



KNOWLEDGE PRODUCT

SUSTAINABILITY ALTERNATIVES

Evidence-Based Insights for Climate Policy, Transport Emission Reduction & Carbon Credit Valuation

Air Quality | Transport Policy | Climate Mitigation & SDG 13 Advisory

Executive Summary: A Pathway to Cleaner Air and a Cooler Climate

This study comprehensively assesses the significant climatic and economic benefits achievable through black carbon (BC) emission reductions in India's on-road transport sector. By adopting emission standards equivalent to those in the US, India can unlock substantial environmental and financial gains.



Objective

Quantify potential BC reduction and its climatic and economic impact.



Key Findings

- Revised BC estimates: 74–254 Gg/year
- Potential BC reduction: ~69% (51–175 Gg/year)
- Radiative forcing reduction: -0.0025 to -0.0087 W/m²
- Economic potential: \$0.56–\$1.92 billion/year



Implications

Informs robust policy for transport emission reduction, climate mitigation, and carbon credit opportunities.

Background & Context: The Urgency of Black Carbon Mitigation

Black carbon (BC) is a short-lived climate pollutant with a disproportionately strong warming effect, making its reduction a critical component of climate change mitigation strategies. In India, the transport sector is a significant contributor to BC emissions, impacting both regional climate and local air quality.

Why Black Carbon Matters

- **Potent Climate Forcer:** BC absorbs sunlight, warming the atmosphere and accelerating ice melt, particularly in the Himalayas.
- **Transport Sector Contribution:** On-road vehicles are a major source of BC emissions in India, especially from diesel engines.
- **Urban Health Impacts:** BC is a component of fine particulate matter (PM_{2.5}), linked to severe respiratory and cardiovascular diseases.
- **SDG 13 Alignment:** Reducing BC directly contributes to Sustainable Development Goal 13 (Climate Action) and improves air quality (SDG 3 and 11).

Historical Uncertainty

Previous estimates of BC emissions in India have varied widely, posing challenges for precise policy formulation. This study addresses this by using more refined methodologies to constrain these estimates and provide a clearer picture of mitigation potential.

"Understanding the exact contribution of black carbon from the transport sector is the first step towards effective and targeted intervention."



Unpacking the Challenge: Research Objectives

This research aimed to provide actionable insights for policymakers by rigorously quantifying the potential for black carbon reduction and its multifaceted benefits. The objectives were designed to fill critical data gaps and inform strategic interventions.



Quantify BC Emission Reduction

Precisely determine the achievable reduction in black carbon emissions from India's on-road transport sector.



Assess Climatic Benefits

Evaluate the reduction in radiative forcing, a key indicator of climate impact, resulting from BC mitigation.



Estimate Economic Value

Calculate the potential economic gains through carbon credit valuation for reduced BC emissions.

