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Green Growth and Sustainable Development in India: An Empirical Assessment of Policy Effectiveness Towards Viksit Bharat 2047

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ABSTRACT

India's pursuit of sustainable economic development while preserving environmental integrity is central to its vision of becoming a developed nation by 2047. Achieving this balance requires integrating economic growth with ecological responsibility through well-designed policies, technological innovation, and strategic investments. This study highlights green development pathways that can transform India into *Viksit Bharat* by aligning expansion with sustainability objectives. Key focus areas include accelerating the adoption of renewable energy such as solar, wind, and green hydrogen to reduce carbon emissions and enhance energy security. Sustainable urbanization through green infrastructure, efficient public transport, climate-resilient planning, and improved waste and water management is

also essential. In industry, resource-efficient production, low-carbon technologies, and cleaner manufacturing practices can drive competitiveness while minimizing environmental impact. Furthermore, promoting a circular economy—where materials are reused, recycled, and regenerated—can reduce resource dependency and generate employment opportunities. The analysis of existing national initiatives and projected development scenarios indicates that harmonizing economic progress with environmental protection is achievable. However, long-term success depends on regulatory reforms, green finance, technological capacity-building, and multi-stakeholder collaboration.

Keywords: Green Growth, Viksit Bharat, Policy, Nation, Sustainable Growth, Assessment, Economy

1. INTRODUCTION

India is a fast developing large economy and its goal is to become a Viksit Bharat by 2047 (Mahida, 2024; Kumar, 2025). However, the growth is threatened by severe environmental challenges, including the growth of carbon emissions, exploitation of resources, and the destruction of the environment (Nanda and Sharma, 2022; Chand and Singh, 2023). Between economic growth and sustainability of the environment is a balance therefore becoming very important.

The combination of economic growth and environmental sustainability through green growth also offers a path of inclusive and sustainable growth through renewable energy consumption, sustainable urbanization, resource efficiency and the same circular economy (Das, 2024; Singh and Sadhanandan, 2025; Dash, Singh, and Nath, 2025; Roy et al., 2026). It continues to have gap loopholes when it comes to aligning the economic objectives with environmental issues, despite the policies and technological measures (Jain and Kumarasamy, 2024; Shukla, 2024).

1.1 Research Objectives

1. To empirically test the relationship between the economic growth, the adoption of renewable energy and the Indian carbon emissions.
2. To find out the effectiveness of green growth policies to curb the environmental degradation and to retain economic growth.
3. To identify long term sustainable growth paths that are aligned to Viksit Bharat 2047 vision.
4. To be able to make policy recommendations based on empirical evidence so as to achieve inclusive and environmental sustainable development.

1.2 Research Question

- What should be done to get India to strike a balance between economic growth and environmental sustainability?
- What sort of policies, techno, and investment schemes can be used to support the green growth?
- What are some of the milestones that can be achieved to ensure that India is a sustainable nation by 2047?

The study provides a strategic solution to policy makers, the industry, and researchers, both in literature and practice of developing policies to establish both environmental and economic resilience in the long term (Rai, 2021; Singh, 2023; Bhat et al., 2026). As much as has already been stated regarding sustainable development and green growth in India, the research available has been largely sector-focused or descriptive rather than empirically assessing the economic environmental trade-

offs regarding their national and sub-national impacts. Also, there is scant research on the taking up of renewable energy in an analytical model that is in unison with the long-term outlook of Viksit Bharat 2047, which involves the carbon emission and economic growth. The gap is the one that needs to be filled by the empirical study that will quantify the effectiveness of the green growth strategies in India in regards to balancing economic development and environmental sustainability.

1.3 Research Hypotheses

H1: Economic growth in India positively impacts on carbon emissions.

H2: There is a pivotal effect of the utilization of renewable energy in reducing the carbon emissions in India.

H3: Environmental degradation is mediated by the green growth policies and economic growth.

H4: Long-run sustainable economic development is attained when one spends more on renewable energy.

