

Research Articles

Balancing Economic Growth and Emission Reductions: Policy Trade-offs in India's Power Sector Towards Achieving the 2070 Net-Zero Goal

Kaavyaa Gupta, BBA¹ 

¹ Indian Institute of Management Rohtak

Keywords: India, Net Zero, Power Sector, Greenhouse Gas Emissions, Macroeconomics

<https://doi.org/10.56020/001c.125773>

Journal for Global Business and Community

Vol. 15, Issue 1, 2024

India faces significant policy trade-offs between raising living standards for 1.4 billion people and reducing global GHG emissions. While the government has introduced policies to promote renewable energy and reduce coal dependency, numerous efforts are required to meet the 2070 net-zero target. Cutting emissions will likely slow short-term growth and affect coal-dependent communities. However, the right policies can minimize these costs. This paper reviews India's current climate policies and models emission trajectories under various policy scenarios to explore ways to reduce GHG emissions effectively.

Background

Climate change has imposed policy tradeoffs for policy-makers. There is a need to reduce the burning of fossil fuels but at the same time, this process requires new policies which may pose a huge burden on short-term growth and generate winners and losers (Chateau et al., 2023). In 2021, India set a net zero target (Jai, 2024) at the United Nations Climate Change Conference: COP26 (Priyadarshini, 2021). However, McKinsey Global Institute (2022) estimated that it might take up to US \$9.2 trillion annually to reach the goal of net zero by 2050.

The annual mean temperature has risen by 0.8 °C from 1901 to 2021 (World Bank Group, 2021). The Government of India expects that climate change will cause about 250,000 additional deaths per year between 2030 and 2050 due to malnutrition, malaria, diarrhea, and heat stress.

Currently, India stands as the world's third-largest emitter of greenhouse gases, and under current policies, the emissions have been increasing continuously (International Energy Agency, 2024). As average income rises, the average demand for amenities like air conditioners is expected to rise too (Davis et al., 2021). Such growth will only further increase the greenhouse gas emissions and traverse India farther from its net zero goal.

Data from the International Energy Agency (2024) indicate that the power sector (electricity and heat-producing sectors) contributes to 51.2% of the greenhouse emissions, followed by industry (24.5%), transport (12.9%) and residential (4.2%). Hence, to critically analyze India's emissions mitigation strategy, this paper narrows this appraisal to the power sector.

Motivation

Having been a major asthmatic patient who is affected by even the slightest of increase in pollution levels or climate changes for the past 19 years, I wanted to study the current state of India with regards to the net zero goal which I myself am vouching for.

Objectives

1. **Assess Policy Trade-offs:** Evaluate the economic and social trade-offs involved in transitioning India's power sector from coal to renewable energy sources, particularly focusing on short-term growth impacts.
2. **Examine Policy Effectiveness:** Analyze the effectiveness of current policy measures, such as subsidies, excise taxes, and carbon pricing, in promoting renewable energy and reducing greenhouse gas emissions in the power sector.
3. **Quantify Socio-economic Impacts:** Investigate the socio-economic effects of transitioning away from coal on coal-dependent communities, particularly in terms of employment, income, and regional development.
4. **Identify Optimal Policy Mix:** Propose a balanced policy mix that minimizes the economic costs of the transition while ensuring long-term sustainable growth and addressing the needs of vulnerable populations.

Theoretical Framework: IMF-ENV Model

The IMF-ENV model is a global dynamic, neoclassical equilibrium model built on a national economy database and bilateral trade. The model assesses the linkage between

