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The Political Economy of Renewable Energy in India: How Policy, Politics, and Market Forces Shape the Transition to Sustainability

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Abstract
India, one of the world's fastest-growing economies, faces a dual challenge of meeting its increasing energy demands while mitigating environmental degradation and climate change. The transition to renewable energy is pivotal for achieving sustainable development. This article explores the political economy of renewable energy in India, examining how policy frameworks, political dynamics, and market forces interact to shape the country's energy transition. By analysing the historical evolution of renewable energy policies, the role of state and non-state actors, and the influence of global and domestic market forces, this article provides a comprehensive understanding of the opportunities and challenges in India's renewable energy sector. The study concludes with policy recommendations to accelerate the transition to a sustainable energy future.

Keywords: Renewable Energy, Political Economy, Energy Policy in India, Sustainable Development, Market Forces and Renewable Energy.

Introduction

India's energy landscape is undergoing a significant transformation. With a population of over 1.3 billion and a rapidly growing economy, the country's energy demand is projected to double in the near future. Fossil fuels, particularly coal, have traditionally dominated India's energy mix, contributing to severe environmental pollution and making India one of the largest greenhouse gas emitters globally. However, the increasing recognition of the adverse impacts of climate change, coupled with the declining costs of renewable energy technologies, has spurred India's shift towards cleaner energy sources. The Indian government has set ambitious targets for renewable energy. This includes solar power, wind power, and other sources like biomass, small hydro, and nuclear energy. Achieving these targets requires an understanding of the political economy of renewable energy in India, encompassing the interplay of policy, politics, and market forces.

Historical Evolution of Renewable Energy Policies in India

India's journey towards renewable energy began in the 1980s with the establishment of the Commission for Additional Sources of Energy (CASE) in 1981, which later evolved into the Ministry of New and Renewable Energy (MNRE) in 1992 (Mangotra 2016). The initial focus was on small-scale renewable energy projects, particularly in rural areas, to address energy poverty and promote decentralised energy systems. The 1990s saw the introduction of market-oriented reforms, including the liberalisation of the power sector and the entry of private players. The Electricity Act of 2003 was a landmark legislation that mandated the promotion of renewable energy and allowed for open access in power distribution, enabling renewable energy generators to sell electricity directly to consumers(Kumar et al. 2010).

The launch of the Jawaharlal Nehru National Solar Mission (JNNSM) in 2010 marked a significant turning point in India's renewable energy policy. The mission aimed to establish India as a global leader in solar energy. The success of the Jawaharlal Nehru National Solar Mission can be attributed to a combination of policy instruments, including feed-in tariffs, reverse auctions, and incentives for domestic manufacturing. The mission also facilitated international collaborations, such as the International Solar Alliance (ISA), which India co-founded with France in 2015 to promote solar energy deployment globally (Akoijam and Krishna 2017).

In recent years, the Indian government has introduced several policy measures to accelerate the renewable energy transition. These include the Renewable Purchase Obligations (RPOs) mandating utilities to procure a certain percentage of their electricity from renewable sources (Singh 2009),Green Energy Corridors for developing transmission infrastructure to integrate renewable energy into the grid (Kumar. J and Majid 2020), Production Linked Incentive (PLI) scheme for providing financial incentives for domestic manufacturing of solar photovoltaic (PV) modules and other renewable energy technologies (Takyar and Yadav 2021) and Hydrogen Energy Mission for promoting the production and use of green hydrogen as a clean energy source (Pal, Yadav, and Tyagi 2017). Despite these initiatives, the implementation of renewable energy policies faces several challenges, including land acquisition issues, regulatory hurdles, and financial constraints.

Political Dynamics and the Renewable Energy Transition

India's federal structure plays a crucial role in shaping the renewable energy landscape. While the central government sets the overall policy framework, state governments have significant autonomy in implementing renewable energy projects. This has led to a diverse range of approaches across states, with some emerging as leaders in renewable energy deployment. For instance, states like Gujarat, Rajasthan, and Tamil Nadu have made significant strides in solar and wind energy, driven by favourable

policies, abundant natural resources, and proactive state governments (Elavarasan et al. 2020). The interplay between the centre and states is often characterised by cooperation and competition. While the central government provides financial and technical support, states compete to attract investments and achieve their renewable energy targets. This dynamic has both positive and negative implications, fostering innovation and experimentation but also leading to inconsistencies and inefficiencies.

Energy subsidies have long been a contentious issue in India's political economy. Historically, subsidies have been skewed towards fossil fuels, particularly coal and petroleum products, to ensure affordable energy access and support domestic industries. However, this has created a distorted energy market, discouraging investment in renewable energy (Victor 2009).In recent years, there has been a gradual shift towards rationalizing energy subsidies and redirecting them towards renewable energy. The introduction of direct benefit transfers (DBT) for LPG subsidies and the reduction of diesel subsidies are steps in this direction. However, the political sensitivity of energy pricing and the vested interests of fossil fuel industries continue to pose challenges.