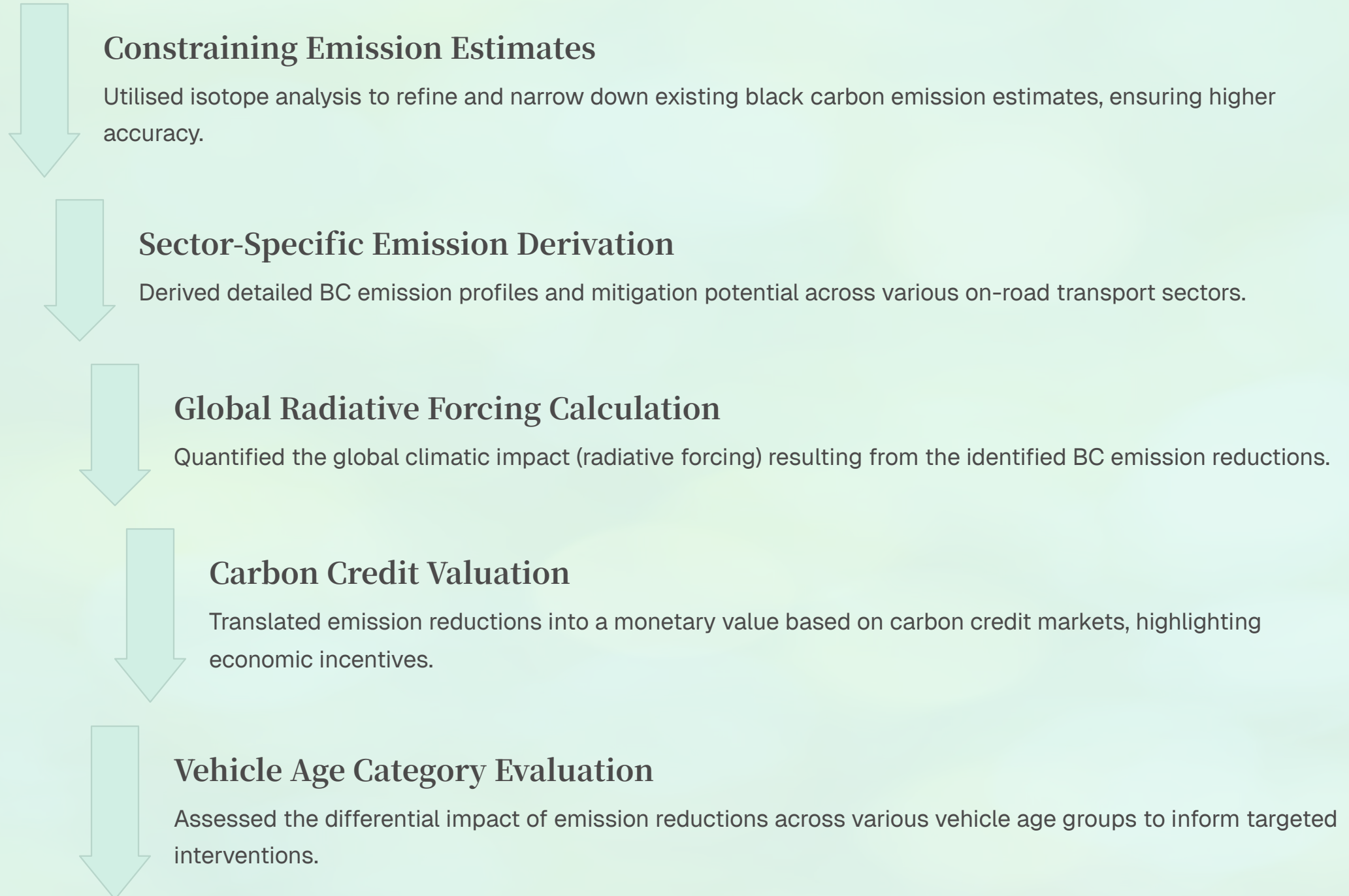


Identify Key Fleet Segments

Pinpoint which vehicle age categories offer the highest and lowest BC reduction potential, guiding targeted policies.

Methodology: A Data-Driven Approach

To achieve its objectives, the study employed a robust, multi-faceted methodology, integrating advanced analytical techniques with economic modelling. This approach ensured that the findings were grounded in empirical evidence and provided a comprehensive understanding of the impacts.



Key Findings: Substantial Reductions and Economic Opportunities

The research reveals compelling evidence of significant climatic and economic benefits from adopting cleaner on-road emission standards in India. These findings provide a clear mandate for policy action and investment in sustainable transport solutions.

69%

BC Emission Reduction

Achievable across India's on-road transport sector.

Targeting vehicles aged **5–10 years** yields the maximum reduction potential, whereas **15–20-year-old** vehicles show minimum reduction.

-0.0087

W/m² Radiative Forcing

Maximum reduction in warming effect on the atmosphere.

This reduction in radiative forcing contributes significantly to mitigating climate change, equivalent to a notable decrease in global warming potential.

\$1.92B

Annual Carbon Credit Potential

Maximum economic value from reduced BC emissions, offering a strong financial incentive.

Policy Implications: Shaping a Sustainable Transport Future

The study's findings offer crucial guidance for policymakers seeking to address both climate change and air quality challenges. Implementing the recommended measures can lead to a healthier environment and a more sustainable economy for India.

Adopt US On-Road Emission Standards

Mandating emission levels equivalent to those in the US is a pivotal step towards significant BC reduction across the national fleet.

Prioritise Fleet Age for Intervention

Policies should strategically target vehicles in the 5–10-year age bracket for retrofitting, replacement, or incentivised upgrades to maximise BC reduction.

Integrate BC Reduction with Urban Programmes

Align BC mitigation efforts with existing urban air quality initiatives and broader climate action plans for synergistic benefits.

Align with SDG 13 and Climate Initiatives

Ensure that transport sector strategies are in harmony with India's commitments to Sustainable Development Goal 13 and other global climate frameworks.

An illustration of a meeting taking place around a round white table. Five people are seated: a woman on the left in a white shirt and dark trousers, a man in a white shirt and yellow jacket, a man in a dark suit and glasses, and two other people partially visible. They are looking at a large screen that displays various data visualizations, including two pie charts at the top, a bar chart with a line graph overlay, and a small inset showing a mountain landscape. The background features stylized green and yellow foliage.

Strategic Recommendations: Actions for Impact

Translating research into tangible outcomes requires clear strategic actions. These recommendations provide a roadmap for policymakers and stakeholders to drive effective black carbon reduction and foster a green transition in India's transport sector.

Implement US-Equivalent Standards

Enforce stringent emission standards nationwide for all new and existing vehicles.

Incentivise Fleet Modernisation

Develop programmes to encourage the replacement or upgrading of older, high-emitting vehicles, especially those aged 5-10 years.