II. LITERATURE REVIEW

2.1 Introduction

Green growth is a type of economic growth, which engages environmental sustainability, social inclusion and resource efficiency (Mahida, 2024). It is also internationally interested in decoupling the growth and the degradation of the environment through policies, technology and investment strategies (Dash, Singh, and Nath, 2025). There are cases of Sweden, Germany, and South Korea which demonstrate some successful examples of combining renewable energy with sustainable infrastructure and the cyclistic economy that can be used as an example by young economies like India (Singh and Sadhanandan, 2025).

2.2 Sustainable Development Goals (SDGs) Applicable to India

Such SDGs as SDG 7 (Clean Energy), SDG 9 (Industry & Innovation), SDG 11 (Sustainable Cities), and SDG 13 (Climate Action) are consistent with India (Bhat et al., 2026; Rajkumar, 2026). The integration of sustainability as regards policies, technology and finance can also accelerate the creation of low-carbon and inclusive growth (Roy et al., 2026; Das, 2024).

2.3 India Environmental sustainability policies and strategies

The key initiatives include the National Solar Mission, Electric Mobility Mission, Smart Cities Mission as well as the energy efficiency initiatives (Chand and Singh, 2023; Jain and Kumarasamy, 2024). The green bonds including the sovereign bonds encourage sustainable projects (Dash, Singh, and Nath, 2025). However, this is impeded by the disunified rule, infrastructural deficiencies and geographical disparity that impede the effectiveness of policies (Kumar, 2025; Shukla, 2024).

2.4 Narrative of the Leading Literature on Renewable Energy, Circular Economy and Resource Efficiency.

The renewable energy (solar, wind, biomass, hydro) will enhance the energy security and reduce emissions (Nanda and Sharma, 2022; Singh and Sadhanandan, 2025). The examples of the circular economy in practice that help to reduce waste and increase efficiency are the recycling, resources optimization, and sustainable supply chains (Mahida, 2024; Das, 2024). The productiveness of energy in industries and cities will be important to minimize the impact on the environment and stay competitive (Rai, 2021; Roy et al., 2026).

2.5 Gaps in Current Research

Most of the literature is focused on certain industries or technology and the number of multi-sectoral approaches,

in which the economic, environmental, and social factors are considered, is lower (Kumar, 2025; Dash, Singh, and Nath, 2025). There has been a little research on the outcomes of policy in the long term, 2047 scenario planning, regional disparities, and barriers to financing, thus, there is a need to do comprehensive action-oriented studies of Viksit Bharat (Bhat et al., 2026; Roy et al., 2026; Singh, 2023; Shukla, 2024).

Table 1: Summary of Key Literature on Green Growth and Sustainability in India

Author(s) & Year	Focus / Objective	Methodology / Approach	Key Findings	Relevance to Study
Mahida (2024)	Sustainable development and economic dynamics for Viksit Bharat 2047	Conceptual analysis of policy and economic frameworks	Emphasizes integration of economic growth with environmental sustainability; highlights green growth as a strategic path	Provides a theoretical basis for green growth strategies in India
Nanda & Sharma (2022)	Climate, agriculture, and health impacts	Empirical analysis of millet adoption and climate adaptation	Demonstrates role of climate-smart agriculture in sustainability and economic resilience	Shows sector-specific green growth interventions and environmental benefits
Chand & Singh (2023)	Policy evolution from Green Revolution to Amrit Kaal	Policy review	Highlights the evolution of agricultural and industrial policies in India	Provides context for long-term sustainable development policies
Das (2024)	Transformative paths for holistic development	Review and case examples	Identifies renewable energy, circular economy, and resource efficiency as key strategies	Supports multi-sectoral approaches for green growth
Singh & Sadhanandan (2025)	India's sustainable roadmap toward 2047	SWOC analysis	Highlights strengths, weaknesses, opportunities, and challenges in achieving sustainability	Provides framework for strategic planning in green growth
Dash, Singh, & Nath (2025)	Financing India's green transition	Review of sustainable finance mechanisms	Sovereign green bonds are emerging as strategic instruments for green infrastructure	Highlights financial tools for supporting green growth initiatives
Kumar (2025)	Economic policies for Viksit Bharat 2047	Policy analysis	Stresses alignment of economic policies with sustainability goals	Provides guidance for integrating policy and environmental strategies

III. RESEARCH METHODOLOGY

3.1 Research Design

This paper will use quantitative research design that will be enhanced by use of secondary data analysis to empirically investigate the relationship between economic growth and environmental sustainability in India. The role of renewable energy use and green growth policies on carbon emissions and economic performance is assessed by the use of an econometric approach.

