



WHITEPAPER

India's Emissions Landscape



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As one of the world's fastest-growing economies and the second-most populous nation, India's developmental strategy faces a unique challenge: balancing economic growth with environmental sustainability. Emissions from energy production, industry, transportation, agriculture, and waste management have risen significantly, impacting air quality, public health, and contributing to global climate change. This white paper explores India's emissions profile, the sources contributing to emissions, and the broader implications for India's environment and population. It aims to present a comprehensive view of the current state of emissions in India, the effectiveness of existing policies, and potential pathways for reduction.

Significance

India's emission levels are pivotal in the global fight against climate change due to the country's large and rapidly growing population, increasing urbanization, and expanding industrial base. Emissions in India are not only a global concern due to greenhouse gas contributions but also a pressing local issue with serious implications for public health, economic stability, and ecological sustainability. Poor air quality in major cities, for example, has led to increased respiratory diseases, school closures, and significant economic costs. India's commitments to the Paris Agreement and other climate targets are ambitious, yet challenging, given its need to provide affordable energy for its citizens while transitioning to cleaner alternatives.

Current Emissions Landscape in India

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India is the third-largest emitter of greenhouse gasses globally, following China and the United States, contributing roughly 7% of the global total. The country's GHG emissions primarily consist of carbon dioxide (CO₂), methane (CH₄), and nitrous oxide (N₂O). Each of these gasses originates from distinct sectors, reflecting the economic and social activities driving India's development.



- **Carbon Dioxide (CO₂):** Primarily produced from burning fossil fuels, coal remains the dominant energy source, accounting for about 55% of electricity generation. Industrial processes, transportation, and residential energy use also significantly contribute.
- **Methane (CH₄):** Emissions stem from rice cultivation, livestock (enteric fermentation), and waste decomposition in landfills. India is the largest emitter of methane globally due to its agricultural practices.
- **Nitrous Oxide (N₂O):** Emissions largely originate from the overuse of nitrogen-based fertilizers in agriculture, making this sector a key contributor.

Sector-Wise Breakdown of Emissions

India's emissions are driven by five major sectors (numbers based on 2022 data):

- **Energy Production (31.55% of emissions):** Coal-fired power plants dominate the energy landscape, making India one of the largest consumers of coal worldwide. The growing energy demand, spurred by industrialization and urbanization, exacerbates reliance on fossil fuels. However, renewables like solar and wind energy have seen a significant uptick, supported by government initiatives and falling costs.
- **Transportation (8.36% of emissions):** With a rapidly increasing vehicle population, transportation is a major contributor to urban air pollution. Over 80% of vehicles in India run on petrol or diesel, and public transportation infrastructure struggles to keep pace with demand. Government schemes promoting electric vehicles (EVs), such as Faster Adoption and Manufacturing of Hybrid and Electric Vehicles (FAME), aim to address this issue to a certain extent.
- **Manufacturing (19.65% of emissions):** The manufacturing sector, including steel, cement, and chemical production, is both energy-intensive and emission-heavy. These industries heavily rely on coal and other fossil fuels. While energy efficiency programs like the Perform, Achieve, and Trade (PAT) scheme have made progress, significant challenges remain.



- **Agriculture (22.37% of emissions):** Agriculture is a key source of methane and nitrous oxide emissions. Traditional practices like paddy irrigation contribute heavily to methane production, while the excessive use of synthetic fertilizers drives nitrous oxide emissions. Efforts to promote sustainable farming practices and alternate wetting and drying (AWD) irrigation techniques are underway.
- **Waste Management (5.84% of emissions):** Rapid urbanization has outpaced the development of effective waste management systems. Open dumping and burning of solid waste, along with untreated wastewater, contribute significantly to methane and CO₂ emissions. Initiatives such as Swachh Bharat Mission aim to modernize waste collection and recycling practices.

