

## **Green Economy and Renewable Energy Transitions in Post-Liberalization**

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### **INTRODUCTION**

Thus, good governance is observed to act as a mediator between renewable energy transition and green growth establishment in these emerging countries. Besides, the results confirm the green growth-hampering effects of international trade, urbanization, industrialization, and financial development. Additionally, governments should firmly support investments in green technology as well as economic and financial stability to boost energy efficiency and promote the adoption and usage of energy-saving products. The impact of GDP growth both in short-run and long-run is environment depletion. However, our result supports the theoretical notion that green growth sustains environment quality.

The green economy expresses an idea where the consumption of fossil fuels is reduced substantially, where carbon emissions are restricted, and which involves all segments of society. There are several similar definitions of the green economy in the literature. The International Chamber of Commerce has defined the green economy as an economic model that fosters improvements in economic growth and social development, with a corresponding emphasis on environmental responsibility. Modern societies, focused on consumption, economic growth, and prosperity in social life, have endeavoured to reduce the human impact on the environment, especially the climate. Based on the definitions in the literature, the green economy can be defined as a concept aiming to measure, prevent, minimize, and end environmental degradation related to soil, water, and air, and problems related to waste, noise, and eco-systems, both in the present and the future, and to achieve sustainable economic growth and development.

The social aspect of the green economy is about social equality and improving welfare, which means achieving a better quality of life for societies. The environmental component entails the reduction of environmental problems and ecological scarcity. In tandem with all these definitions, the green economy provides important opportunities to create new markets, engage in different initiatives, and lower energy costs. The emerging innovations and investments in the markets corroborate this trend. The main objective here is to realize the sustainability of development.

### **LITERATURE REVIEW**

**Muntasir Murshed (2024)** This study emphasizes green growth establishment in the Next Eleven countries, especially by boosting their economic output production rates while simultaneously containing their carbon emission growth figures. Notably, considering the novel concept of 'emission growth-adjusted economic growth rate' for selecting the proxy for green growth, the impacts exerted by renewable energy transition, good governance, globalization, urbanization, industrialization, and financial development on the process of greening the economies of the Next Eleven countries are evaluated in this study. Overall, the results derived from the econometric analyses endorse that undergoing renewable energy transition does not promote green growth unless the quality of governance in the Next Eleven countries is improved in tandem.

**Tomiswa Sunday Adebayo (2023)** This study focuses on uncovering the effect of country risks and renewable energy consumption on environmental quality. In this context, the

study examines Mexico, Indonesia, Nigeria, and Turkey (MINT) nations; takes economic growth, trade openness, and urbanization into account; includes data from 1990 to 2018; applies cross-sectional autoregressive distributed lag (CS-ARDL) as the main model while common correlated effects mean group (CCEMG) and augmented mean group (AMG) for robustness checks. Based on these results, policymakers should promote a sustainable environment to lessen the ecological footprint.

**Munir Ahmad (2022)** Since climate change is the paramount concern of recent literature, macroeconomic factors such as green growth and economic globalization may play an integral role in achieving ecological sustainability in the presence of eco-innovation. However, the combined contributions of green growth, economic globalization, and eco-innovation towards achieving ecological sustainability are missing from the existing knowledge. Therefore, we investigate the combined influence of these variables in the presence of human capital, financial development, and gross domestic product on ecological footprint per capita for a panel of 20 Organization for Economic Co-operation and Development (OECD) countries from 1990 through 2017. The method of panel quantile regression is used to produce sound results across varying levels of the ecological footprint of OECD nations. Secondly, economic globalization manifests mixed effects: it induces ecological deterioration impact in the absence of its interaction with eco-innovation, while it brings about an ecological protection impact with the interaction term.

**Lin-Na Hao (2021)** This study analyses the role of green growth in promoting a sustainable environment. In literature, the empirical and theoretical examination on the role of green growth in carbon dioxide (CO<sub>2</sub>) emissions is missing, especially in combination with other factors, i.e., human capital index, environment-related taxes and development of environment-related technologies. This study investigates the role of environmentally adjusted multifactor productivity growth (i.e. green growth) on CO<sub>2</sub> emissions for G7 countries from 1991 to 2017. The study utilizes second generation panel data method(s), i.e. Cross-Sectionally Augmented Auto-regressive Distributive lag (CS-ARDL) model. The outcomes of theoretical and empirical findings indicate that both linear and non-linear term for green growth reduces CO<sub>2</sub> emissions. Also, environmental tax, human capital and renewable energy use are found to decrease CO<sub>2</sub> emissions.