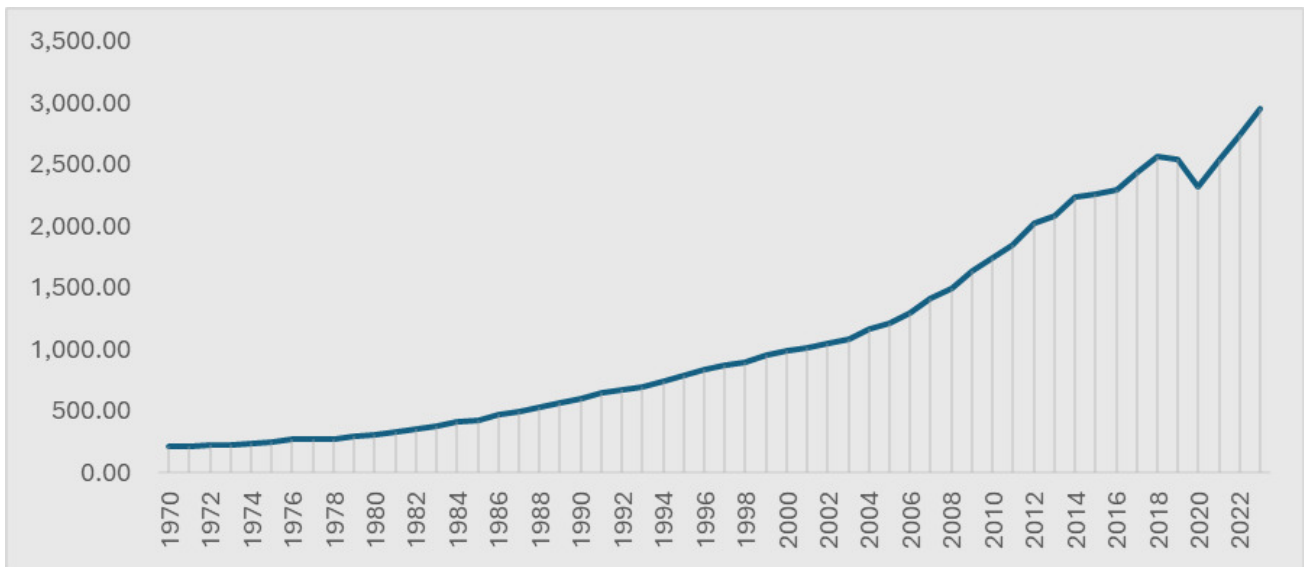


Figure 1. CO2 Emissions Trend in India

economic activities and agents across various economic sectors. It has four main strengths which I have made use of in the paper:

- Provides macroeconomic dynamics up to 2040
- Gives rich detail on inter-sectoral economic linkages and sectoral emissions
- Accounts for interactions between domestic and international policies.
- Considers frictions in domestic reallocation of capital

While studying policy scenarios, the policies are introduced starting 2022 and an equilibrium in commodities and factor markets is solved for in the model through 2022 to 2040. Hence, we can consider the ambit of sectoral growth over a stretch of nearly 25 years.

In addition, the model calibrates each of the G20 countries individually and the rest of the world is divided into six model regions that are linked through bilateral trade across sectors. Therefore, the model captures the cross-border spillovers of policies through the changes in bilateral trade; hence quantifying the global impact of domestic and international policy changes on international trade, commodity prices, and global GHG emissions sectors (Chateau et al., 2023).

Research Question

How can India balance the transition to renewable energy in the power sector while minimizing short-term economic trade-offs and addressing the socio-economic impacts on coal-dependent communities, to achieve its 2070 net-zero emissions goal?

Data and Methodology

After analyzing the database (Crippa et al., 2024), the trends in CO2 emission, I noticed a strong upward trend as shown in [Figure 1](#), far from India's goal of a linear trend for net zero by 2070.

As we keep delaying the adjustments from the net zero path, the harder it'll be to get back to the path. Moreover, with development, greenhouse gas emissions increase even further. A middle-ground will thus need trade-offs between emission reductions and transition costs. This middle ground considers that GHG emissions would continue to rise in India but at a lower rate than in the baseline (see Chateau et al., 2023, p. 31, Figure 16). As a result, emissions would be 15 percent lower in 2030 as compared to the baseline even though they would remain 25 percent higher than current levels.

Now, let us consider three policy packages, each having significantly different costs to lower the emissions trajectory to meet the Alternative Emissions Trajectory line shown above in green.

Subsidy to Renewable Power

This is the first policy package in which the emission reduction target is met using subsidies for the usage of renewable power. It helps in expanding the green power sector and is similar to the Indian government's current approach which uses renewable purchase obligations (RPO) and production-linked incentive (PLI) schemes (Singh, 2022).

Subsidy to Renewable Power + Coal Excise Tax

This is the second policy package with an additional coal excise tax to meet the goal. It can effectively revamp the government's current excise duty on coal of ₹400 for every metric ton (The Hindu, 2024). While using this policy tool, the subsidies act as an incentive for using green power while the coal excise tax limits the usage of coal to produce electricity. Since the coal excise tax is also present, the demand will automatically tend to shift towards renewable energy sources. Hence, the subsidies given will naturally be lower than those in the package 1.

