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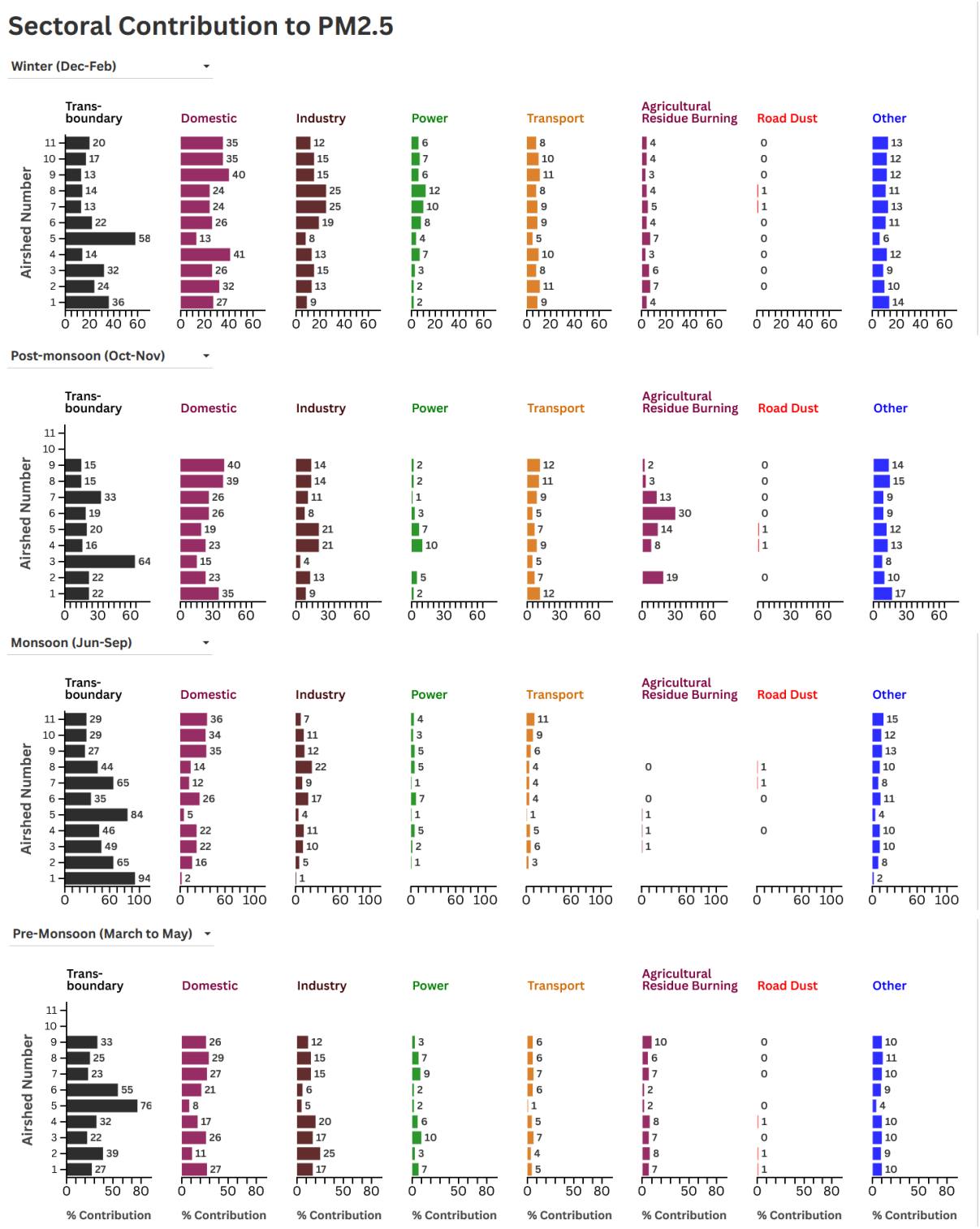
Scientific evidence is clear: Enforcing SO_2 norms in India's coal power plants is non-negotiable

Amidst the ongoing debate over the necessity of flue gas desulphurisation (FGD) systems in coal-fired thermal power plants (CFPPs), the Centre for Research on Energy and Clean Air (CREA) examined the current status of FGD implementation, sulphur dioxide (SO_2) emissions, and insights from two new scientific studies published in 2025 by IIT Delhi and IIT Bombay. The analysis reveals a troubling picture of delayed enforcement and persistent non-compliance across the power sector.

Formed from SO_2, secondary PM2.5 dominates India's air pollution

The IIT Delhi study identified nine to 11 major airsheds in India that shift seasonally, altering pollution patterns both across and within regions. The study highlighted that air pollution in India is driven by multiple sectors (as in the Figure below), with transboundary pollution having the highest impact (13% to 94%), followed by the domestic sector (2% to 41%). Industry contributes 1% to 25%, while transport and power sectors each range between 1% to 12%. Agricultural residue burning, which plays a major role only during the post-monsoon months (October to November) in North India, has minimal influence otherwise. Road dust has the least impact (up to 1%), and other sources contribute 2% to 17%.

