CONSEQUENTIAL LCA OF THE RENEWABLE ENERGY SECTOR IN INDIA: A CIRCULAR ECONOMY APPROACH

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Overview

The world is steadily transitioning towards accommodating a higher share of Renewable Energy (RE) sources in its electricity mix through the adoption of carbon-neutral or decarbonization policies. India's higher emphasis on adoption of Green Energy for power generation in recent years is aligned with the twin Sustainable Development Goals (SDG) 2030 of tackling climate change (SDG 13) and ensuring sustainable, affordable, reliable, and modern energy to all (Goal 7) (UN, 2018). Furthermore, India has also pledged during COP26 in Glasgow to i) Increase RE capacity to 500 GW by 2030 ii) Meet 50% of country's energy requirements through Renewable Energy by 2030 iii) Reduce total projected carbon emission by one billion tonnes between now and 2030 iv) To reduce 45% carbon intensity by 2030 and v) To become carbon neutral and achieve net-zero emissions by 2070. Along with the pursuit of meeting the global decarbonization targets, India's national ambition of providing 24x7 Power for all remains a top priority (PIB, 2017). However, the capacity to replace fossil fuel sources for power generation while simultaneously ensuring energy security still remains a challenge, especially in a developing country like India with a rapidly growing population. In order to accelerate India's transition towards cleaner energy sources, the Government of India has set an ambitious target of achieving 500 GW RE capacity by 2030, constituting 280 GW solar and 140 GW wind (PIB, 2021) (Aggarwal, 2021). Given that only 21.5% of the cumulative target was achieved until January 2022, the balance 80% RE capacity installation to be met within the next 9 years remains an overwhelming challenge for India considering the COVID-19 induced disruption that is still being witnessed in the economy (CEA, 2022).

Methods

This study intends to evaluate the economy wide impact of this ambitious RE capacity expansion programme in India using integrated macroeconomic frameworks. The General Equilibrium framework is employed by developing a hybrid model using the latest Indian Input-Output Table. The electricity sector is disaggregated to include solar and wind energy sources mentioned in the RE expansion programme. The model is also used to estimate the consequential LCA impact for solar and wind energy capacity addition across the economy. To evaluate the economic impact, variables such as GDP, employment and output are assessed. The end-of-life treatment also holds the key to making RE sources even more economic and environmentally efficient by recovering raw materials to substitute virgin materials, thereby eliminating the cost and energy intensive phase of raw material extraction and processing. Therefore, ensuring that energy transition is complemented by a transition to a circular economy through strategies such as reducing, reusing, recycling, recovering, etc. is a prerequisite for the sustainable energy transition. In this direction, the final analysis presented in the study entails measuring the economic, energy and environmental benefits by estimating the circular economy prospects of RE energy sources. To evaluate the economic impact, variables such as GDP, employment and output are assessed.

Results

Preliminary findings provide interesting results. In the end-of-life stage, the decommissioning of 280 GW of solar PV modules and 140 GW wind turbines is expected to generate waste of approximately 19.3 thousand tonnes and 18.5 million tonnes, respectively. Materials such as copper (84.9 tonnes), aluminium (3,527 tonnes), glass (13.2 thousand tonnes) and composite materials (945.5 thousand tonnes) are identified as recyclable and reusable materials from the decommissioned solar PV modules and wind turbines by substituting virgin material manufacturing in the production phase. Since solar and wind industries are at a very nascent stage in their evolution, the economic impact in terms of GDP and employment is minimal, however the environmental impact emanating from this capacity expansion is substantial. In terms of inter-sectoral impact as a result of addition of solid waste recycling industry, sectors which experience the maximum impact are inorganic chemicals (0.29%), electricity generation from other sources (0.08%), transport services and auxiliary activities (0.033%) and construction and construction services (0.015%). Overall, the solid waste recycling industry does not have significant impact on the economy.

Conclusions

Given the current rate of solar and wind capacity installation, India has set a highly ambitious 2030 RE target. RE capacity addition will be beneficial for few sectors of the economy with significant reduction in air and water pollution. Furthermore, environmental burden and the abatement costs of solid waste generation will exceed significantly. Proceeding with the RES capacity expansion, without accounting for the impending waste accumulation, will make India drift further away from its clean energy targets. The study further intends to highlight the economic and environmental benefits through the circular economy prospects of solar and wind capacity installations which will be significant. The substantial savings in emissions and material resources resulting from the RE capacity expansion and circular economy approach can serve as a catalyst in helping India achieve its decarbonization targets under the COP26 accord and SDGs simultaneously.

References

CEA. (2022). *All India Installed Capacity (in MW) in Power Stations (As on 31.01.2022) (UTILITIES).* New Delhi: Central Electricity Authority, Ministry of Power, Government of India. Retrieved from https://cea.nic.in/wp-content/uploads/installed/2022/01/installed_capacity.pdf

PIB. (2017). *Vision of the Government is '24x7 Power for All'*. Retrieved from Press Information Bureau, Government of India: https://pib.gov.in/PressReleseDetail.aspx?PRID=1512041

PIB. (2021). *Mission 500 GW by 2030.* Retrieved from Press Information Bureau, Government of India.: https://pib.gov.in/PressReleaseIframePage.aspx?PRID=1772347

UN. (2018). *The 17 Goals*. Retrieved from Department of Economic and Social Affairs, Sustainable Development, United Nations: https://sdgs.un.org/goals