Subsidy to Renewable Power + Coal Excise Tax + A Carbon Price

This is the third policy package in which we have also introduced a carbon price on the Carbon Dioxide emitted from burning fossil fuels. The subsidy on renewable power will hence be the least among all the policy packages since both a carbon tax and coal excise tax lower the demand for carbon-intensive fuels, contributing towards the emission target and leaving a lower mitigation target to be managed by subsidies for eco-friendly sources.

Results

Energy Mix

The International Energy Agency (2021) has forecasted that India's electricity demand will increase from around 1500 Twh in 2020 to almost 5500 Twh in 2040. The supply of electricity increases when subsidies for renewable power are provided. Each of the policy packages actively support the expansion of the usage of renewable sources of energy and facilitate the decline in the use of coal for electricity generation.

As a result, combining both sources for production increases the percentage of renewable energy sources in the energy mix.

The second and third policy packages act as feebates while the subsidies increase renewable energy usage. With this, the net electricity price declines from 11 to 7 percent. However, since renewable sources still remain cheaper, the energy mix also remains tilted towards the same (see Chateau et al., 2023, p. 34, Figure 17).

Energy Security

A core result that we get from each of the three policies is that they all enhance the security of energy in India. This is because the import of fuels is dependent on the price of fuels which is directly affected by the mitigation efforts both domestically and internationally.

With the policies, since the demand for power can be met domestically, the coal imports decline. Electricity imports also get replaced by the now subsidized renewable electricity produced in India itself.

Output Costs (Potential Decline in GDP) and Trade-offs

Even though the policy packages will result in emissions mitigation, increasing usage of renewable energy and greater energy security, is not without its trade-offs. By design, each of the policies will give similar emission reductions but due to the differences in the policy tool used, they will have varied impacts on the output.

However, it is estimated that this could lead to a 0.45 percent reduction in GDP by 2030 compared to the baseline (Chateau et al., 2023, pp. 35–36, Figure 19). The channel is explained as follows:

- If the government finances the subsidies by increasing the taxes on wages, the demand for labor is likely to decrease.
- The reduced demand will thereby reduce the disposable income per household.
- The reduced disposable income will in turn reduce the demand for goods.
- A lower demand for goods will give rise to an inflationary gap.
- With the self-correcting mechanism of the free market, the supply will also reduce, hence lowering the GDP of the economy.

Just Transition

Apart from aggregate losses, the impact of the policies on labor becomes a vital consideration. Sectors such as solar and wind will expand while those such as coal and gas shall shrink. Currently, more than 13 million people find themselves employed in coal mining, transportation, power generation, and brick sectors (Singhal & Dsouza, 2021). Furthermore, these figures only account for the formal sector.

Changes in unemployment trends owing to the policy packages are a concern (see Chateau et al., 2023, p. 37, Figure 20). A few policies mentioned below could prove useful for such workers:

- Training programs to help displaced workers to equip them with new skills to work in the modern-day.
- Assistance in finding jobs to reduce frictional unemployment.
- Taxes based on the income of the workers to tax the upper class higher than the lower ones.

Future Scope of Research

1. **Optimal Financing Models:** Explore innovative financing mechanisms, including leveraging domestic and international capital markets, to support large-scale investment in renewable energy while minimizing public debt.
2. **Impact of Technological Innovations:** Investigate how advancements in renewable energy technologies, such as battery storage and grid efficiency can accelerate the transition to a greener power sector and lower the associated costs.
3. **Just Transition Strategies:** Develop a deeper understanding of how to support a just transition for coal-dependent workers and regions through targeted reskilling programs, financial assistance, and community development initiatives.
4. **Long-term Global Impact Analysis:** Extend the research to evaluate the long-term global effects of India's transition, particularly how India's shift in energy policy may influence global climate change mitigation efforts.
5. **Comparative Policy Studies:** Conduct comparative analyses between India and other large GHG-emitting countries to identify best practices in policy imple-

mentation and cross-border cooperation for climate goals.

