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# Macroeconomic Impacts of

## Decarbonising Mobility in India

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# Introduction

India committed to achieving net-zero emissions by 2070 at COP26 in Glasgow. Decarbonising the transport sector is crucial in accomplishing this target. Road transport accounted for 12% of India's energy-related emissions in 2022[1]. These emissions are projected to increase in the future because of a rise in population and urbanisation.

Transport sector decarbonisation policies in India revolve around two key interventions: ethanol blending with petrol and electrification of vehicles. In 2021, the NITI Aayog released the *Roadmap for Ethanol Blending in India 2020-2025* (NITI Aayog, 2021), which set a target to achieve 20% ethanol blending with petrol by 2025 (advanced from the earlier 2030 target year set by the National Biofuels Policy, 2018 [MoPNG, 2018]). This supply-side intervention is aimed at reducing emissions from on-road fuel use, improving the financial health of sugar mills[2], improving energy security by reducing dependence on imported crude oil, and reducing sugarcane arrears.

On the demand side, the Ministry of Heavy Industries provides subsidies to reduce the upfront cost of purchasing electric vehicles (EVs) through the Faster Adoption and Manufacturing of (Hybrid &) Electric Vehicles in India (FAME India) scheme (Ministry of Heavy Industries, n.d.; Press Information Bureau, 2022). In addition, there are other types of policy support such as production-linked incentive schemes for domestic vehicle manufacturing and battery cell production, tax breaks on EV chargers and charging stations, and capital subsidies to oil manufacturing companies for setting up public EV charging infrastructure. However, there is a large price disparity between EV and conventional internal combustion engine vehicles (ICEVs).

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1 India's total energy-related greenhouse gas emissions in 2022 was 2.9 gigatons.

2 Sugar mill finances were under threat because of the ban placed on sugar exports from India by the World Trade Organization (WTO). WTO enforced the ban citing the unfair competitive advantage enjoyed by India's sugar manufacturing sector because of the financial assistance provided by the Government of India.

These policies and strategies are aimed at developing ethanol and EV value chains in India, which could have positive environmental and climate impacts. The value chains link input markets, trade, and final demand both domestically and internationally. Therefore, apart from environmental impacts, investment in these value chains has a strong multiplier effect on the economy.

A study by the Center for Study of Science, Technology and Policy (CSTEP) titled *Decarbonising India's Transport Sector: Navigating Trade-offs of Biofuel Use and Electrification* (CSTEP, 2024) considered both economic and environmental factors. The study used a social accounting matrix–based multiplier model to simulate changes in EV consumption and increased ethanol blending to assess macroeconomic impacts. The study assessed and compared the effects of different interventions (Table 1) to formulate a transport decarbonisation strategy that could achieve the desired levels of mitigation without compromising on economic growth and job creation[3].

3 The multiplier model is static. There are no time periods associated with the results presented. However, growth in vehicle demand, blending rate, and EV penetration for the scenarios have been taken from the 2030 projections provided by CSTEP's Sustainable Alternative Futures for India model.

**Table 1: Policy scenarios and description**

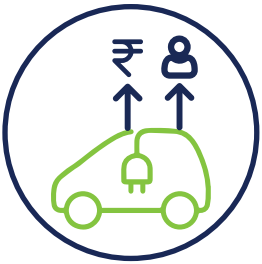
| Policy | Scenario name | Description |
|---|---|---|
| No policy | No policy | • Increase in household petrol vehicle ownership<br>• No ethanol blending or electrification policy |
| Ethanol blending | Blending + Vehicle demand | • Increase in household petrol vehicle ownership<br>• Increase in ethanol blending with petrol from 5% to 20% |
| Electrification of passenger transport | Partial electrification + Vehicle demand | • Increase in vehicle demand<br>• EVs account for 45% of new 2Ws and 20% of new cars |
| | Partial electrification + Vehicle demand + RE | • Increase in vehicle demand<br>• EVs account for 45% of new 2Ws and 20% of new cars<br>• Electricity grid decarbonised: 45% coal, 10% solar, 5% non-coal fossil fuel, 21% hydro, and 19% other nonconventional energy |
| | Electric vehicle (EV) demand | • Increase in vehicle demand<br>• EVs account for all new vehicles |

# Key Insights

Both ethanol blending and electrification policies result in economic growth because of higher investment in related sectors (Figure 1). This results in growth across upstream industries (e.g., agriculture and iron and steel).


