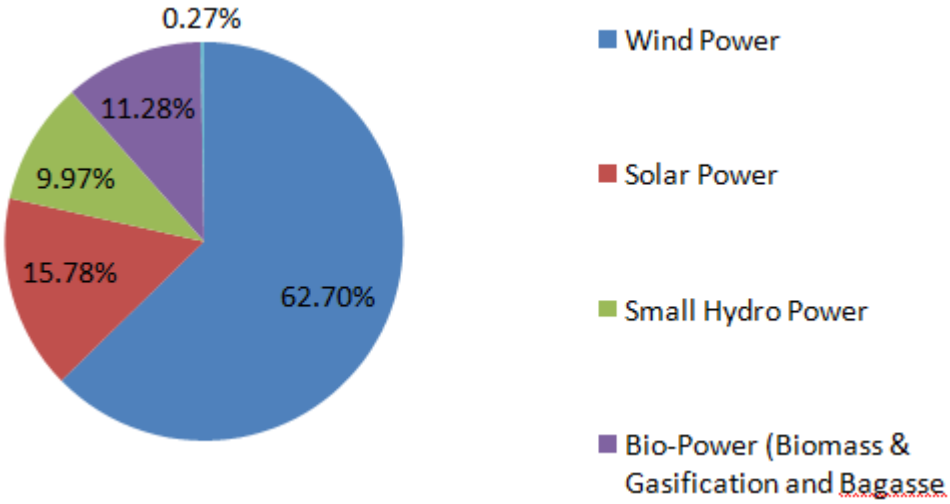


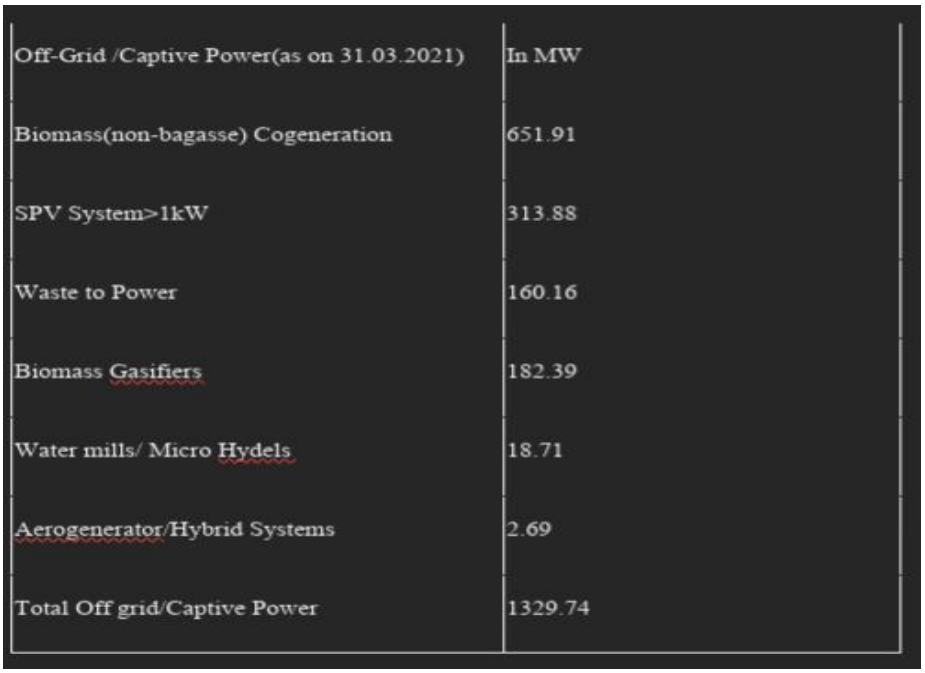
Fig 1.4: RE Installed Capacity Breakup in India as on 31.03.2021

The following table displays numerous sources of off-grid electricity (cumulative achievement)[13].