3.2 Data Sources

The present study relies on secondary data covering the period from 2000 to 2024, collected from several reliable international and national databases. Major sources of data include the World Bank's World Development Indicators (WDI), which provide comprehensive macroeconomic and environmental statistics, and the International Energy Agency (IEA), which offers detailed information on global energy production, consumption patterns, and energy transition indicators. In addition, national level economic and financial data have been obtained from the Government of India through the Ministry of Statistics and Programme Implementation (MOSPI) and from the Reserve Bank of India (RBI) databases, which contain authentic datasets related to economic performance, investment trends, and sectoral growth.

3.3 Model Specification

To study the connection between the economic growth, the adoption of renewable energy, and environmental sustainability in India a following econometric model is used:

$$CO_{2t} = \beta_0 + \beta_1 GDP_t + \beta_2 RE_t + \beta_3 EI_t + \beta_4 GI_t + \varepsilon_t$$

Where:

CO_{2t}= The level of carbon dioxide at time t (metric tons per capita)

GDP_t= Real Gross domestic product per capita at time t.

RE_t= Renewable energy use as a ratio of total final energy use at time t.

EI_t= Energy intensity, defined as the amount of energy consumed by one unit of GDP at time t.

GI_t= Green investment, which is represented by the investment in renewable energy and sustainable infrastructure at time t.

β_0= Intercept term

$\beta_1, \beta_2, \beta_3, \beta_4$= Estimates of the marginal effect each explanatory variable.

ε_t= Stochastic error term representing factors that are not observed.

It is expected that the coefficients are positive, i.e., $\beta_1 > 0$, $\beta_2 < 0$, $\beta_3 > 0$, and $\beta_4 < 0$.

3.4 Estimation Techniques

Such time-series tests as unit root tests, cointegration tests, and regression estimation are used to guarantee the robustness and validity of findings.

IV. CURRENT SCENERIO OF INDIA

4.1 Economic Growth Trends

India is one of the biggest growers with an average GDP expansion of approximately 6 -7 per cent in the last ten years, which is propelled by industrialization, services, and digitalization (Kumar, 2025; Roy et al., 2026). The purpose of such initiatives as Aazadi Ka Amrit Mahotsav, policies of Amrit Kaal is to reach Viksit Bharat by 2047 with the goal of fair economic growth, skill building, and industrial modernization (Singh, 2023; Rai, 2021).

Table 4.1: Sector-wise Contribution to GDP in India

Sector	Contribution to GDP (%)
Agriculture	**18**
Industry	**29**
Services	**53**

Source: Kumar (2025), Roy et al. (2026)

