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Global Trends in Energy Consumption, Economic Development and Future Prospectus for Renewable Energy: a Review of Recent Policies, Potential scope and Way forward for India

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Abstract
The world is in a unique and necessary phase of energy transition, where emerging low-carbon technologies are replacing existing fossil fuel assets and are shaping a new energy paradigm. This paper presents a brief review about the recent policies and agreements made at global summits towards energy conservation, sustainable development and moving forward towards decarbonisation. As the economic development has an intimate link with energy consumption, the global economic trends and those of India are presented. An analysis of energy consumption globally and in India is discussed. The paper makes an insight into the renewable energy generation status and the outlook for the coming years. Finally, the way forward for the nations to deliberate, implement and act towards generating green and clean energy is addressed in the paper.
Keywords*: Energy consumption, GDP, Renewable energy, Green policy*

1. Introduction:

Today climate change is a global emergency that needs the nations round the globe to unite. It is an issue that calls for international cooperation and coordinated efforts at all levels. A better living standard in today's scenario means that living in a pollution free environment. Climate change and net-zero commitment are accelerating the shift from fossil fuel to alternatives, such as clean energy. The share of renewable energy in the global power generation mix is forecast to rise from 29% in 2022 to 35% in 2025. In all scenarios, renewables are projected to lead the power generation mix, reaching 80-90% in 2050. It is beyond doubt that policy framework of today will have a long-lasting impact on the country's energy story.

2. Global Agreements for climate betterment:

To address the climate change and its deleterious impacts, 196 nations put a historic step forward at UN Climate Change Conference (COP21) in Paris on 12th December 2015, popularly known as Paris Agreement. The article 2 of the agreement makes a legal binding for holding the increase in the global average temperature to well below 2°C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5°C above pre-industrial levels, recognizing that this would significantly reduce the risks and impacts of climate change whereas article 6 mandates the parties to make finance flows consistent with a pathway towards low greenhouse gas emissions and climate-resilient development. The Paris Agreement marks the beginning of a shift towards a net-zero emissions throughout the world. Implementation of the Agreement is also essential for the achievement of the Sustainable Development Goals. The UN Climate Change Conference in Glasgow (COP26) held from 31st October to 13th November, 2021 proved to be a booster for rapid implementation of the Paris Agreement through actions that can get the world on a more sustainable, clean and green environment.

3. India's action plan:

India has one of the largest proven coal reserves in the world. However, one of the objectives of India's energy mix has been to promote the production of energy through the use of renewable energy sources in accordance with climate, environment and macroeconomic considerations in order to reduce dependence on fossil fuels, ensure security of supply and reduce emissions of CO_2 and other greenhouse gases. India came forward with its

commitment towards negating the impacts of climate change at COP26 gathering. In its action plan India gave its target to reach 500 GW Non-fossil energy capacity by 2030, to generate 50% of its energy requirements from renewable energy by 2030. India also assured the world about its mission to reduce the total projected carbon emissions by one billion tonnes from the current status to 2030, to reduce the carbon intensity of the economy by 45% by 2030 from the 2005 levels and finally to achieve the target of net zero emissions by 2070.

4. Global Economy and India's growth forecast:

It is a known fact that higher levels of GDP are correlated with greater electricity use, access, reliability, and affordability. Presently, the global economy has been facing multitude challenges due to the ongoing Russia - Ukraine war and the hike in central bank rates aimed to bring the inflation under control. The International Monetary Fund's (IMF) January 2023 World Economic Outlook provides forecasts up to 2024 and shows global Gross Domestic Product (GDP) growth of 6.2% in 2021 shrinking to 3.4% in 2022 and easing to 2.9% in 2023. The report projects the GDP to improve by 2024 to 3.1%. The latest forecast represents downward revisions of 0.2%, 0.7% and 0.3%, respectively, compared with the April 2022 prediction. The January 2023 outlook is an optimistic projection than the October 2022 forecast for the short term, with global GDP growth for both 2022 and 2023 raised by 0.2 %. The October outlook, which provided projections up to 2027, forecast a global GDP growth rate of 3.4% in 2025. Because of robust domestic consumption, government spending, investments, and exports, India's GDP has an upward trend. In 2022, India was the world's 6th-largest importer and the 9th-largest exporter. The GDP growth for India is estimated at 6.8% for 2022.The outlook was revised downward in January to 6.1% from 6.9% for 2023, largely due to slow economic growth in its trading partner countries. GDP growth for 2024 was unchanged at 6.8%. The 2025 forecast from the previous October outlook is 6.8%.