**Massimiliano Mazzanti (2020)** Over the recent years, there has been evidence of a decline in energy intensity worldwide. Most of this decline was industry or sector specific. The main aim of the quantitative analysis is to enhance the understanding of how green energy innovative activities are entangled with energy intensity in the OECD through models that take into account heterogeneity and serial correlation. The existing literature does not fully address this country related heterogeneity in either the short- or long-run scales. We use some specific estimators that address those key econometric issues. The analysis specifically focuses on the dynamics of green energy innovation and finds the existence of both short-term and long-term relationships between energy intensity and green energy innovative activities, though this relationship loses its significance over time.

### **Renewables in Energy Transition**

In developing countries like India, apart from availability, accessibility becomes equally crucial in the transition path. Unlike hydrocarbon-based system, which is highly centralized, renewable provides the option to conceive decentralized mode, thereby closer to meet the accessibility requirements of these countries. The Paris Agreement has made it obligatory for

countries to move to low carbon economy with targets and dateline popularly described as Intended Nationally Determined Contribution (INDC). The above commitment can be accomplished only by shifting the energy regime towards renewable energy sources.

Adopting renewable energy through a suitable energy regime becomes the biggest challenge for developing country like India. Renewable energy sources are technologically dependent, and their success is linked to the energy transition pathways. Owing to lack of capital, research and development (R&D) developing countries fall short of their indigenous renewable energy technologies due to which they need to depend on western countries. As a result, developing countries become more technologically dependent and import-dependent on the west. Given this situation, energy security becomes a serious concern giving essential impetus to develop indigenous technologies for clean energy. However, it is realized that even under the best-case scenario, India's emissions are liable to increase.

It further implies the large-scale deployment of renewable energy, followed by technological advances. To attain the targets of India's Nationally determined commitments of reducing the emissions intensity of its GDP by 33 to 35% by 2030 from 2005 levels, to achieve about 40% cumulative electric power installed capacity from non-fossil-based fuel by 2030.

#### **Transition Phase to A Green Economy**

The process of transition to a green economy starts with the identification and definition of the natural resources, public actions, limited public resources, and social instruments used as a result of global cooperation. In the process of transition to a green economy, favorable conditions should be created for the success of public and private investments, and education and communication methods should be shared with the whole society to raise awareness. Moreover, ensuring the participation of all stakeholders and social cooperation is crucial in the transition to a green economy model.

Along with all the above-mentioned criteria, a strategic roadmap should be drafted and revised to identify the risks that might be encountered at the social aspect in the transition to a green economy with a collaborative approach, to implement relevant investments by the public, private sector, and social organizations, to determine financial mechanisms that are compatible with green economy principles, to harmonize economic policies and performance metrics for green and sustainable development, to support relevant studies by taking the most effective and comprehensive green economy practices as a model, and to put the relevant legal, political and financial regulations into effect. All these measures provide a strategic roadmap for the transition to a green economy. Immediate action is required for a future where circularity is prioritized and environmental impact is minimal.

#### **From Sustainable Development to Green Growth**

To understand the origins of the concept of green growth, examining the historical development of the relationship between humans and the environment is a vital step. These steps are categorized into three different phases. These are: the dichotomy of environmental protection versus economic growth, the absolute ignorance towards the environment, and sustainable development. Initially, the environment was a hostile place for new species to survive, but the ultimate goal was to enable humans to live a healthier life. The second step is that people have concluded that economic growth has a negative impact on the environment. The pressure to improve the environment increased during this period, resulting in a significant improvement in the environment.

However, expenditures for environmental conservation have imposed an additional cost, which in turn has slowed economic growth. In the third step, greater problems have been posed by the limits of economic growth and its impact on society, the environment, and the economy. The United Nations Environment Program (UNEP) was established in 1973 to address these problems. This approach is stated as an approach that is grounded in a production system in which humans have healthy and balanced air, water, and soil, and in which the solution to environmental problems fundamentally requires cooperation on a global scale.

### **Low-carbon economy**

As observed in the preceding sections, the low-carbon economy is one of the main aims of the Green Economy. Advocates of a low-carbon economy transition bet on the following three main policies to achieve it: control over the price of carbon, boost of alternative energies via increases in investments and a strong regulatory framework. The first policy regarding carbon price control can be approached either by the creation of a market for the emissions based on the work, by the implementation of an environmental tax based on the work by a combination of both.

