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Economics

LOW-CARBON FUTURE: SWITCHING FROM CONVENTIONAL TO CLEAN ENERGY HARVESTING IN INDIA

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ABSTRACT For thousands of years, the persistent use of conventional energies that has been driving economic progress, is now-a-day a being considered not only unsustainable but also environmentally destructive. India's abundant renewable energy sources is capable of generating clean energy and providing an attainable replacement of the polluting and expeditiously depleting conventional energy sources. Initially, this study embellished a scenario of fossil fuel dependency coupled with a looming conventional energy crisis in the foreseeable future followed by the non-renewable energy consumption and carbon footprint nexus. This paper briefly explores the background, significant achievement, potentiality of India's major renewable energy sources such as solar, wind, biomass, small hydropower and liberal environment designed by the Government. India has been able to make remarkable progress in shrinking its share of power generation from fossil fuels. Additionally, some hindrances regarding the massive harvesting in clean electricity and the smooth way forward are addressed here. Unwaving endeavour is going on in innovation and promotion of energy-efficient green technologies domestically and the current promotion policies, perspectives, and strategies of Indian government are supposed to transpire to be a success story.

KEYWORDS : Carbon Emission, Clean Energy, Conventional Energy

Introduction:

Energy, happens to be the key factor for meeting development demands of an economy and it serves as the focal debatable issue in the perspective of environmental protection. The historical aspect is showing the trend of widespread use of energy for economic activity as, agriculture, industry and domestic activities that are associated with huge carbon emissions. The potential for growth of alternative sources i.e. clean energy in India proves to be an option to mitigate the challenges in meeting high energy demands, less air pollution and reduced depletion of fossil fuel simultaneously.

The trend of conventional energy consumption and carbon footprint:

India is the seventh largest producer and fifth largest consumer of energy in the world. Since ages, the non-conventional sources of energy could not stop the supremacy of conventional energy for economic and commercial purposes. The principal source of conventional energy in India is coal (approximately 45.88 %, 2018). About 29.55% and 6.17% of primary energy consumption come from crude oil and natural gas sources respectively. Naturally, the amount of fossil fuels energy is finite. It is widely used because of its inexpensive extraction cost and easy to use feature. To meet the exorbitant demand of growing population of India, these types of energies are depleted more rapidly than it can be regenerated. This conventional energy is alternatively known as non-renewable energy because it takes thousands of years to be replaced.The Indian economy is mostly dependent on non-renewable energies. Once these resources are depleted more and more, the supply will be reduced and they cannot be used on large scale. The conservation of rest of the conventional energy has become a serious anxiety to the government of India. Fig 1, illustrates the comparison of India's energy consumption division by sources between 2000 and 2020. Consumption of renewable energy increased from 6% to 9%, but instead of decreasing, reliance on coal has been reported to be high.

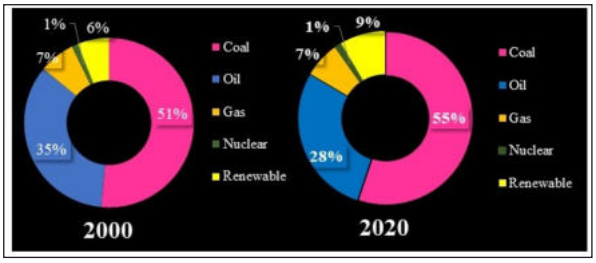

Fig 1: Energy Consumption by sources

Carbon footprint is basically a measurement of total greenhouse gas specially the carbon dioxide emitted through manufacturing production, processing and retailing of goods during a particular time period. Recently, Research Institute for Humanity and Nature had estimated the per capita carbon footprint at 0.56 tons per year in India. Over the last decades, the contribution of non-renewable energies to carbon emissionhad become a matter of concern. According to the *Union of Concerned Scientists2020*, India is the third-largest country with aglobal carbon footprint; it produces 7% of CO_2 in world CO_2emission. Fig 2 shows the trend in carbon emission over two decades.

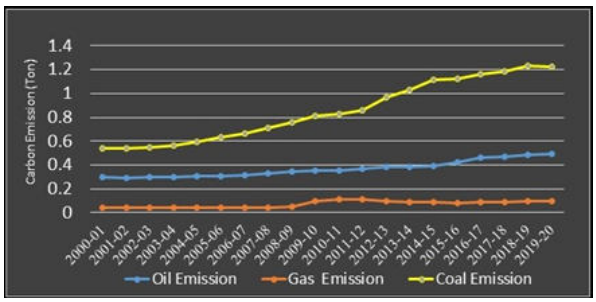

Fig 2: Per Capita Carbon Emission from Fossil Fuels

Clean energy harvesting:

Non-conventional energy system is the process of converting natural energies as sunlight, wind, geothermal, falling water, sea waves, or biomass into heat or electricity. These non-conventional energies are also known as renewable energies because they are continuously replenished naturally.During the last few decades, these clean and low-carbon energy commercialization strategies has been gradually fueling in sustainable economic growth in India.