5. Global energy consumption trends:

Global electricity demand remained strong in 2022 amid the global energy crisis triggered by Russia-Ukraine war. Demand rose by almost 2% compared with the 2.4% average growth rate seen over the period 2015-2019. The electrification of the transport and heating sectors continued to accelerate globally, with record numbers of electric vehicles and heat pumps sold in 2022 contributing to growth. China's zero-Covid policy weighed heavily on its economic activity in 2022, and a degree of uncertainty remains over the pace of its electricity demand growth. It is estimated to be 2.6% in 2022 much below than the average of over 5% in the 2015-2019 period. It is projected that over the next three years, more than 70% of the growth in global electricity demand is set to come from China, India and Southeast Asia combined. The global electricity demand is expected to grow at a much faster pace of 3% per year over the 2023-2025 period compared with the 2022 growth rate.

In September 2015, the General Assembly adopted the 2030 Agenda for Sustainable Development that includes 17 Sustainable Development Goals (SDGs). Building on the principle of "leaving no one behind", the new Agenda emphasizes a holistic approach of achieving sustainable development for all. Realizing that Energy is critical for people deprived of the opportunity of access to sustainable energy, Goal 7 with the aim to ensure access to affordable, reliable, sustainable and modern energy to all was adopted as one of the 17 Sustainable Development Goals (SDGs).

6. Energy Consumption trends in India:

India saw a very steep rise in electricity demand at 8.4% in 2022 due to robust post pandemic economic recovery and high temperatures in summer. Total investments across energy sectors are expected to grow by more than 4% per annum and are projected to be increasingly slanted towards non-fossil and decarbonisation technologies. It is expected that by 2050, electricity and enabling hydrogen and synfuels could account for 50% of the energy mix. Electricity demand is projected to triple by 2050 as sectors electrify and hydrogen and hydrogen-based fuels increase their market share due to decarbonisation. India has experienced a healthy growth in consumption of Energy. India's power consumption logged a double-digit year-on-year growth of nearly 13% to 126.16 billion units in January 2023, according to government data. The robust growth of power consumption indicates sustained momentum of economic activities in January. In January 2022, power consumption stood at 111.80 billion units (BU), higher than the 109.76 BU in the same month of 2021. Electricity consumption in January 2020 stood at 105.15 BU.

7. Renewable energy trends in the world for the coming decades:

Renewables have been torchbearers of the green initiative since the beginning of the 21st century. Renewable generation is projected to reach 80–90% of the global energy mix by 2050 as the global build-out rates for solar and wind grow by a factor of five and eight respectively. Hydrogen demand in new sectors could reach 350–600 metric tonnes per annum (mtpa) in 2050 compared to present demand of about 80 mtpa; global demand for sustainable fuels is expected to mature, reaching 8–22% of all liquid fuels by 2050. Renewable Energy Source (RES) share is expected to double in the next 15 years, from 29% to 60%. Most of the growth in RES is expected to come from solar and onshore wind, due to declining costs, and they are projected to make up 43% and 26% of generation respectively in 2050. Offshore wind is projected to remain limited to less than 7% of global generation due to permitting constraints and policy issues. Thermal generation is still expected to play an important role as a flexibility provider, with gas providing substantial shares of base-load generation up to 2040 in regions with favourable fuel costs. Nuclear generation is still expected to require economic support from policies, which is not yet present in many regions as public acceptance continues to prove challenging.