Conclusion

India faces complex policy decisions in addressing climate change, but a path toward greener, more inclusive growth is achievable. While the country must continue advancing development goals and improving living standards for over a billion citizens, it also has a critical role in reducing global greenhouse gas emissions, being one of the largest emitters globally. The government has already implemented numerous policies to support renewable energy adoption, such as PLI schemes, RPOs, PAT, and more recently, a carbon trading market. However, further measures are essential to achieve the 2070 net-zero target.

Transitioning away from coal remains a significant challenge, given its role in generating over 70% of India's electricity and contributing to nearly 40% of CO₂ emissions. The coal industry also supports over 20 million jobs, directly or indirectly. Despite this, the government is em-

ploying various strategies to facilitate the shift toward renewable energy. Although these policies have begun the transition, without more aggressive action, emissions are likely to continue rising. Scaling up investments in renewables will require optimal leverage of technology transfer, international funding, and domestic capital markets.

India's approach to meeting its net-zero goal will involve trade-offs. Different policy scenarios indicate that while reducing emissions may have short-term economic costs and social implications for communities dependent on coal, the right policies can mitigate these effects. Benefits, such as improved health and productivity due to reduced pollution, will also emerge. Ensuring that vulnerable communities are supported through reskilling and financial assistance will be crucial. Delays in transitioning will only heighten costs and reduce the potential benefits.

Submitted: October 10, 2024 EST, Accepted: November 10, 2024 EST

References

- Chateau, J., Dang, G., MacDonald, M., Spray, J. A., & Thube, S. D. (2023). *A Framework for Climate Change Mitigation in India* (No. 2023/218; pp. 1–49). International Monetary Fund Working Paper. <https://www.imf.org/en/Publications/WP/Issues/2023/10/20/A-Framework-for-Climate-Change-Mitigation-in-India-535854>
- Crippa, M., Guizzardi, D., Pagani, F., Banja, M., Muntean, M., Schaaf, E., Becker, W., Monforti-Ferrario, F., Quadrelli, R., Risquez Martin, A., Taghavi-Moharamli, P., Grassi, G., Rossi, S., Melo, J., Oom, D., Branco, A., San-Miguel, J., Manca, G., Pisoni, E., ... Pekar, F. (2024). *GHG Emissions of All World Countries – JRC/IEA 2024 Report* (No. JRC138862). Luxembourg. <https://doi.org/10.2760/4002897>
- Davis, L., Gertler, P., Jarvis, S., & Wolfram, C. (2021). Air conditioning and global inequality. *Global Environmental Change*, 69, 102299. <https://doi.org/10.1016/j.gloenvcha.2021.102299>
- International Energy Agency. (2021). *India Energy Outlook 2021*. <https://www.iea.org/reports/india-energy-outlook-2021>
- International Energy Agency. (2024, August). *Countries & Regions – India*. <https://www.iea.org/countries/india/emissions>
- Jai, S. (2024, June 30). *India takes First Steps to meet 2070 net-zero goal, NITI Aayog forms panels*. Business Standard. https://www.business-standard.com/economy/news/india-takes-first-steps-towards-net-zero-2047-target-niti-aayog-forms-comm-124063000455_1.html
- McKinsey Global Institute. (2022). *The Net-zero Transition: What it would cost, what it could bring*.
- Priyadarshini, S. (2021, November 3). *Episode 12: Degree of intent: Business unusual for India at COP26*. Nature India. <https://doi.org/10.1038/d44151-021-00066-2>
- Singh, P. (2022). *Renewable Purchase Obligation and Energy Storage Obligation Trajectory till 2029-30* (pp. 1–4). Ministry of Power, Government of India. https://powermin.gov.in/sites/default/files/Renewable_Purchase_Obligation_and_Energy_Storage_Obligation_Trajectory_till_2029_30.pdf
- Singhal, K., & Dsouza, S. (2021). *Socio-economic Impacts of Coal Transitions in India: Bottom-up analysis of jobs in coal and coal-consuming industries*. National Foundation for India.
- The Hindu. (2024, March 8). *Govt. panel backs higher carbon tax on coal imports*. <https://www.thehindu.com/business/Economy/govt-panel-backs-higher-carbon-tax-on-coal-imports/article67927783.ece>
- World Bank Group. (2021). *Climate Risk Country Profile: India*.