India's renewable energy transition is also influenced by its position in global climate politics. As a developing country with significant historical emissions, India has emphasised the principles of equity and common but differentiated responsibilities (CBDR) in international climate negotiations. At the same time, India has sought to position itself as a global leader in renewable energy, leveraging initiatives like the International Solar Alliance(ISA) to enhance its diplomatic influence (Shidore and Busby 2019). The Paris Agreement of 2015 marked a turning point in global climate action, with India committing to reduce its emissions intensity by 33-35% by 2030 and achieve 40% of its installed power capacity from non-fossil fuels. While these commitments have bolstered India's international standing, they have also increased the pressure to deliver on its renewable energy targets(Blah 2016).

Market Forces and the Renewable Energy Sector

The growth of renewable energy in India is closely tied to investment trends and financing mechanisms. Over the past decade, there has been a significant increase in both domestic and foreign investments in the sector. Key drivers include declining technology costs, favourable government policies, and growing awareness of climate risks. However, financing renewable energy projects remains a challenge, particularly for small and medium-sized enterprises (SMEs) and decentralized energy systems. Traditional financing mechanisms, such as bank loans, are often inadequate due to high perceived risks and lack of collateral. Innovative financing models, such as green bonds, crowdfunding, and public-private partnerships (PPPs), are emerging as potential solutions (Schoenmaker and Schramade 2019).

Technological innovation has been a major driver of the renewable energy transition in India. The rapid decline in the cost of solar PV modules and wind turbines has made renewable energy increasingly cost-competitive with fossil fuels. India has also made significant strides in energy storage technologies, which are critical for addressing the intermittency of renewable energy sources (Prasad, Venkatramanan, and Singh 2021). However, the reliance on imported technology and components remains a concern. While the PLI scheme aims to boost domestic manufacturing, achieving self-reliance in renewable energy technologies will require sustained investment in research and development (R&D) and capacity building.

The renewable energy sector in India is characterised by intense competition, with a mix of domestic and international players. The entry of large corporations, such as Adani Green Energy and Tata Power, has transformed the industry landscape, leading to economies of scale and improved efficiency (Arabindoo 2020). However, this has also raised concerns about market concentration and the marginalisation of smaller players. The role of state-owned enterprises (SOEs) in the renewable energy sector is another important aspect. While SOEs like National Thermal Power Corporation (NTPC) and National Hydroelectric Power Corporation (NHPC) have traditionally dominated the power sector, their involvement in renewable energy has been relatively limited. Encouraging greater participation of state-owned enterprises in renewable energy could help bridge the investment gap and ensure a more balanced industry structure.

Socio-Economic Implications of the Renewable Energy Transition

The renewable energy sector has the potential to generate significant employment opportunities, particularly in rural and semi-urban areas. Jobs in solar panel installation, wind turbine maintenance, and biomass production can provide livelihoods for millions of people. However, realising this potential requires targeted skill development programs and vocational training. The transition to renewable energy also poses challenges for workers in the fossil fuel industry, particularly in coal mining and power generation. Ensuring a just transition for these workers, through reskilling and social safety nets, is critical for maintaining social cohesion and political stability.

Renewable energy has the potential to improve energy access and reduce energy poverty, particularly in remote and underserved areas. Decentralised renewable energy systems, such as solar home systems and mini-grids, can provide reliable and affordable electricity to communities that are not connected to the central grid (Sharma, Agrawal, and Urpelainen 2020). However, ensuring equitable access to renewable energy requires addressing barriers such as high upfront costs, lack of awareness, and inadequate infrastructure. Policy interventions, such as subsidies for low-income households and community-based energy projects, can help bridge these gaps.

The shift to renewable energy offers significant environmental and health benefits, including reduced air pollution, lower greenhouse gas (GHG) emissions, and improved public health. The reduction in coal-based power generation can lead to a decline in respiratory diseases and other health issues associated with air pollution. However, the environmental impacts of renewable energy projects, such as land use changes and biodiversity loss, must also be carefully managed. Sustainable siting practices and environmental impact assessments (EIAs) are essential for minimising negative impacts and ensuring the long-term viability of renewable energy projects (Tsoutsos, Frantzeskaki, and Gekas 2005).