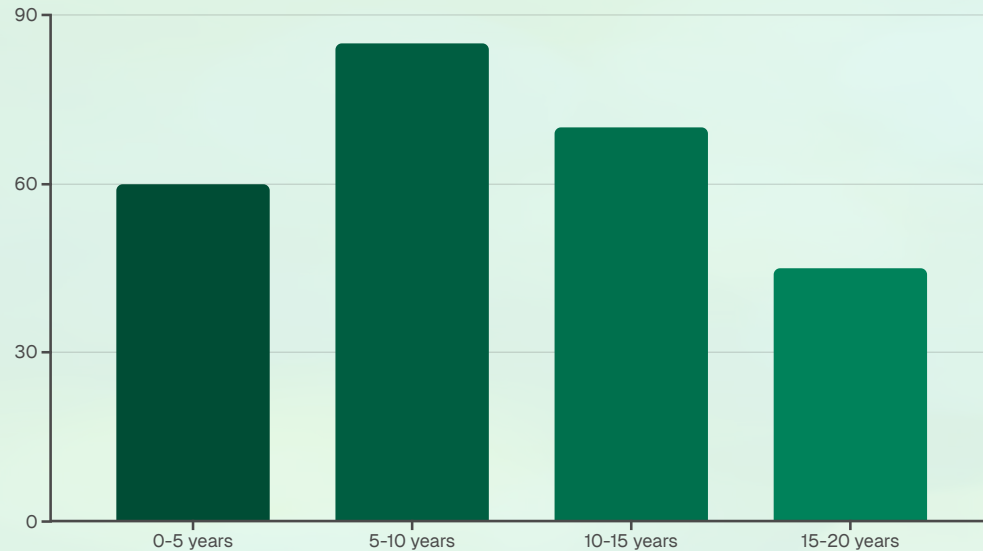
Leverage Carbon Credit Financing

Explore mechanisms to finance BC reduction projects through carbon markets, capitalising on the estimated \$0.56–\$1.92 billion/year potential.

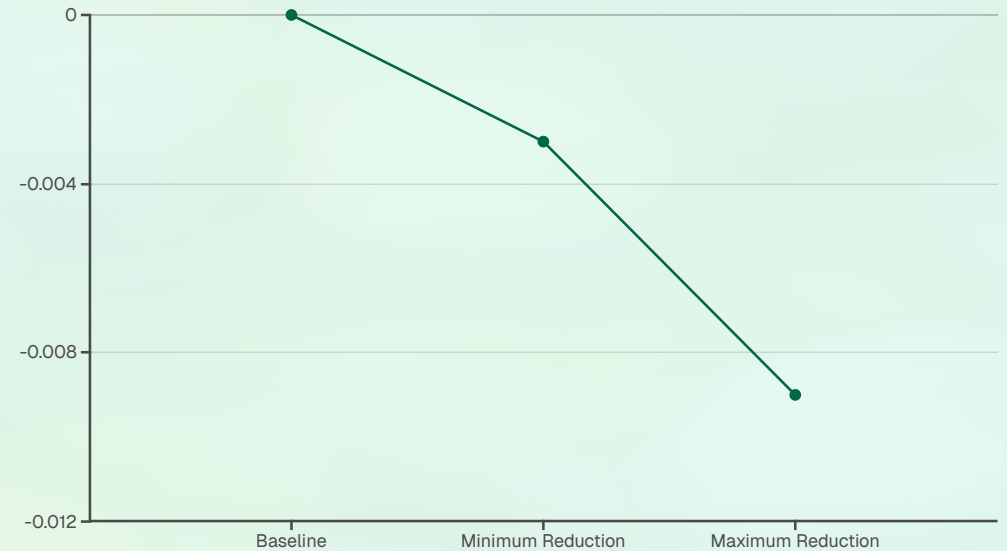
Integrate into Urban Sustainability

Incorporate black carbon reduction targets and strategies into broader urban planning, public transport development, and smart city initiatives.

Supporting Data & Visuals: Evidence at a Glance



BC Emission Reduction by Vehicle Age Category: This chart illustrates the varying potential for black carbon reduction across different vehicle age segments, highlighting the peak in the 5-10 year category.



Radiative Forcing Impact vs. Baseline: This line graph visually compares the radiative forcing impact under different black carbon reduction scenarios against a baseline, demonstrating the positive climatic benefits.

Research Source & Contact

This briefing document is based on rigorous, evidence-based research conducted by leading experts in environmental science and policy.

Primary Research Source:

Sharma, A., & Chung, C. E. (2015). Climatic benefits of black carbon emission reduction when India adopts the US on-road emission level. *Future Cities and Environment*, 1(1), 13.

Access Original Research: <https://link.springer.com/article/10.1186/s40984-015-0013-8>

Explore Our Capabilities:

At Sustainability Alternatives, we provide cutting-edge insights and strategic advisory to accelerate the transition to a sustainable future.

- Strategic advisory for climate mitigation, transport decarbonisation, and carbon credit monetization
- Policy design and SDG-aligned sustainability strategies
- Data-driven insights for air quality and climate action planning

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