One of the study's significant findings is the dominance of secondary $PM_{2.5}$ rather than primary $PM_{2.5}$. Secondary $PM_{2.5}$ forms in the atmosphere due to chemical reactions of precursor gases such as SO_2. Annually, local sources contribute about 81% of India's secondary $PM_{2.5}$. Population-weighted exposure to secondary $PM_{2.5}$ across India comes from the residential sector (22%), industry (14%), power (11%), and transport (11%). There has been some progress in expanding EV (electric vehicle) adoption and clean cooking solutions. However, emissions from industries and the power sector remain largely unaddressed, continuing to be major sources of pollution.



Source: Supplementary Information "Sectoral Contributions to Primary and Secondary PM2.5 in Regional Airsheds of India"

Transboundary sources account for 85% of $PM_{2.5}$

The IIT Bombay study assessed the share of transboundary pollution in urban $PM_{2.5}$ levels across 143 Indian cities using modelling approaches. On average, transboundary sources accounted for around 85% of $PM_{2.5}$, with 107 of the 122 NCAP cities recording more than 80% of their pollution load from outside their boundaries. The findings imply that most cities, even with complete elimination of local anthropogenic sources, cannot meet the national clean air targets. Larger cities like Delhi, Mumbai, and Kolkata had relatively lower transboundary shares due to strong in-boundary emissions from power, transport, and industry.

The study also identified biomass burning (32%), energy generation (16%), and industry (15%) as the top contributors to transboundary $PM_{2.5}$. Seasonal variations were significant, with transboundary pollution peaking during non-monsoon periods when atmospheric conditions favor long-range transport.

Stalled progress on FGD poses huge public health risk

India's persistent delays in enforcing SO_2 emission norms for coal-fired CFPPs have significantly weakened the country's efforts to combat air pollution. Initially notified in 2015, the emission norms mandated the installation of FGD systems to reduce SO_2 emissions by 2017. However, progress has been sluggish, leading to multiple extensions. In December 2024, the Ministry of Environment, Forest and Climate Change (MoEFCC) announced a fourth extension, pushing the compliance deadlines further till 2029. The ongoing postponements not only delay progress toward cleaner air but also pose serious risks to public health, with CFPPs remaining key contributors to air pollution in the country.

In FY 2024–25, out of a total of 537 CFPP units, 44 had FGD systems installed, a mere 8% of the total units in India. Among the 493 units without FGDs, 380 (77%) were exceeding the prescribed limits, 59 (12%) were found complying with emission norms, and data was not available for the remaining 54 units (11%). These findings paint a disturbing picture of non-compliance, with a significant proportion of power plants continuing to release SO_2 at dangerously high levels. For example, plants required to meet the most stringent limit of 100 mg/Nm^3 averaged 1,068 mg/Nm^3, more than 10 times the allowed SO_2 limit. Even plants under the 200 mg/Nm^3 standard averaged 996 mg/Nm^3, nearly five times the permissible limit, while those under the 600 mg/Nm^3 norm recorded an average emission of 1,007 mg/Nm^3, still exceeding the allowed limit.

When examined by the location of the power plants, the statistics are equally concerning. Category A plants – those situated within 10 km of the National Capital Region (NCR) or million-plus cities – had an average SO_2 emission of 991 mg/Nm^3. Meanwhile, Category B plants – located near critically polluted areas or non-attainment cities – recorded an average of 1,001 mg/Nm^3. Also, Category C plants, which are located outside the NCR and pollution hotspots, had an average emission of 1,014 mg/Nm^3. These numbers highlight the widespread non-compliance across the country, reinforcing the need for stronger regulatory action and the urgent installation of FGDs.

Table: Average SO_2 emissions in non-compliant thermal power plants categorized based on location and installation date

Classification	Norms/Category	Number of units	Average SO_2 emissions (mg/Nm3)
Emission Norms based on power plant installation date	100 mg/Nm3	44	1,068
	200 mg/Nm3	156	996
	600 mg/Nm3	180	1,007
Category based on power plant location	A	40	991
	B	48	1,001
	C	292	1,014

It's important to note that FGD installation is not just a necessity in already polluted regions such as the IGP. Even in areas where current pollution levels may appear moderate, emissions from thermal power plants contribute to the regional pollution load. Therefore, FGD implementation should be made mandatory irrespective of geography, ensuring installation across the country and addressing the cumulative and long-range nature of air pollution.

While stringent penalties have been imposed on farmers for seasonal agriculture residue burning, the year-round industrial and power sector emissions continue largely unchecked due to regulatory leniency and delays in enforcement. Without robust compliance mechanisms, air quality will continue to deteriorate despite existing policies. If transparency in emissions data is ensured and penalties for non-compliance in the power sectors are enforced with the same rigor as biomass burning, pollution levels could be significantly reduced.

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About CREA

The Centre for Research on Energy and Clean Air (CREA) is an independent research organisation focused on revealing the trends, causes, and health impacts, as well as the solutions, to air pollution. The organisation's work is funded through philanthropic grants and revenue from commissioned research. www.energyandcleanair.org.