- An additional 1.8% gross domestic product (GDP) growth resulted from the combination of increased blending rate and vehicle demand.
  - This translates to an additional GDP of INR 3.72 for every rupee of 20% ethanol-blended petrol sold.
- Ethanol production is predominantly dependent on sugarcane, which accounts for only 7% of agricultural production. Consequently, the ethanol blending policy leads to limited GDP growth compared to passenger transport electrification.
- Ethanol blending is expected to reduce import dependence and, thus, improve India's energy security by reducing the demand for crude oil for petrol production.

The key drivers of growth in the 'Partial electrification + Vehicle demand' scenario are automobile manufacturing, power generation, iron and steel manufacturing, and coal mining.



An additional INR 1 lakh crore per annum can be generated by increasing the share of EVs in expected new vehicle demand between 2017 and 2030. This is cumulatively equivalent to 7.5% of India's 2023–24 GDP.

- With every INR of EVs sold, GDP increases by INR 12.70 in the 'Partial electrification + Vehicle demand' scenario.

» As coal accounts for 19.5% of the production cost of iron and steel products and 12.4% of the cost of generating coal-based thermal power, coal mining grows by almost 36% in the 'Partial electrification + Vehicle demand' scenario without grid decarbonisation.

» With grid decarbonisation, coal-mining growth diminishes to 16.5%. However, it is larger than expected because of the key role played by iron and steel in solar power generation. This limits emission reduction, emphasising the need for deep decarbonisation of emissions-intensive industries to facilitate the transition to clean energy.

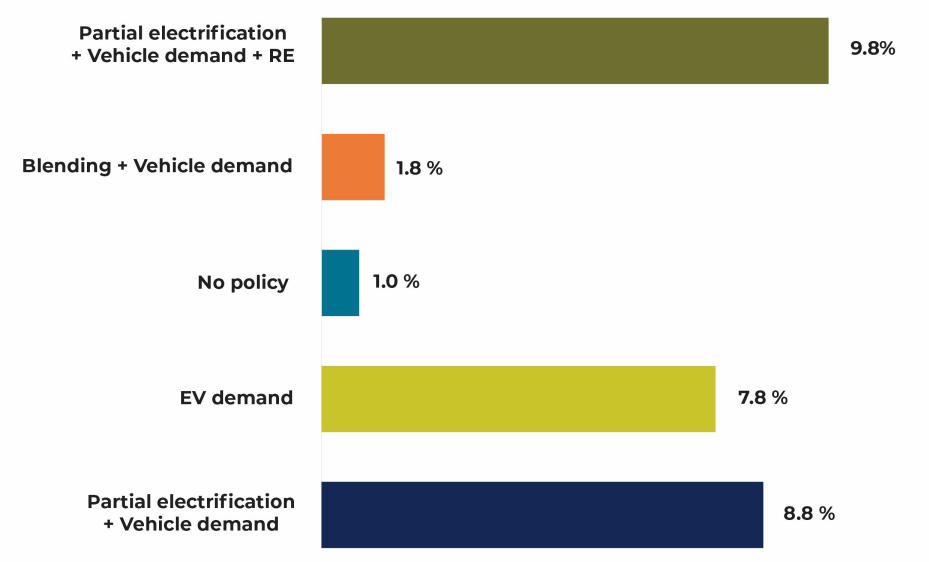



*Figure 1: GDP growth in different scenarios*

**Table 2: Change in government revenue across scenarios (%)**

| No policy | Blending + Vehicle demand | Partial electrification + Vehicle demand | Partial electrification + Vehicle demand + RE |
|---|---|---|---|
| 1.5 | 1.6 | 8.3 | 8.0 |

Government revenue rises with both ethanol blending and electrification policies (Table 2).

- Government revenue rises by 8.3% from 2017 to 2030 in the 'Partial electrification + Vehicle demand' scenario. This is primarily because of the growth in both petrol and electric vehicle ownership, driving demand for petrol and coal, both of which are heavily taxed.
- Increased adoption of EVs drives demand for electricity, leading to higher coal tax revenue because of India's coal cess.
- Government revenue growth is marginally lower with grid decarbonisation because of lower coal demand from the power sector but higher demand from the iron and steel manufacturing sector.

There is potential for uneven regional development in the country because of the difference in employment opportunities created by ethanol blending and electrification.

- Ethanol blending benefits the agriculture sector, which is the most labour-intensive sector in India and depends primarily on rural labour. In contrast, sectors benefitting from electrification are urban labour–dependent and much more capital-intensive.
- The ethanol blending policy significantly enhances rural employment, contributing to a total additional 53.8 million jobs (Table 3), thus supporting both decarbonisation and employment goals in India. Sugarcane cultivation alone accounts for 18 million jobs and sugar/ethanol manufacturing accounts for an additional 2 million as it employs 3.3 times more labour than petroleum manufacturing.

