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Impact of electric vehicles on road transport and power sector emissions in India

A new study from researchers at the International Council on Clean Transportation (ICCT) and the Indian Institute of Technology, Kanpur (IIT Kanpur) explores the impact of a large-scale transition to electric vehicles (EVs) on road transport and power sector emissions in India in the coming decades. The analysis sheds light on a key question for policymakers in India and elsewhere who are considering ambitious EV goals while still heavily reliant on coal-powered electricity.

ICCT's India Emissions Model was used to project emissions from on-road vehicles and evaluate the tailpipe emissions impacts of increased electric vehicle deployment. Power sector emissions were estimated by IIT Kanpur based on India-specific power plant data and projections. Emissions from all other sectors were based on the Evaluating the Climate and Air Quality Impacts of Short-Lived Pollutants (ECLIPSE) V5a project's current legislation scenario. Results show that even in regions of India with significant coal power plant generation, vehicle electrification coupled with improved power plant emission controls and increased renewable electricity generation can lead to an aggregate reduction in emissions of fine particulate matter ($PM_{2.5}$), nitrogen oxides (NO_x), and carbon dioxide (CO_2) in 2030 and 2040 compared to a Baseline scenario under which EVs remain at about 1% of new vehicle sales.

KEY FINDINGS

An ambitious vehicle electrification pathway under which EVs reach 95% of total new vehicle sales by 2040 is projected to reduce road transport emissions in 2040 by about 18%, 24%, and 50% for $PM_{2.5}$, NO_x, and CO_2, respectively, compared to the Baseline scenario. This pathway assumes more rapid electrification of vehicle classes such as two-wheelers and passenger cars than heavy-duty trucks. Even with rapid EV uptake, the additional electricity demand from vehicle electrification is projected to be small compared to total electricity demand in India: The ambitious EV pathway results in a 0.9% increase in generation in 2030 and a 1% increase in generation in 2040 compared to the Baseline scenario. Under a Reference (REF) scenario without new policies to control power plant emissions or decarbonize the grid, additional demand from vehicle electrification adds about 10%–13% to $PM_{2.5}$, sulfur dioxide (SO_2), CO_2, and NO_x emissions from the power sector in 2040—and this is with a pessimistic assumption that all additional demand from EVs is being met by coal and gas fired power plants. However, results in Figure 1 show these increases could be more than offset by emissions reductions due to improved power plant emission controls (IEC scenario),

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coal power plant retirement (Coal Phaseout [CP] scenario), or both (COM scenario). Indeed, compared to the Baseline for the power sector in 2040, reductions of up to 27% for $PM_{2.5}$, 85% for SO_2, 77% NO_x, and 25% for CO_2 are achieved.