Experts on the determinants of the carbon price define the following factors affecting its future fluctuation: supply capacity of renewable energies, innovation and technological level of those energies, state engagement on providing certainty to alternative energy markets and conditions of the emission trade agreement (ibid.). Since CO<sub>2</sub> emissions are one of the main causes of global warming and its level in the atmosphere has reached unprecedented levels, environmental economists suggest that a higher price of carbon would reflect the negative repercussions of CO<sub>2</sub> emissions and consequently reduce them.

### **Green Economy indicators and shortcomings**

As previously clarified, the concept of decoupling manages the interaction of environmentally negative externalities and economic growth. In order to account for and monitor the improvements in the low-carbon economy transition and the resource efficiency fields towards a Green Economy, international organizations made use of a series of indicators. For instance, the EU monitors four different indicators to evaluate national and communitarian progress towards a green and sustainable growth. These indicators are the level of greenhouse gases (GHG) emissions, the renewable energy share in gross final energy consumption, the level of primary energy consumption and the level of final energy consumption.

### **RESEARCH METHODOLOGY**

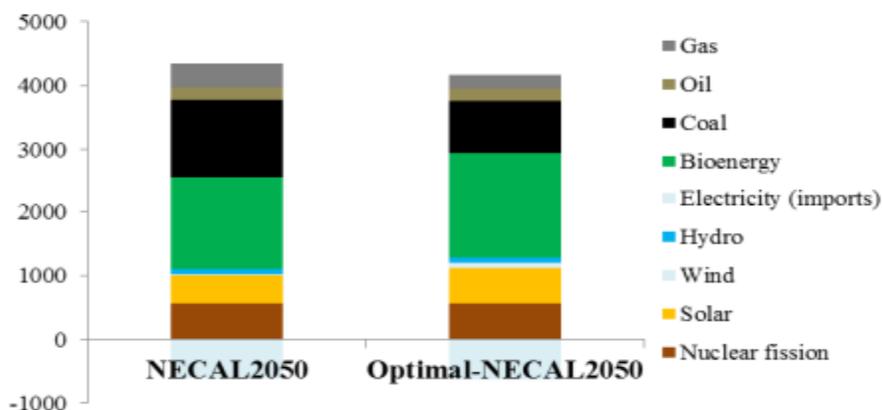
This strategy enables a thorough comprehension of the intricate socioeconomic and environmental elements that affect the adoption and application of renewable energy programs. The researcher used secondary data analysis of existing data from other researchers, organizations or agencies for the purpose of developing a well-designed study. This approach capitalized on the strengths of both methods, enabling the researcher to gain a more comprehensive and nuanced understanding of complex phenomena like the transition to a green economy. To elucidate the social, cultural, and behavioural elements that influence the transition process by utilizing qualitative techniques including interviews, focus groups, and content analysis. When a mixed-methodologies approach is used in research, quantitative and qualitative research methods are combined.

This method seeks to enhance the benefits of each while minimizing the drawbacks of each separately. Statistics on energy consumption and the adoption of renewable energy sources from neighbouring India countries were gathered. The overarching goal of this research

is to contribute valuable insights and recommendations that can inform policy-making, industry development, and sustainable energy planning in the region. Secondary data analysis offered useful quantitative insights into economic patterns and the consequences of green initiatives.

**RESULTS AND DISCUSSIONS**

The different energy supply projections from the two model versions are depicted in Graph 1 clearly indicating the variations in the shares of different fuel sources by the year 2050. The overall reduction in primary energy supply can be attributed to the improved efficiency of energy system and use that results from the planned attitudinal changes as well as reduced conversion, transmission and distribution losses from ever growing technological enhancement through innovation.