» Coal-based power generation accounts for the largest share of total jobs generated in the 'Partial electrification + Vehicle demand' scenario without grid decarbonisation. It employs 36 million additional workers and is a major contributor to the creation of 0.2 million coal mining jobs annually between 2017 and 2030[4].

**Table 3: Number of additional workers employed across scenarios**

| No policy | Blending + Vehicle demand | Partial electrification + Vehicle demand | Partial electrification + Vehicle demand + RE |
|---|---|---|---|
| 29.03 million | 53.8 million | 176.5 million | 205.4 million |

Over 40% of workers in India are employed by the agriculture sector (MoSPI and NSO, 2019). It is widely recognised that agricultural jobs are relatively low paying. The Periodic Labour Force Survey data allow for the estimation of sectoral wages, and it is seen that agriculture pays on average about INR 62,000 per worker per year, which is far below the national average of INR 1.1 lakh. In contrast, mining jobs are among the highest paying (apart from the services sector), affording workers INR 2.04 lakh annually.

The disparity in the number and quality of employment opportunities made available by ethanol blending and electrification could cause migration from rural to urban areas (ILO, n.d.). This could further intensify uneven development in rural versus urban areas because of the shortage of agricultural labour. Further, the need to provide additional housing, infrastructure, and services on a large scale could put pressure on the finances of local governments (Singh, 2016). However, some studies (Lyu et al., 2019) suggest that the migration to urban areas could be avoided if agricultural jobs are made more lucrative (by paying higher wages).

4 Impacts on growth and employment are observed in relation to the base year of the SAM multiplier model (2017).

# Recommendations

Current subsidies may be continued to increase EV penetration and drive down prices as the subsidies form a small fraction of GDP. FAME Phase II subsidies account for INR 10,000 crore of government expenditure over 5 years (Press Information Bureau, 2022), which is less than 0.1% of India's total 2023–24 GDP. Once cost parity with ICEVs is achieved, which is expected in the near future given the rising trend in EV sales, subsidies can be rolled back. The money that is saved can be redirected towards investment in the EV supply chain. The expected growth because of the promotion of this sector can, therefore, be achieved with a much lower level of expenditure on transfers.


To achieve desired GDP growth and employment along with mitigation, investing in EV manufacturing, grid decarbonisation, and cleaner industrial processes is recommended. This approach will ensure a balanced transition that avoids shifting the burden to the power sector.

Ethanol blending is not a growth engine, but it does positively impact the rural economy through its strong connection with the agriculture sector. Ensuring higher wages in agricultural employment to make it more lucrative would help strengthen the job creation potential of the ethanol blending policy and lessen the risk of migration and allow for balanced regional development across the country. Thus, a combination of ethanol blending and grid decarbonisation is suggested to encourage the rural economy along with the development of EV manufacturing and the promotion of its consumption.

# Benefits

- A comprehensive approach to transport decarbonisation that includes both blending and electrification along with grid decarbonisation achieves the goals of economic growth, lower unemployment, and emissions mitigation.
- An additional GDP growth of over 9.8% can be achieved with partial electrification and grid decarbonisation.
- Ethanol blending and electrification are complementary as electrification requires significant investment expenditure while ethanol blending is less expensive to implement.
- The generation of over 15.8 million jobs annually during the transition to 20% blending and higher electrification is possible as
  - » blending provides additional rural income by creating a new market for sugarcane output and
  - » electrification provides an opportunity for supplemental income by creating employment in sectors such as mining and manufacturing.
- Implementation of a comprehensive transport decarbonisation strategy that incorporates both ethanol blending and passenger transport electrification will result in well-rounded development across both rural and urban areas.

# Barriers

Mobilising finance for investments in developing a domestic EV manufacturing supply chain could become a significant barrier to the implementation of electrification. Investment in the sector is generally expected to be spearheaded by the public sector. Additionally, competition for finances arises from the need to increase renewable energy (RE) generation capacity. These competing sources of demand for investment could put pressure on the country's public finances as well as the financial system.

Electrification as a mitigation strategy is hindered by the inherently coal-dependent manufacturing processes of key growth-driving industries, such as iron and steel and cement. Research and development to decarbonise these processes is necessary to develop and diffuse technologies that can enable electrification as a mitigation strategy.

There is the possibility of higher rural–urban migration because of lower-quality jobs in the rural sector, which could put pressure on infrastructure and services in urban areas and affect productivity in the labour-intensive agricultural sector. This could hinder just transition.

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