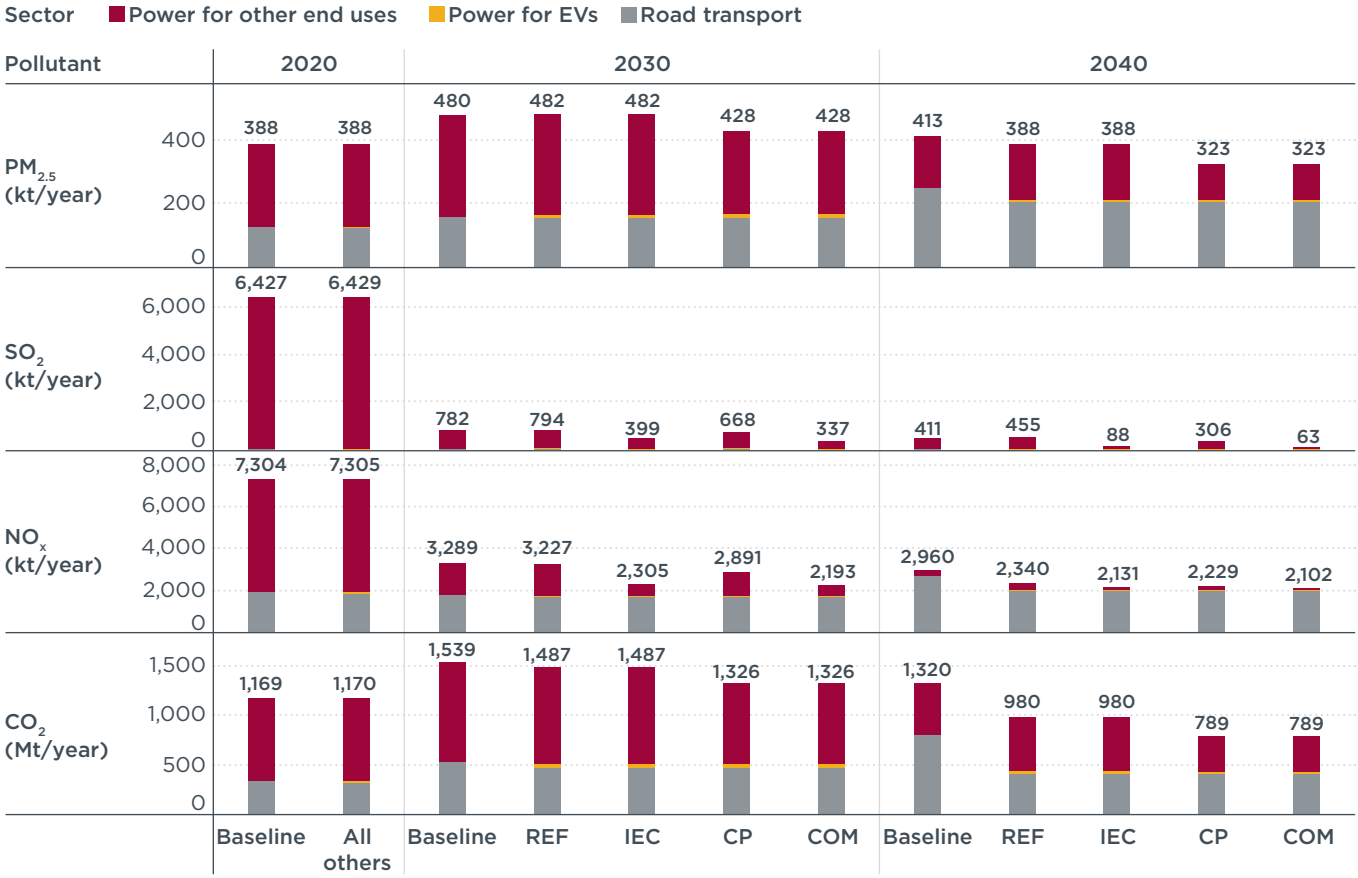

Figure 1. Aggregate emissions by sector and scenario.

Power sector decarbonization and emission control measures would especially benefit the northern and eastern parts of the country, where major thermal power plants are located (Figure 2). In the REF scenario, increased power demand due to vehicle electrification could result in slightly higher NO_x emissions (median 5%) from power plants across India compared to the Baseline under the conservative assumption that coal power plants are the main source of electricity for EVs. However, coal power plant retirements and/or tighter emissions controls in the IEC, CP, and COM scenarios could lead to substantial net reductions in power plant NO_x emissions across the country, with only a handful of locations projected to see modest increases in power plant NO_x emissions. In the COM scenario in 2040, all grid cells would see net reductions in combined power and road transport NO_x emissions.