Table 1.4: Off- grid power from various sources (cumulative achievement)

"[13] Wikipedia (2016). Electricity Sector in India. Retrieved on 21.05.2016 from https://en.**wikipedia**.org/

: https://en.wikipedia.org/wiki/**Electricity_sector_in_India**



Off-Grid /Captive Power(as on 31.03.2021)	In MW
Biomass(non-bagasse) Cogeneration	651.91
SPV System>1kW	313.88
Waste to Power	160.16
Biomass Gasifiers	182.39
Water mills/ Micro Hydels	18.71
Aerogenerator/Hybrid Systems	2.69
Total Off grid/Captive Power	1329.74

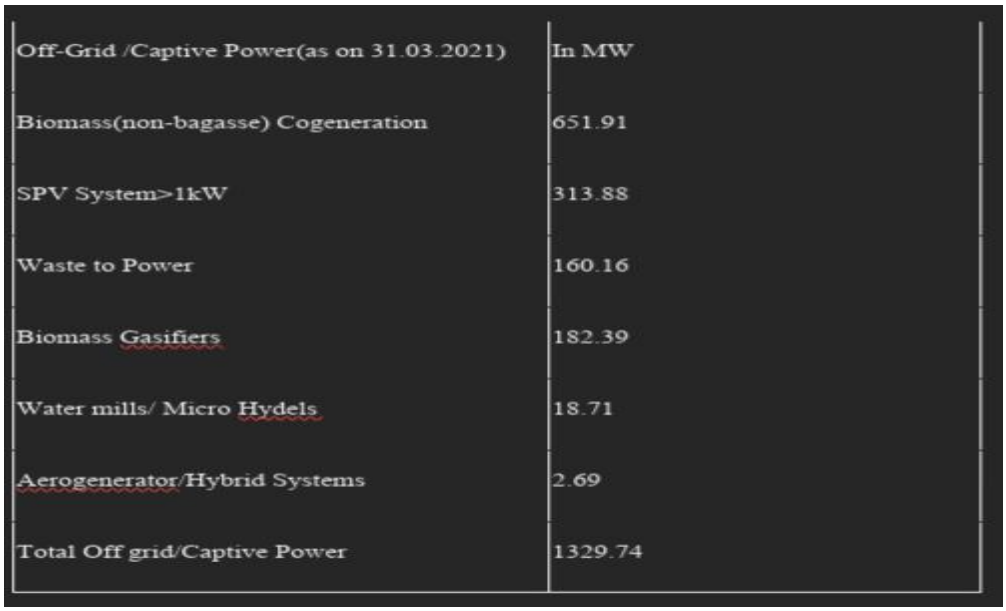
Most electricity produced from renewable energy sources is produced through grid-connected systems. According to the Indian Energy Security projection 2047, up to 410 GW of wind and 479 GW of solar PV might be installed by the year 2047. Government of New and Alternative Energy, or MNRE, is a distinct ministry in India. It is to India's credit that a distinct ministry for unconventional energy was established before anybody else in the world.

In 1987, the Indian Ministry Of Environment Agency (IREDA) was founded. It is a financial organisation that the Central Government owns entirely for the purpose of economically promoting renewable energy. The government has changed the objective for power to be produced from different renewable energy resources in light of the importance and expansion of renewable energy.

The updated targets are shown in the table below[14].

Table 1.5: Revised RE Targets Till 2022 (Capacity in MW)

[14] Ministry of New and Renewable Energy (2015). Renewable Energy in India: Growth and Targets. Retrieved 22.05.2016 from www.cseindia.org : http://cseindia.org/docs/photogallery/ifs/Renewable%20Energy%20in%20India%20Growth%20and%20Targets.pdf:



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Total Off grid/Captive Power	1329.74

Yet, the distribution enterprises' perilous financial status continues to be the primary barrier.