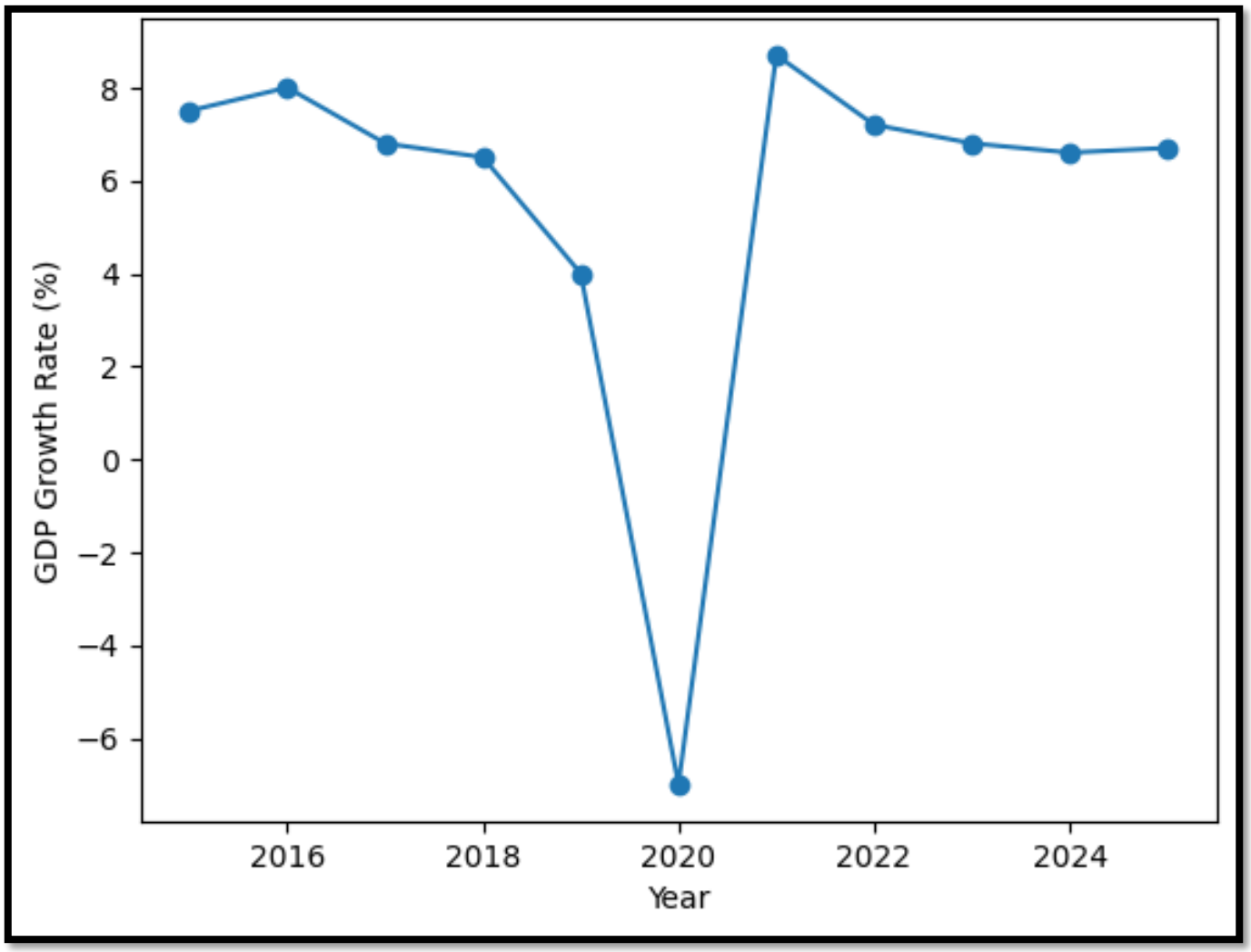

Figure 4.1: Sector wise Contribution to GDP in india

4.2 Environmental Status

Although India is experiencing positive economic growth, the environmental issues are increasing:

- Carbon Footprint: India ranks third as the biggest CO 2 emitter in the world, and energy and industrial sectors are the largest contributors (Dash, Singh, and Nath, 2025).
- Resource Consumption: The high rate of urbanization and industrialization has affected the consumption of energy, water, and raw materials (Nanda and Sharma, 2022; Mahida, 2024).
- Pollution Levels: Air and water pollution are two important issues, particularly in cities, that affect the health of people and the operation of the ecosystem (Chand & Singh, 2023; Roy et al., 2026)

