Press Release

Balancing clean technologies and sustainability in India's transport sector

For Immediate Release

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As India is on a trajectory to decarbonise the transport sector and reach its net-zero goals by 2070, it is imperative to closely examine decarbonisation strategies to avoid any unintended economic and natural resource–related trade-offs. Bengaluru-based think tank, Center for Study of Science, Technology and Policy (CSTEP)'s latest study highlights that sustaining 10% ethanol blending (E10) might be the right way forward, considering it avoids any trade-offs between food and fuel and existing vehicles and infrastructure are already E10-compliant. The study also notes that while electrification of the transport sector is critical to meeting net-zero targets, it may increase the critical mineral demand, further augmenting India's import dependency for these minerals.

The study on '*Decarbonising India's Transport Sector: Navigating Trade-offs of Biofuel Use and Electrification*' uses the Sustainable Alternative Futures for India (SAFARI) and Social Accounting Matrix (SAM)-based multipliers models to explore the natural resource and macroeconomic implications of biofuel use and electrification to help develop a sustainable decarbonisation strategy for the transport sector. Considering various trade-offs and co-benefits of low-carbon strategies, the study suggests a roadmap for decarbonising the sector, with specific policy directions to reach this goal.

As a step to reduce the transport sector's carbon footprint, India is promoting the use of cleaner energy sources like ethanol, with a phased increase in ethanol blending from 10% (E10) to 20% (E20). The study notes that India will face significant challenges in meeting or maintaining this 20% ethanol blending target without resorting to imports, which contradicts the main overarching goals of improving energy security and promoting *atmanirbharta* (self-reliance). Moreover, with domestically produced ethanol being diverted for fuel blending, the country has already begun importing ethanol for industrial purposes.

One solution to meet the growing ethanol demand and reduce import dependency is to avoid using maize and continue using sugarcane mainly for ethanol production. This will require an additional land of 3.5 Mha to be brought under sugarcane cultivation by 2050, in turn leading to an annual additional water demand of 60 BCM. In addition, while maize (with a lower water footprint than sugarcane) is a possible alternative to sugarcane, it has a lower yield and requires the same amount of water per litre of ethanol produced as sugarcane.

Alternatively, a 50–50 combination of both maize and sugarcane can be used, but the additional requirement of bringing 8–10 Mha of land under maize cultivation remains. Nevertheless, this land requirement could be reduced if the yields drastically increase.

The study also highlights that potential breakthroughs in second-generation (2G) ethanol or other advanced technologies, which sustainably use crop residues and other waste biomass, can contribute to sustainable ethanol supply. However, biomass supply chain challenges may limit this progress.

In contrast, sustaining 10% ethanol blending (E10) may be a winning scenario, as the existing sugarcane cultivation is adequate, no maize is needed, and this avoids the trade-off between food and fuel. Moreover, existing vehicles and infrastructure are already E10-compliant, and the surplus ethanol over time can be used for jet fuel production via the alcohol-to-jet pathway.

The study notes that while electrification of the transport sector is key to reaching net-zero emissions, it will increase the critical mineral demand, posing more challenges for India considering its import dependency for most critical minerals and supply chain irregularities. In 2050, the demand for graphite, nickel, and cobalt for passenger electric vehicles (EVs) in a net-zero scenario for India could be 5%–10% of the International Energy Agency's estimate of the global mineral demand for EVs. The demand for copper could be up to 21% of the global demand, whereas lithium demand would likely be <5%. To overcome these issues, the study recommends promoting battery recycling, shifting consumer preference towards smaller vehicles (reducing battery capacity), decreasing mineral intensities, increasing the lifetime of EVs and batteries, and improving battery chemistries such as a greater share of lithium iron phosphate (LFP) batteries or even a technological shift away from lithium-ion chemistries altogether by 2070. Moreover, promoting public transport could even help reduce the overall burden on EV demand.

Both ethanol blending and transport electrification lead to significant economic benefits. While ethanol blending boosts rural employment, electrification drives overall economic growth by benefiting industries like manufacturing, power generation, and iron and steel. For every INR of EV sold, the GDP increases by INR 12.7, whereas for every INR of ethanol-blended (20%) petrol sold, the GDP increases by INR 3.72. Electrification also creates more than 150 million additional jobs.

The roadmap proposed by the study considers the current policies and targets, covering improved efficiency, electrification, ethanol blending, and modal shifts and avoiding the negative impacts of land-use change and burgeoning critical raw mineral demand. This pathway can help reduce transport sector emissions by >70% in 2070 from what it could have been without these interventions, thus aligning well with the 'net zero by 2070' action plan.

For more insights and recommendations, click here to read the full report.

The study findings also provide policy insights impacting the net-zero landscape. You can access the policy briefs here:

Towards the long-term sustainability of ethanol use in India: https://cstep.in/publications-details.php?id=3057

Macroeconomic impacts of decarbonising mobility in India: https://cstep.in/publications-details.php?id=3058

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About Climate Change Mitigation: Our team focusses on building models to simulate India's future across sectors, such as transport, industries, buildings, agriculture, and forestry, to find interventions required to achieve a sustainable and secure future. Our work also involves the study of certain themes that cut across sectors (such as quality of life and development vs climate action and water and land demands for agriculture vs power).