Of of all the options, wind energy is considered as the most dependable biofuels in India. This is one of the most affordable and secure energy sources available right now. And it is free, wind turbine is not always available. It is more costly than water but less cheap than solar in terms of price. In India, a filled to the brim wind energy programme didn't start until the years 1983–1984. A market-oriented strategy was implemented right away, and it worked fairly well. Installed capacity will reach 26866.66 MW by March 31st, 2021. Around 63% of the current grid-connected RE capacity is represented by this.

Wind energy made for around 2% of the total electricity in 2012. This has risen to 8% at the end of the year in 2015. Up to 25% of India's electricity requirements might be met by wind energy by 2020.

A variety of subsidies have been made available by IREDA to help the wind energy sector expand in India. Tax exemptions, accelerated depreciation, and other incentives have all played key roles in India's growth of wind power. Indian efforts to enhance the use of wind power have been impeded by the high expenses of doing so. The typical debt-to-equity ratio for wind power producing projects is 70:30. Combine it with high interest rates on debt, and getting a loan becomes a very pricey proposition.

Solar energy has come a long way from its 1% share of projected electricity output in 2010 to its predicted 15.78% share of total installed renewable power in March 2021. As of January 14, 2021, solar photovoltaic capacity has surpassed 5000 MW, which is impressive.

Rajasthan, which has a total installed capacity of 1269.932 MW, is the state with the largest installed capacity, followed by Madhya Pradesh and Maharashtra, which have installed capacities of 1119.173 MW and 776.370 MW, respectively. The installed solar capacity is broken down by state in the following table[15].

An additional 3GW of generator solar power generation volume was installed even during financial year 2020–2021.

India's third top clean energy source is biomass. There is a bounty of biomass in India, under which agriculture is an important industry, which is unrestricted by place or time like wind and sun are. At the end of March 2021, ethanol accounted for 4831.33 MW of the total 42849.38 MW of installed RE that was grid-connected. This amount is far less than India's anticipated 17,000 MW of agricultural leftovers,

[15] Ministry of New and Renewable Energy Sources (2016). Retrieved on 04.06.2016 fromwww.mnre.gov.in"

5,000 MW of cogeneration, and 5,000 MW of bagasse. India has a total biomass stockpile of over 500 million metric tonnes. According to MNRE, bagasse-based cogeneration may provide an extra 5000 MW of power per year, and agriculture and forestry waste, which comprises 120-150 million metric tonnes of biomass, can create an additional 120-150 million metric tonnes per year. Recently, there has been a lot of interest in this plentiful energy source as a substantial replacement for fossil fuels. If just half of India's waste land could be converted into biomass energy crops, an astounding 30,000MW of electricity might be generated. So, it is clear that corn is a product that is mostly underutilised and has great potential for supplying India's energy demands. Burning produces the bulk of the bioenergy in India.

Technical, financial, institutional, legal, and other limitations are to blame for India's insufficient exploitation of its bioenergy potential. This energy source is constant. The biomass supply chain, which is seen to be one of the main barriers to this energy source, has problems. Agricultural waste is the main source of biomass in India, although it is only usable for two to three months after harvest each year. Hence, biomass must be acquired and maintained within this time range. Moreover, controlling transportation costs is essential since they make up a significant amount of a biomass power plant's operational expenditures. The state governments of Karnataka, Andhra Pradesh, Maharashtra, Uttar Pradesh, and other significant states in India provide a range of financial incentives in acknowledgment of the potential of bioenergy. From the middle of the 1990s, MNRE has been a prominent backer of the country's bioenergy programme. By 2022, MNRE wants to provide 10,000 villages with biomass-based energy.

It is plausible to claim that biomass will significantly increase the capacity and reach of RE given the many innovations and advances, notably in the areas of fuel production and procurement.

