Air Quality, Health and Carbon Implications of Various Power Sector Strategies for India

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Introduction

- The electricity demand in India is projected to increase rapidly over the next two decades. How India meets this growing demand will have significant effects on local air quality and human health, as well as the global climate challenge.
- We explore how different combinations of energy and air pollution strategies would affect the air quality, health and CO_2 impacts from India's future power sector.
- We design five state-level scenarios from 2015-2040 with:
  1) **Energy strategy**: Various levels of future demand and low-carbon investment
  2) **Air pollution strategy**: Various enforcement levels of conventional air pollution control policies
- We adopt an integrated modeling approach that combines the GAINS-India model, a state-level source-receptor matrix, and a health impact assessment model.

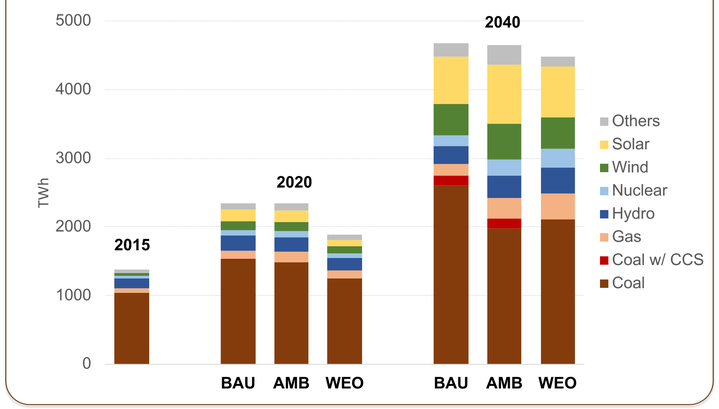
Scenarios

Method: Developed using GAINS-India, with information on energy projections and existing air pollution policies

Table 1. Five state-level scenarios from 2015-2040

Scenario Name	Energy Strategy			Air pollution strategy
	National projection		State-level renewable pattern	
BAU-CLE	**BAU:** Business-as-usual	NITI Aayog, Government of India, Draft Energy Policy 2017, Scenarios for 2022 and 2040	Based on India 2022 installation targets	**CLE:** Successful implementation of current legislation, especially the emission standards for coal power plants released in 2015
AMB-CLE	**AMB:** Ambitious			
WEO-CLE	**WEO:** World Energy Outlook	IEA World Energy Outlook 2017, New Policy Scenario	Developed by IIASA	
WEO-DEL				**DEL:** 10 year delay in control strategy compared to CLE
WEO-FRO				**FRO:** control strategy frozen after 2025

Fig 1. National-level electricity generation



Emissions

Method: Calculated using GAINS-India emissions factors

Finding 1. Future CO_2 emissions from the power sector will depend primarily on the energy strategy, especially the demand level and low-carbon energy share.

Finding 2. Future air pollutant emissions from the power sector can be reduced significantly by implementing existing control policies on coal power plants. The additional SO_2 and PM reduction from energy strategy is relatively small in 2040.

Fig 2. BAU-CLE, national emissions by sector

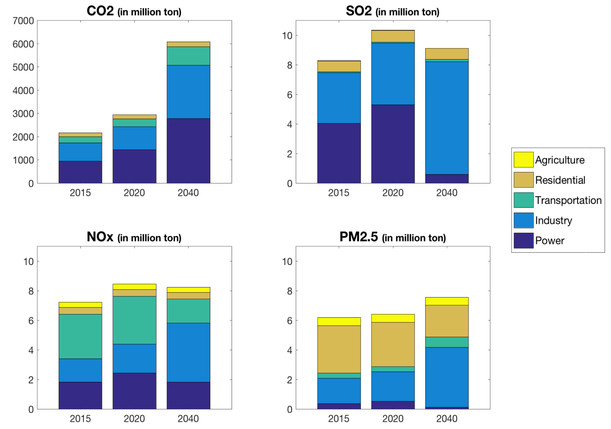
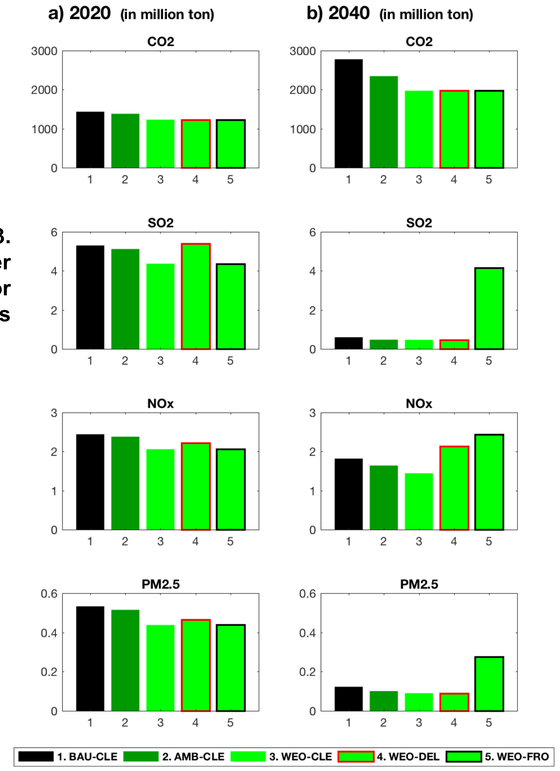