Challenges and Barriers to Renewable Energy Deployment

Land acquisition is one of the most significant challenges in renewable energy deployment in India. Large-scale solar and wind projects require vast tracts of land, often leading to conflicts with local communities and indigenous populations. The lack of clear land titles and inadequate compensation mechanisms exacerbate these conflicts (Hernandez et al. 2014). Addressing land acquisition issues requires a multi-pronged approach, including transparent and participatory decision-making processes, fair compensation, and alternative land use models such as agri-voltaics, which combine agriculture with solar power generation(Santra et al. 2017).

Integrating renewable energy into the grid poses technical and infrastructural challenges. The intermittent nature of solar and wind power requires advanced grid management systems, energy storage solutions, and flexible power generation sources. The existing grid infrastructure in India is often inadequate to handle the variability and decentralized nature of renewable energy. Investments in grid modernization, smart grid technologies, and energy storage are essential for overcoming these challenges. The development of green energy corridors and regional grid interconnections can also enhance grid stability and facilitate the seamless integration of renewable energy.

Financial and regulatory barriers continue to hinder the growth of renewable energy in India. Despite the declining costs of renewable energy technologies, the high capital expenditure and long payback periods deter investors (Yaqoot, Diwan, and Kandpal 2016). Regulatory uncertainties, such as delays in project approvals and power purchase agreements (PPAs), further exacerbate the risks. Streamlining regulatory processes, providing long-term policy certainty, and enhancing access to low-cost financing are critical for attracting investments and accelerating renewable energy deployment. The role of multilateral development banks (MDBs) and international financial institutions (IFIs) in providing concessional finance and technical assistance is also crucial (Nanwani 2019).

Policy Recommendations

India's transition to renewable energy requires a robust policy framework and enhanced institutional capacity to drive sustainable growth. A long-term policy vision is essential, providing clear and consistent goals with well-defined targets and milestones to guide the development of renewable energy infrastructure. Regulatory reforms must be implemented to streamline bureaucratic processes, ensuring faster approvals, and reducing administrative bottlenecks that hinder project implementation. Strengthening institutional capacity, particularly at the state and local levels, is equally crucial. Governments must be equipped with the necessary skills, resources, and technical expertise to efficiently implement and oversee renewable energy policies and projects, fostering a more coordinated and effective approach to energy transition.

A just and inclusive transition to renewable energy requires policies that ensure equitable access and benefits for all sections of society. Financial incentives and subsidies should be directed toward low-income households and marginalised communities, enabling them to adopt renewable energy solutions and reducing their dependence on costly conventional energy sources. Engaging local communities in the planning and execution of renewable energy projects is vital, as it fosters a sense of ownership, ensures social acceptance, and maximises the positive impact of such initiatives. Also, workers from the fossil fuel industry must be supported through targeted social safety nets and reskilling programs, enabling them to transition into the renewable energy workforce without economic distress.

International cooperation and financial support play a crucial role in accelerating India's renewable energy ambitions. Strengthening partnerships with global organisations, such as the International Solar Alliance (ISA), facilitates knowledge-sharing, capacity building, and access to cutting-edge renewable energy technologies. Mobilising climate finance from developed nations and international financial institutions is imperative to fund large-scale renewable energy projects, grid infrastructure, and research initiatives. Also, facilitating the transfer of advanced technologies from developed to developing countries ensures that India can leverage global best practices, enhancing efficiency, reducing costs, and expediting the adoption of innovative renewable energy solutions.

Investing in research and development (R&D) is fundamental to fostering technological innovation and making renewable energy more cost-effective and scalable. Collaborative efforts between the government, academia, and industry through public-private partnerships can drive advancements in solar, wind, and other renewable technologies. Establishing dedicated innovation hubs and technology incubators will further support startups and small enterprises, fostering entrepreneurship and accelerating the commercialisation of new energy solutions. Scaling up pilot projects and demonstration plants is also essential, as they serve as testing grounds for novel technologies and business models before broader deployment. By prioritising research and development, India can position itself as a global leader in renewable energy innovation, ensuring long-term energy security and sustainability.

Conclusion

India's transition to renewable energy is a complex and multifaceted process, shaped by the interplay of policy, politics, and market forces. While significant progress has been made, several challenges remain, including land acquisition issues, grid integration constraints, and financial barriers. Addressing these challenges requires a holistic approach, encompassing policy reforms, institutional capacity building, and international cooperation. The renewable energy transition offers immense opportunities for sustainable development, including job creation, energy access, and environmental benefits. However, realizing these opportunities requires ensuring that the transition is inclusive and equitable, with a focus on marginalized communities and workers in the fossil fuel industry. As India continues to navigate its renewable energy journey, the lessons learned and best practices developed can serve as a model for other developing countries seeking to achieve a sustainable energy future. By leveraging its strengths and addressing its challenges, India can emerge as a global leader in renewable energy, contributing to the global fight against climate change and paving the way for a greener and more sustainable future.

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