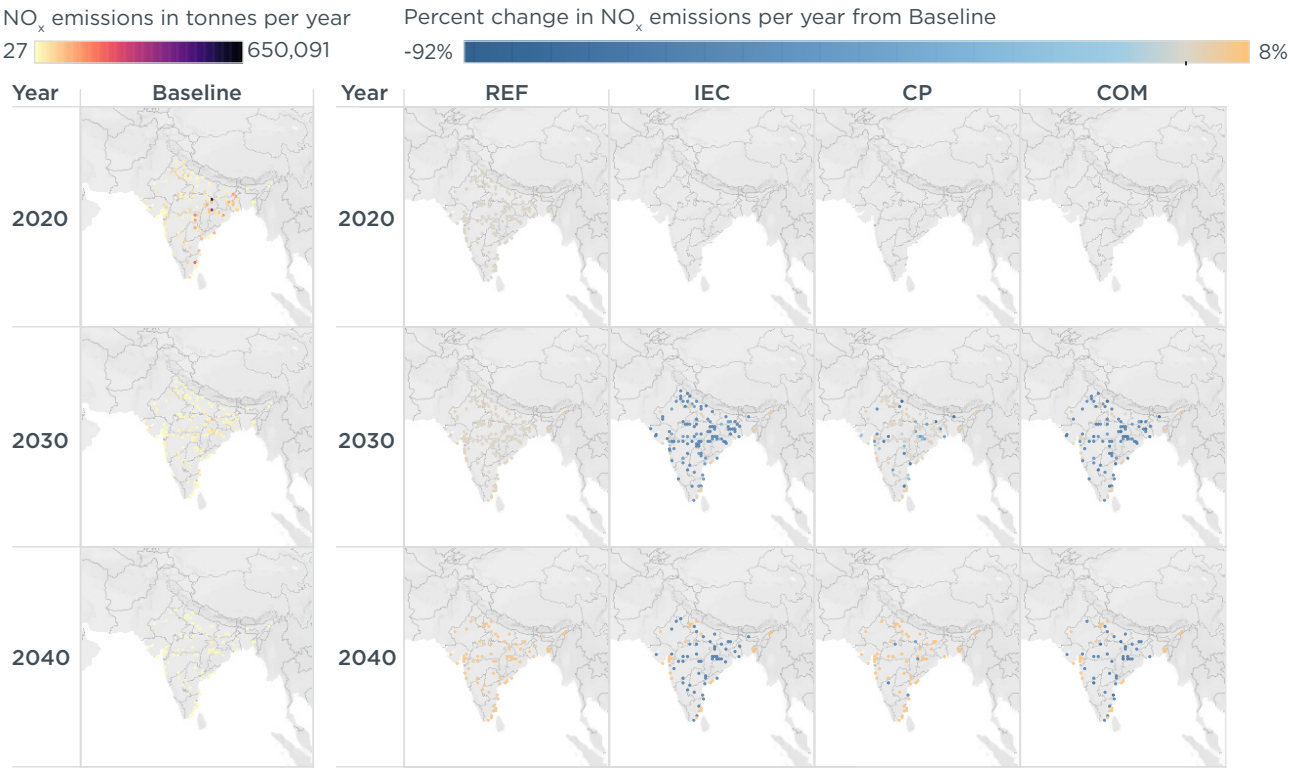

Figure 2. Gridded NO_x emissions from power plants. Results for the REF, IEC, CP, and COM scenarios are shown as percent changes in emissions from the Baseline scenario for the same year.

*This map is presented without prejudice as to the status of or sovereignty over any territory, the delimitation of international frontiers and boundaries, and the name of any territory, city, or area.

POLICY IMPLICATIONS

The findings underscore the benefits of improved power plant emission controls and progressive phaseout of coal power, as these substantially reduce power sector emissions regardless of EV penetration in the vehicle fleet. Additionally, the study projects that road transport emissions will exceed power sector emissions in 2040, and that heavy-duty vehicles will account for the bulk of tailpipe emissions in 2040 under the ambitious vehicle electrification pathway. Therefore, reversing emissions growth in India would require developing and implementing strategies that electrify vehicles faster, accelerate fleet renewal, increase vehicle efficiency, and improve upon existing Euro 6/VI emission standards.

PUBLICATION DETAILS

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