8. Renewable Energy Trends in India:

India has one of the highest rates of growth for renewable energy in the world. As per the Global Trends in Renewable Energy Investment 2020 report, during the period 2014-2019, renewable energy programs and projects in India attracted an investment of anout 4.7 lakh crores. The country has achieved a cumulative installed renewable energy capacity of 92.54 GW out of which 5.47 GW was added in the period between April 2020 and January 2021. Globally, today India stands 4th in RE power capacity, wind power, and solar power capacity.
India has set its sight on becoming energy independent by 2047 and achieving Net Zero by 2070. To achieve this target, increasing renewable energy use across all economic spheres is central to India's Energy Transition. Green Hydrogen is considered a promising alternative for enabling this transition. Hydrogen can be utilized for long-duration storage of renewable energy, replacement of fossil fuels in industry, clean transportation, and potentially also for decentralized power generation, aviation, and marine transport.

Out of the total installed generation capacity of renewable sources of power in 2022, installed capacity of Solar power including roof tops accounted for about 49 %, followed by Wind power (37%) and Bio Power & Waste to Energy (10%) as depicted in Fig 1.

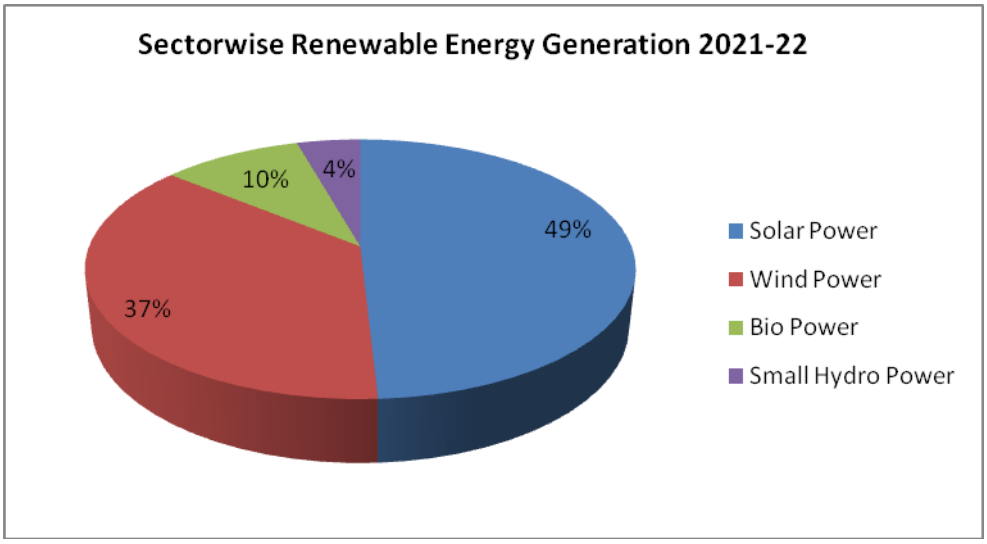

Fig 1. Data Source: India Energy Statistics 2023

However, in terms of growth rates year on year, Solar power installed capacity has a growth rate of 30.95% from FY: 2020-21 to FY: 2021-22 as shown in Fig 2.