**Graph 1: Primary energy supply by 2050**

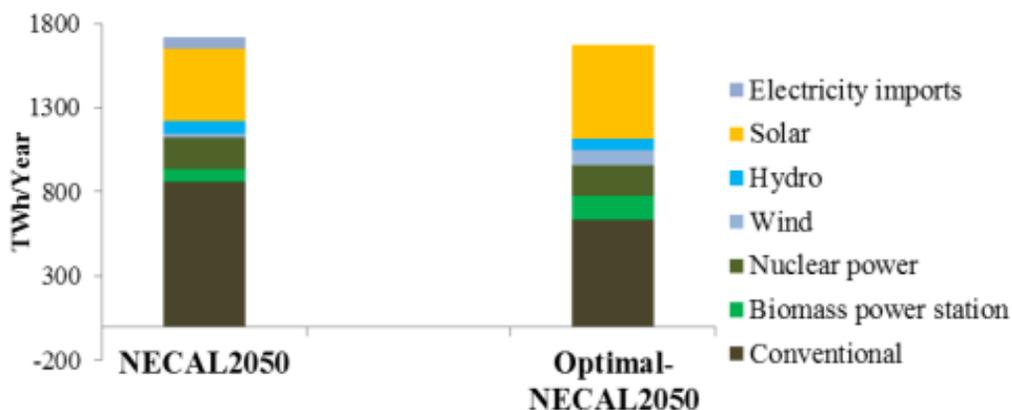
It is clear that, the major source of emissions, as established by existing narratives currently and by 2050 is fuel combustion and can be seen as having the biggest portion of the two bars in both NECAL2050 and its optimal version.

Fuel combustion constitutes of emissions from oil, gas and coal combined. Its however, clear that the emission is less in Optimal-NECAL2050 than in the original version, which is a result of the alterations made to coal, bioenergy, solar and wind. The level of carbon footprint of the two scenarios will also give another insight into the extent of their sustainability. It can be seen from table 1 that for

**Table 1: Carbon Footprint of the Scenarios by 2050**

Description	NECAL2050	Optimal-NECAL2050	Units
Emissions	625.21	449.46	MtCO <sub>2</sub> e
Energy	3743	3552	TWh
Energy per Mt of emission	<b>5.99</b>	<b>7.90</b>	TWh
Emission per TWh of energy	<b>0.17</b>	<b>0.13</b>	MtCO <sub>2</sub> e

every 1TWh of energy produce in the NECAL2050's best scenario, about 0.17MtCO<sub>2</sub>e are produced, put differently, 1MtCO<sub>2</sub>e is released in the process of producing about 5.99TWh of energy. Conversely, every Optial-NECAL2050 TWh produces only 0.13MtCO<sub>2</sub>e or alternatively, every MtCO<sub>2</sub>e released was a result of producing about 7.9TWh of energy signifying sustainable superiority of Optimal NECAL2050.



**Graph 2: Electricity supply in 2050**

An important aspect of the energy system is electricity supply as a significant portion of the total primary energy supply (about 1669TWh by 2050 - See Graph 2) and the predominant source of emissions. It can be clearly seen that the differences in the share of renewables for electricity supply in 2050 are visible on the two bars of Graph 2 for NECAL2050 and the optimal version. The electricity supply volume is a little less in the Optimal-NECAL2050 but with higher shares of renewables as is seen in the total primary energy supply, with less conventional (fossil) fuels.

The estimates included capital, operation/maintenance and fuel costs with optional provision for extra cost due to financing capital. The estimates of investment required for the two modelled scenarios by 2050 ranging from the USD6,504.18 billion as the lowest to USD6,756.10 as the highest are presented in the table 2 below;

**Table 2: Estimates of Investment Requirement by 2050 (USD' Billion)**

Estimates Level	NECAL2050	Optimal-NECAL2050	Difference	% Diff.
Low	6,504.18	6,520.98	16.80	0.26
Medium	6,604.19	6,638.62	34.43	<b>0.52</b>
High	6,729.92	6,756.10	26.18	0.39

It is not surprising to see that the cost estimates for Optimal-NECAL2050 are higher at all levels than those for NECAL2050's best energy scenario, but it is even astonishing to find out that the difference is infinitesimal. The difference is below one percent across all (low, medium and high) levels of estimates, with the medium estimates having the highest margin of above 0.5%.

**CONCLUSIONS**

In this case, while trying to help countries solve their energy issues; more problems are created and compounded by developing models that do not fit their circumstances. The NECAL2050 is a good model that failed to cover some of the most important requirements of the Indian economy, particularly most of the rural households and some of the urban ones and the complete economy in some ways. Neglecting agricultural demand for energy despite its phenomenal growth currently and

undermining the electricity generation capability of India as well as the role of RE in the energy system at the best scenario of the model are the pronounced flaws identified in the NECAL2050.

Therefore, the need for a better understanding as well as inclusion of these local conditions is the best way to go about, not only energy modelling for developing countries but also all other works that involves interactions between developed and developing countries. One way of doing that has been suggested in the proposed methodological structure of the Optimal-Mix-Model and Optimal-NECAL2050 that tried to include the local conditions into the adopted NECAL2050 model by way of introducing changes in selected sectors of the model with reflection of the local, regional, national and international policies, programmes and initiatives in mind.

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