Regional Variations in Emissions

India's emission profile varies significantly across states due to differences in industrial activity, population density, and energy consumption patterns. For example:

- **High Emission States:** Industrial states like Maharashtra, Gujarat, and Uttar Pradesh lead in emissions due to concentrated industrial and transportation activities.
- **Agricultural States:** Punjab and Haryana see significant methane emissions from rice paddies and stubble burning.
- **Urban Centers:** Cities like Delhi, Mumbai, and Bengaluru face high emissions due to vehicle pollution, construction, and waste.



Sectoral Analysis of Emissions Sources

India's emissions are driven by activities across several key sectors, each contributing unique challenges and opportunities for mitigation. Below is a detailed analysis of these sectors:

Energy Sector

Key Drivers

- Heavy reliance on coal, which constitutes over 55% of electricity generation.
- Growing energy demands from industrialization, urbanization, and population growth.
- Low penetration of cleaner fuels in rural areas, where biomass burning remains prevalent.

Challenges

- Transitioning away from coal while ensuring enough energy is delivered.
- Financing renewable energy projects in less-developed regions.
- Integrating renewable energy into the existing grid infrastructure.

Progress

- India has achieved significant milestones in renewable energy, with over 125 GW installed capacity as of 2023.
- Initiatives like the International Solar Alliance (ISA) and the Pradhan Mantri Kisan Urja Suraksha Evam Utthan Mahabhiyan (PM-KUSUM) are helping scale renewable energy deployment.

Transportation Sector

Key Drivers

- Rapid urbanization leading to increased vehicle ownership.
- Inadequate public transportation systems in urban and rural areas.
- Dependence on fossil fuels for over 90% of transportation energy needs

Challenges

- Expanding electric vehicle (EV) infrastructure, including charging stations.
- Reducing emissions from heavy-duty vehicles and freight transportation.
- Addressing air pollution in cities where vehicle emissions are a major contributor



Progress

- Government schemes such as Faster Adoption and Manufacturing of Hybrid and Electric Vehicles (FAME) and BS-VI emission norms have been introduced to curb vehicular emissions.
- Development of metro rail systems and smart urban transport projects in major cities.

Industrial Sector

Key Drivers

- High energy consumption by industries like cement, steel, and chemicals.
- Use of outdated technologies and processes that are energy-intensive.
- Dependency on coal and oil for industrial energy needs.

Challenges

- Modernizing infrastructure in small- and medium-scale enterprises (SMEs).
- Scaling carbon capture, utilization, and storage (CCUS) technologies.
- Encouraging industries to adopt circular economy principles to minimize waste.

Progress

- The Perform, Achieve, and Trade (PAT) scheme under the National Mission on Enhanced Energy Efficiency (NMEEE) has helped improve energy efficiency in major industries.
- Innovations in green steel and alternative materials in construction are gaining traction.

Agriculture Sector

Key Drivers

- Methane emissions from rice paddies and enteric fermentation in livestock.
- Excessive use of nitrogen-based fertilizers leading to nitrous oxide emissions.
- Traditional practices like stubble burning contribute to local air pollution

Challenges

- Promoting sustainable farming practices like crop rotation and alternate wetting and drying (AWD).
- Educating farmers on reducing fertilizer use without impacting productivity.
- Addressing social and economic barriers to adopting eco-friendly practices.



Progress

- Implementation of soil health cards and organic farming schemes.
- Research on methane-inhibiting feed additives for livestock to reduce emissions.

Waste Management Sector

Key Drivers

- Methane emissions from landfills due to improper waste segregation and disposal.
- Open burning of solid waste in urban and peri-urban areas.
- Lack of wastewater treatment facilities, especially in smaller towns

Challenges

- Scaling up waste-to-energy (WTE) plants and biogas systems.
- Improving awareness about waste segregation and recycling at the source.
- Strengthening municipal capacities to handle increasing waste volumes.

Progress

- The Swachh Bharat Mission has significantly improved sanitation and waste management awareness.
- Emerging startups are leveraging technology for waste recycling and circular economy initiatives

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