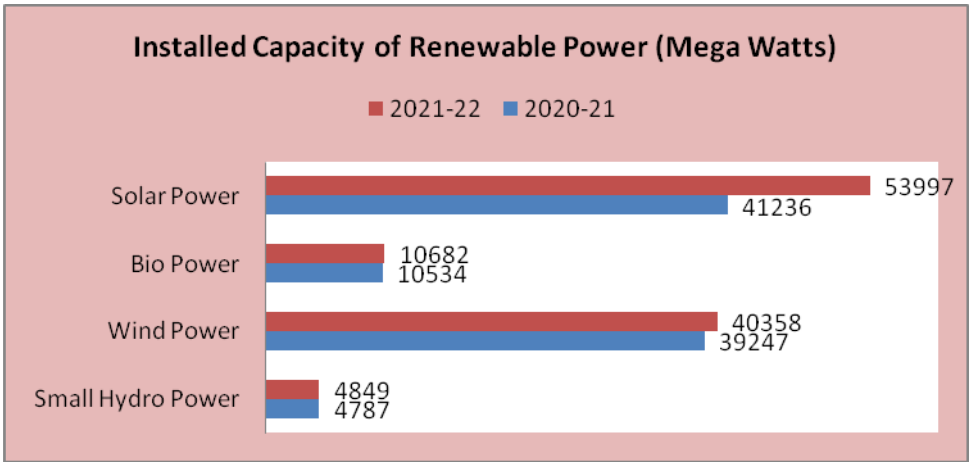

Fig 2. Data Source: India Energy Statistics 2023

India's Nationally Determined Contribution (NDC) under the Paris Agreement for the period 2021-2030 includes a reduction in the emission intensity of its GDP by 33 to 35 per cent by 2030 from 2005 levels and the achievement of about 40 per cent cumulative electric power installed capacity from non-fossil fuel-based energy by 2030 with the help of the transfer of technology and low-cost international finance.

9. Recent Developments towards Green Energy:

The National Green Hydrogen Mission was approved by the Union Cabinet on 4 January 2022, with the intended objectives of Making India a leading producer and supplier of Green Hydrogen in the world.

Honourable Prime Minister of India launched the National Hydrogen Mission on India's 75th Independence Day (i.e. 15th August, 2021). The Mission aims to aid the government in meeting its climate targets and making India a green hydrogen hub. This will help in meeting the target of production of 5 million tonnes of Green hydrogen by 2030 and the related development of renewable energy capacity.

On 17th February 2022, the Government of India unveiled India's New Green Hydrogen Policy under the National Hydrogen Mission. There is an increased consensus around the world that concerted steps need to be taken to reduce global warming to levels less than 2^{o} C and if possible, to cap it at 1.5^{o} C higher than pre-industrial levels.

.A new report from the International Renewable Energy Agency (IRENA) highlights that hydrogen is increasingly seen as an important element in the energy transition to decarbonize harder-to-abate sectors. Hydrogen could account for up to 12 per cent of global energy use by 2050, leading to a rise in new energy superpowers. It is likely to influence the geography of energy trade, further regionalizing energy relations.
Hydrogen as an energy carrier has a vital role in the diversification of renewable energy across key economic sectors, by increasing the share of renewable energy in the electricity mix, enabling clean transportation, and decarbonizing industries like fertilizers, chemicals, petrochemicals, iron, and steel.

10. Conclusion:

Countries need to encourage a more efficient management of energy resources, coupled with an accelerated growth of renewable and sustainable sources of energy. Burning of traditional fuel adds a large amount of carbon dioxide into atmosphere and increases air pollution. To avoid the worst consequences of climate change, the global energy system must rapidly reduce its emissions. Calls to reduce global greenhouse gas emissions are growing louder every year, but emissions remain at unsustainably high levels. A vast majority of global CO_2 emissions come from the energy sector, making clear the need for a cleaner energy system**.** Transition to Green Hydrogen and Green Ammonia is one of the major requirements for the reduction of emissions. It's a high time for the nations around the world to act swiftly to put the policies on paper into reality to save the environment and pledge for sustainable development.

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Presently Working as Associate Professor of Physics at Government Degree College, Luxettipet Dist. Mancherial, Telangana State since 2018.

Successfully completed a Minor Research Project (MRP) in 2017 on "DFT and Normal Coordinate analysis of some Biomolecules" sanctioned by UGC in 2017.

Awards: Awarded with "State Best Teacher Award" by Telangana State Government in 2020.

Research Publications:

International – 9, National – 4

Books & Edited Chapters:

Basic Instrumentation, B.Sc (Physics) Text Book published by Telugu Academy, Government of Telangana (2022)

Chapter in the book “Innovations in Environment, Health & Medical Research”, Global Science Publishing Group, Pages 36 – 45, 2023

Current Research Interest:

DFT and Quantum Molecular Calculations, FT Infrared and Raman Spectroscopy, Climate Change, Renewable Energy Sources, Green Hydrogen.