India is among the biggest hydroelectric power potentials in the whole planet. India is the sixth most wind energy nation in the world, with an estimated total hydropower capacity of more above 150,000 MW. In India, there are two categories of hydro projects:

1. A little hydro project
2. a big hydroproject

Little hydro adventures are hydro projects with a limit up to 25 MW, while enormous hydro projects are those with a limit in excess of 25 MW. Albeit minor hydro projects are classified as sun based projects and are under the locale of MNRE, huge hydro projects are heavily influenced by the Service of Power.

Run-of-the-stream hydro projects are limited scale ones. They needn't bother with the development of dams. In India, the first humble hydropower plant was worked in 1987. The potential for all little hydro projects in India is estimate to reach 20,000 MW, contrasted with the 4273.47 MW of existing limit as of Spring 31st, 2021. The Himalayan locales of Uttarakhand, Jammu and Kashmir, Himachal Pradesh, and Arunachal Pradesh have the greater part of the potential for little hydro. Maharashtra, Karnataka, and Chhattisgarh are other striking states with significant potential. Critical confidential venture has been made in this industry. As per Amitabh Sinha (2015), one of the elements obstructing the development of little hydro projects is the ascent in development costs from 5-6 crores for every megawatt to 8.5-9.5 crores per megawatt.

By the finish of the twelfth five-year plan, MNRE needs the introduced limit of little hydro activities to reach around 7,000MW. MNRE's objective is for 2% or so of the framework associated power to come from SHP. The twelfth long term plan has generally 2100MW of limit extension anticipated this (2010-2022). The way that SHP in India is driven by capital speculation recognizes it from different nations.

The public authority has laid out a Public Mission with a five-year objective of 5000 MW of little huge dams. For the mission's most memorable stage, which will give different impetuses to the advancement of SHP, Rs 386.5 Cr has been conceded.

MNRE offers monetary help for the foundation of little hydro plants. The gathering of undertaking reports, the ID of feasible destinations, and the restoration and modernization of as of now existing, dated projects are only a couple of the SHP-related tasks for which government workers are likewise given monetary help.

One more protected and reliable wellspring of energy is geothermal energy. India has a lot of undiscovered geothermal energy potential. A sum of 340 spots with a potential for 10,600 Megawatts in geothermal energy have been tracked down by India's geographical review. Seven geothermal territories are framed from the 340 natural aquifers:

1. Himalayan II
2. The Sahara Valley
3. Cambay Basin
4. Belt of the Son-Narmada-Tapti line.
5. Coast West
6. The Godavari Basin
7. The Mahanadi basin

A geothermal map book has been made by GSI and is oftentimes refreshed by GSI. India right now misses the mark on geothermal plant in activity. In any case, with MNRE planning a public procedure putting forth out an objective of 100 MW to be delivered from land development before the year's over 2022, this underutilized area has started to draw consideration. A 30% capital sponsorship has been prescribed for project establishment to forcefully foster this industry, while a half endowment has been proposed for science and development related exercises.

Conclusion

There is no longer a choice or an alternative when it comes to renewable energy. Instead, it is the sole means of surviving. It may be argued that, if not right now, then definitely in the future, the benefit of renewable energy technologies will exceed their drawbacks. With the technology breakthroughs and continuous study in the sector, limitations or disadvantages will undoubtedly be eliminated in the near future.

RE technology transition takes a large amount of money. To close the investment gap between the existing level and the targeted level, more work must be done. Investors base their choices on a project's risk-return profile. They evaluate each unique risk and the available mitigation options. So, if the amount of renewable energy is to be significantly increased, this element needs to be carefully considered.

High economic development and access to energy for everyone are the foundations of Indian energy planning. Nevertheless, given India's abundant renewable energy potential, achieving these goals now would only be achievable by progressively raising the amount of renewable energy to a large level. It is clear that even if the growth figures are encouraging, more focus is undoubtedly needed for improved development given that renewable energy currently accounts for just 14% of all power output. The biggest untapped potential among the range of renewable energy sources is found in solar, which, if properly used, may significantly contribute to the nation's energy security.

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