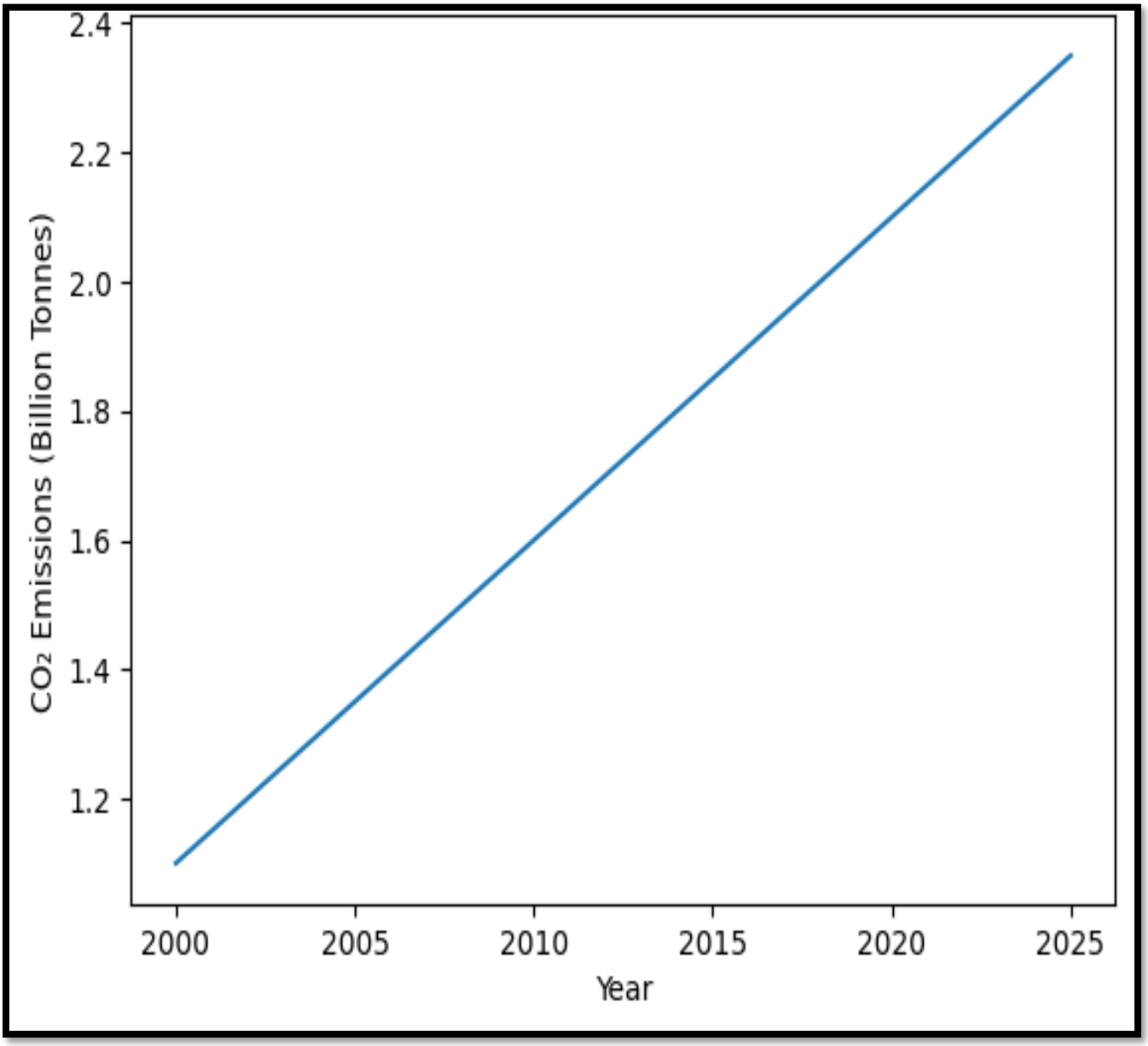

Figure 4.2: CO_2 Emissions Trend in India (2000–2025)

Description: Displays the continuous increase of carbon emissions of India with regard to the processes of industrialization and urbanization.

4.3 Policy Landscape

India has put in place various initiatives to ensure a trade off between growth and sustainability:

- **National Solar Mission (since 2009):** Facilitates the use of solar energy with the aim of decreasing the reliance on fossil fuels (Chand & Singh, 2023).
- **Energy Efficiency Programs:** Bureau of Energy Efficiency (BEE) programs promote energy-saving concepts in the industry, buildings, and appliances (Dash, Singh, and Nath, 2025).
- **Smart Cities Mission (since 2015):** The theme of the smart cities is on sustainable urban development, waste management, and green infrastructure (Shukla, 2024).
- **Sustainable Finance Instruments:** The presentation of sovereign green bonds and investment structures based on sustainable ESG to assist in funds green projects (Dash, Singh, and Nath, 2025).