Fig 3. Power sector emissions

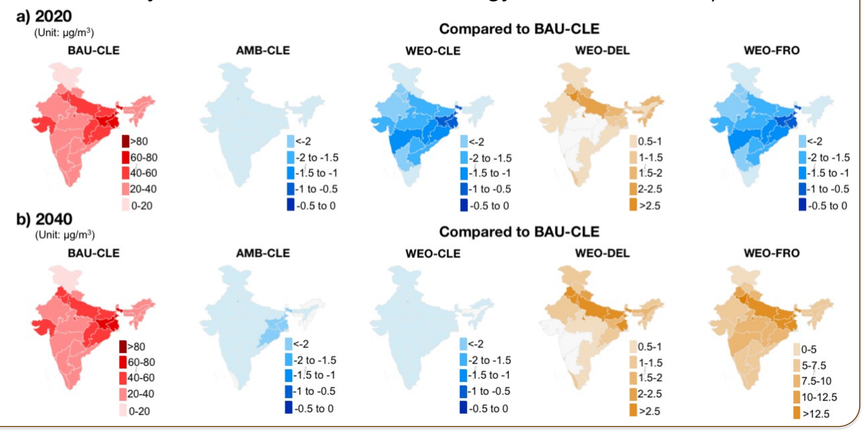


Surface $PM_{2.5}$ concentrations

Method: Calculated using a state-level source-receptor matrix derived from TM5

Finding 3. Energy strategy (e.g. WEO relative to BAU) could help reduce $PM_{2.5}$ concentrations throughout the country. However, unsuccessful implementation of air pollution control policies can increase the pollution level (key factor for 2020: delay in implementation; key factor for 2040: control strategy frozen after 2025)

Fig 4. Annual average $PM_{2.5}$ concentrations

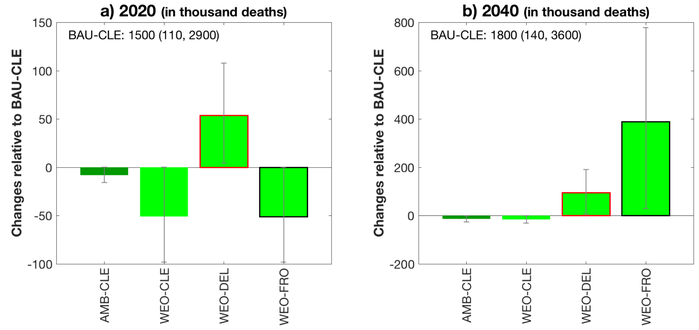


Air-pollution-related deaths

Method: Calculated using the IMED|HEL (Integrated Model of Energy, Environment and Economy for Sustainable Development | Health), with concentration-response relationships from the Global Burden of Disease Study and state-level population projection consistent with the IIASA-developed WEO-CLE scenario.

Finding 4. While the mortality difference driven by energy strategy may not be significant, the increase in air-pollution-related mortality due to unsuccessful implementation of air pollution control policies can be large.

Fig 5. National total air-pollution-related deaths



Note: Error bars reflect the confidence intervals of relative risk functions.

Conclusion

- Successful enforcement of existing air pollution control policies on coal power plants is the key to reduce air pollution and health impacts of India's power sector.
- CO_2 impacts will depend on the scale of demand growth and low-carbon transition.
- Our results highlight the importance of coordinated air pollution and energy policy to simultaneously achieve air pollution, health and CO_2 mitigation goals in India.

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