After 1973 oil crisis, the Indian government had started to think about shifting to alternative energy sources and renewable energy technologies effectively started by launching a *Commission for Additional Sources of Energy* in 1981 and Department of Non-Conventional Energy Sources (DNES) in 1982. After that in 1987, "Indian Renewable Energy Development Agency (IREDA)" was set up for providing financial assistance in renewable energy development.The DNES was renamed to Ministry of Non-Conventional Energy Sources (MNES) in 1992 and finally, this department was converted into Ministry of New and Renewable Energy (MNRE) in 2006.

- **Solar Energy:**

According to the Ernst & Young index, the highest score 62.7 in solar energy was achieved by India. Solar power technologies can be utilized through Solar Photovoltaic (SPV) plants and Solar Thermal Power plants. From the initial tiny base, Solar energy production in India grew dramatically from less than 12 MW in 2009 to 190 MW in 2011 and in the last five years, it has increased from 6.7 GW to 40 GW in March 2021.

Achievement(March, 2021): 41.09 GW

Target: 100 GW (in 2022), 300 GW (in 2030)
Estimated Potentiality: 750 GW

Government Initiatives:
- Electricity Act 2003 (Jan 2003)
- National Electricity Policy (Feb 2005)
- Tariff Policy (Jan2006)
- National Action Plan on Climate Change (June 2008)
- The Jawaharlal Nehru National Solar Mission (January 2010)

- **Wind Energy:**

India has the fourth largest wind power installed capacity globally and it has occupied the second position in Asia. Initially, the onshore wind power potentiality was estimated at around 45 GB by the Center for Wind Energy Technology. Now, India has the world third onshore wind turbine- Muppandal wind farm in Tamil Nadu with 1,500-MW and fourth wind turbine- Jaisalmer Wind Park in Rajasthan with 1,064-MW capacity. On the other side, offshore wind is more complex and seems to have been relegated behind. The central government of India had put more emphasis on policy farming to boost offshore wind.Under the national wind resource assessment program, cumulatively 877 stations have been set up in December 2018.

Achievement(March, 2021): 39.44 GW
Target: 60 GW (in 2022), 140 GW (in 2030)
Estimated Potentiality: 102 GW

Government Initiatives:
- National Wind Resource Assessment Program- 1985
- National Institute of Wind Energy- 1998
- National Wind Energy Mission-2014

- **Bioenergy**:

India has a tremendously high potentiality to adopt bioenergy for its climatic feature and availability of organic bio- manure. In the modern era of technology, bioenergy significantly mitigates carbon. The forms of bio energies like biomass (biogas, bio protein, waste to energy and biofuels (bioethanol, bio hydrogen, biodiesel) are unique to their productive capacity.

Achievement(March, 2021): 10.34 GW
Target: 10 GW (in 2022)
Estimated Potentiality: 25

Government Initiatives:
Biomass:
- Biomass Power/ Cogeneration Programme
- National Biomass Resource Assessment Program

Biogas:
- National Biogas and Manure Management Programme
- New National Biogas and Organic Manure programme
- Central Sector Scheme on National Biogas Programme,
- Biogas Power Generation (Off-grid) and Thermal Energy Application Programme
- Sustainable Alternative Towards Affordable Transportation- 2018 (for Compressed Bio-gas)
- Galvanising Organic Bio-Agro Resources Dhan -2018

Biofuels:
- Ethanol Blended Petrol Programme
- Biodiesel Blending Program

Small Hydro Energy:

More than a century ago, the concept of small hydro project was developed to be a solution of electricity problem in remote hill stations and extension of economic grid system. According to the project capacity, small hydro project is classified into micro (up to 100 kw), mini (101 kw to 2 MW) & small (2 MW to 25 MW). Small hydro project development was started in Darjeeling hill with 130 kW (1897). With the passage of time, several projects have been initiated by Indian Government in Mysore district of Karnataka, Sivasamudram project of4.5MW (1902), at Galgoi in Mussoorie with3MW (1907), at Chaba near Shimla with 1.75MW.