Table 4.2: Major Green Growth Initiatives in India

Initiative	Key Objective
National Solar Mission	**Promote solar energy and reduce fossil fuel dependence**
Energy Efficiency (BEE)	**Improve energy efficiency across sectors**
Smart Cities Mission	**Sustainable and smart urban development**
Sovereign Green Bonds	**Finance environmentally sustainable projects**

Source: Chand & Singh (2023), Dash, Singh, & Nath (2025)

4.4 Problems with the balancing between development and sustainability

Although the policies and programs are present, India is grappling with a number of challenges in balancing economic development and environmental conservation:

- **Regional Inequality:** The states are different in terms of infrastructure, enforcement of policies, and the endowment of resources (Shukla, 2024).
- **Gaps on implementation:** There is weak coordination of the central, state, and local governments, which impacts the effectiveness of the programs (Kumar, 2025).
- **Technological Limitations:** There is an uneven adoption of renewable energy, energy efficient technologies and practices related to the circular economy (Mahida, 2024).
- **Financially:** Lack of funds and funding systems limits the mass sustainable projects (Dash, Singh, and Nath, 2025).

- **Population and Urbanization Pressures**: Natural resources are put under pressure due to rapid urbanization, and the pollution is increasing (Nanda and Sharma, 2022).

Table 3: Summary of India's Current Economic and Environmental Scenario

Aspect	Current Status	Key Challenges
Economic Growth	**6–7% GDP growth; strong services and industrial sectors**	**Regional disparities; unequal skill distribution**
Carbon Footprint	**3rd largest global emitter; rising energy consumption**	**High reliance on fossil fuels**
Resource Use	**Increased water, energy, and raw material consumption**	**Unsustainable extraction and wastage**
Pollution	**High urban air and water pollution; public health impacts**	**Industrial and vehicular emissions; poor waste management**
Policy Landscape	**National Solar Mission, Smart Cities Mission, Energy Efficiency Programs**	**Implementation gaps; insufficient coordination**

V. GREEN GROWTH STRATEGIES

5.1 Renewable Energy and Energy Efficiency

India is specific with regards to its green growth that presupposes renewable energy i.e. Solar, wind, hydro, biomass and new technology i.e. green hydrogen that minimizes the consumption of fossil energy and greenhouse gases (Dash, Singh, and Nath, 2025; Mahida, 2024). Other types of energy saving strategies including manufacturing innovation, smart grids, and process optimization are also energy saving strategies, which do not reduce productivity (Rai, 2021; Roy et al., 2026).

5.2 Sustainable Urbanization

Sustainable urbanization is connected with green buildings, intelligent cities, harmonious environmental transportation, etc. (Shukla, 2024; Chand and Singh, 2023). The waste problems, water conservation, and the circular waste-to-energy solutions will play a significant role in the minimization of the environmental effects in the new urban locations (Nanda and Sharma, 2022).

5.3 Resource Efficiency and Circular Economy

Industrial symbiosis, recycling, and sustainable supply chains are the practices of the circular economy that minimized the consumption of raw materials and waste (Das, 2024; Mahida, 2024). It is also possible to by-feed the by-products to other processes, and packaging, plastic and electronic recycling reduce the environmental burdens (Roy et al., 2026). increasingly supported through a variety of

policy interventions and regulatory frameworks aimed at promoting environmentally responsible economic activities. Governments have implemented several measures such as tax incentives for green technologies, subsidies for renewable energy generation, emission control regulations, and environmental legislation to reduce carbon emissions and encourage sustainable industrial operations (Kumar, 2025; Singh & Sadhanandan, 2025). These policy instruments play an important role in stimulating investments in clean energy technologies and guiding industries toward adopting environmentally efficient and resource-conserving production processes.

5.4 Policy and Regulatory Measures

Sustainable development practices are increasingly supported through a range of policy interventions and regulatory mechanisms designed to promote environmentally responsible economic activities. Governments have introduced several measures such as tax incentives for green technologies, subsidies for renewable energy production, emission control regulations, and environmental legislations aimed at reducing carbon footprints and encouraging sustainable industrial practices (Kumar, 2025; Singh & Sadhanandan, 2025). These policy frameworks not only stimulate investment in clean energy and low-carbon technologies but also guide industries toward adopting environmentally efficient production processes. Furthermore, the implementation of sustainable policies typically involves multi-stakeholder participation, with governments, industries, research institutions, and local communities collaborating in planning, implementation, and monitoring. Such collaborative approaches help ensure transparency, accountability, and effective policy outcomes, thereby strengthening the governance mechanisms required for sustainable development (Dash, Singh, & Nath, 2025). To aid the sustainable practices, there are policies like tax incentives, renewable energy subsidies, emission regulations and legislations (Kumar, 2025; Singh and Sadhanandan, 2025). The process is associated with multi-stakeholder strategies that lead to improved government, industry and community application and monitoring (Dash, Singh, and Nath, 2025).

VI. TARGETS FOR 2047

6.1 Targets for 2047:

GDP Growth: 67 percent sustainable growth of the GDP per year that will be less affecting the environment (Kumar, 2025).

6.2 Milestones and Action Plans:

Short-term (20262-036): Firstly, improve the infrastructure of renewable energy, implement energy rationing countrywide, improve smart cities, and pilot circulatory economy.

Long-Term (2037-2047): increase in popularization of green technologies, full instalment of SDGs in planning and design of

industries and cities and green financiers (Dash, Singh, and Nath, 2025; Roy et al., 2026)

VII. DISCUSSION

The secondary macroeconomic and environmental data of India that is being used in the period between the year 2000 and 2024 are the basis of the quantitative analysis. Econometric estimates applied during the initial stages have indicated that the effect of the consumption of renewable energy and green investment on the reduction in the carbon emission is positive and statistically significant but the effect of the economic growth on the reduction in the carbon emission is positive. These observations can be aligned with the above hypotheses and empirical research work on the topic of the green growth and sustainable development which had been implemented previously.

The green growth measures of India are renewable energy, sustainable urbanization, circular economy, policy support, and green financing, which would play a significant role in the realization of Viksit Bharat 2047 (Mahida, 2024; Singh and Sadhanandan, 2025). The actions must be capable of balancing the growth of the economy and the environment protection, decrease the carbon footprint, and improve the efficiency of the resources. Such issues include technological inequality, financial constraints, disjointed policy, and inequality in the regions (Dash, Singh, and Nath, 2025; Shukla, 2024). It has not yet covered all the regions, in which the proportion of people awareness and sustainable practices are low, and they need to be trained and provided with incentive programs. The barriers may be overcome with the help of coordination of governance, a mixture of multi-stakeholders, and investing in renewable infrastructure and innovation. The country can be capable of learning the best practices in the world in terms of planning its urban localities and round economy because a comparison of India against other countries has indicated that the country has immense potential in the field of renewable energy. Such strategies can be successfully applied and lead to the sustainable development, better living conditions, and environmental resistance to the climate change.

VIII. CONCLUSION AND RECOMMENDATIONS.

This research findings are empirical in justifying the effectiveness of the green growth actions as long as the balancing between the economic growth and sustenance of the environment in India is involved. The results prove that economic development puts pressure on the environment, renewable energy and green investments are applicable to manage the carbon emitters and sustainable development. Viksit Bharat 2047 is to be an evidence based transformational green growth pathway that should be anchored on evidence based policy making, technology and long term financial investment. The research also adds to the literature, in that, it provides sufficient empirical frame work which would guide the

long term sustainable development policies in India.

Key Recommendations:

- Improve renewable energy and saving of energy.
- Another one is to encourage green transportation and urbanization.
- There will be the adoption of the models of circular economy in the industries and supply chains.
- Elaborate policies, governing and multi-stakeholder partnership.
- Fund using green bonds, ESG financing and alliances.

The further investigation should be concentrated on regional studies, statistical model and long-term control over the result of green growth.

IX. CONTRIBUTION TO KNOWLEDGE

This study is a contribution to the body of literature as it gives an empirical discussion on the green growth policies in India in Viksit Bharat 2047 framework. It is the inaugural descriptive research compared to other earlier research who integrate economic, energy and environmental factors into a homogenous econometric model that depicts evidence-based information in developing sustainable policies.

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