Achievement(March, 2021): 4.79 GW
Target: 5 GW (in 2022), 60 GW (in 2030)
Estimated Potentiality: 20 GW

Government Initiatives:
- Alternate Hydro Energy Centre
- Small Hydro Power Programme

Significant increases in low-carbon power generation are needed for increased energy demand and efforts to tackle climate change. The goal of low-carbon technologies for power generation is to help policy makers make informed decisions about energy technologies, infrastructure and the right mix. The renewable sources such as solar, wind, small hydro, other renewable as well as as total low carbon energy have made great progress in electricity generation (fig 3).

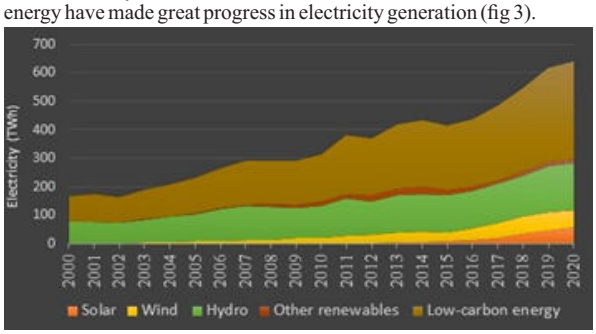

Fig 3: Electricity generation from green energy sources

Two burning questions arise in transition from carbon-intensive energy to low-carbon energy resources. First, how fast the use of clean energy technologies can scale, and second, how much can they reduce the use of fossil fuels. India is the second largest producer and consumer of coal and third largest carbon emitting country in world. The major obstacles of clean energy generation are responsible for the dependency on conventional energies.

Barriers to the clean energy technologies promotion:

Renewable energies still face weighty barriers- technical and non-technical barriers.

A. Technical barriers: Technological barrier includes (a) inefficient and complex technologies, (b) unavailability of backup and storage device, (c) unavailability of solar radiation data, etc.

B. Non-technical barriers:

(i) Political and regulatory barriers: Policy level complexity, lack of subsidies, less investment in research and development, training and infrastructure are the drawback of the government.

(ii) Finance and economic barriers: Various finance related problems as high cost capital, lack of pay capital, inadequate financial intermediaries prevent the expansion of renewable energy.

(iii) Market related barrier: High investment cost in clean energy production claims inflated and unaffordable price for the customers, which creates an insufficient market base in India.

(iv) Socio-cultural barriers: Yet, the citizens of India are less aware of the information and understanding of technologies pertaining to renewable energies.

- **Pathways forward:**

Despite having barriers, experts say with conviction that fossil fuels will no longer be king and unconventional energies will reign in future India.

The *Climate Policy Initiative* report says 2022 renewable energy target requires gross $189.15 billion investment. To overcome this challenge, India should put emphasis on both foreign and domestic financial investment in mix green energies. India has the permission of 100 percent FDI in renewable energy sector. Power minister Sri. R. K. Singh has announced that in the last seven years $ 70 billion has been invested in green energy generation. The central government has allocated an additional capital infusion of $137.04 million to Solar Energy Corporation of India and $205.57 million for Indian Renewable Energy Development Agency, in Union Budget 2021-22.

Additionally, there has been proper government initiatives and policy support to develop renewable energy sector more efficiently.Some recent policies have been promoted by government of India- Jawaharlal Nehru National Solar Mission, Renewable purchase obligation, Renewable energy certification, Energy Conservation Building Code, Unnat Jyoti by Affordable LEDs for All etc.

CONCLUSION:

Under the Paris agreement, India has set 33% reduction in carbon emission for 2030 and India has to produce 40% electricity of its total capacity from non-fossil fuel sources. The notable commitments of Indian government to cure energy related carbon emission still remains inadequate. However, urgency of reducing air pollution and rising energy scarcity are pushing India to develop green technologies. The rapid technology improvement may reduce the cost of renewable energies and promote storage technologies in industrial scale. Energy storage batteries are one of the best solution for a balanced grid. The National Mission on Transformative Mobility and Battery Storage has been set up for the vision of 'Atmanirbhar Bharat'. NITI Aayog have already declared to provide subsidy as an additional financial incentive for promoting the domestic advanced battery manufacturing companies. Alternatively, a progressive carbon tax is considered as an effective weapon to mitigate carbon emission. In India, challenges of politico-economic consideration, policy framing and innovation make carbon tax a complex instrument to implement. Carbon tax may not be a viable option due to its high price. By overcoming the political pitfalls and public opposition, carbon tax must be crafted through proper and effective policy. For instant solution, India should more emphasize on phasing out the clean energy subsidies and levy tax on fossil fuel. So, the pursuit and promotion of clean energy sources through mandating energy policies and implementing monetary incentives will enhance its share in the energy grid. This will provide more energy security while simultaneously reducing carbon emission in future.

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