

independent external peer reviewers from India and other countries, who were selected by HEI for their expertise in different technology sectors and their emissions, in air quality measurement, in atmospheric chemistry and modeling, and in health effects assessment. The list of reviewers can be found in the Contributors list at the end of this document. A draft final version of this report was also reviewed by experts on the GBD MAPS Steering Committee. The GBD MAPS Working Group prepared the final report in response to the comments received.

MAIN FINDINGS

THE SITUATION IN 2015

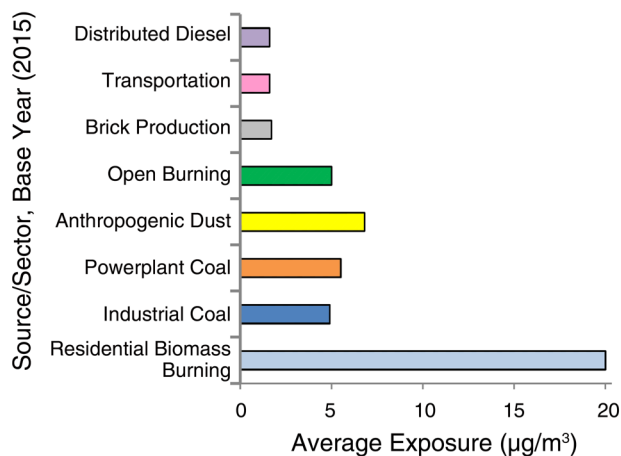
Sources Related to Human Activities Were Responsible for the Largest Proportion of the Population Exposure to PM_{2.5} in India.

In 2015, the leading contributors to ambient PM_{2.5} exposure (defined as “annual average population-weighted PM_{2.5} concentration”) were the sources associated with combustion of biomass and coal and other human activities that generate dust (Summary Figure 4). The India-wide average PM_{2.5} exposure in 2015 was 74.3 µg/m³. Residential biomass burning contributed nearly 24% of the total (see Table 2 in the main report); coal combustion was the next largest contributor (with 7.7% from industry and 7.6% from power generation); and anthropogenic dust (dust related to human activities, including fugitive dust from roads and fly-ash from coal burning and waste burning) contributed about 9%. Also, agricultural burning contributed more than 5%, and transportation, brick production, and distributed diesel each contributed about 2%. **Windblown mineral dust contributes to ambient PM_{2.5} air pollution; however, the extent of the contribution varies greatly across India, with the most significant contribution in the northwest region.**[‡]

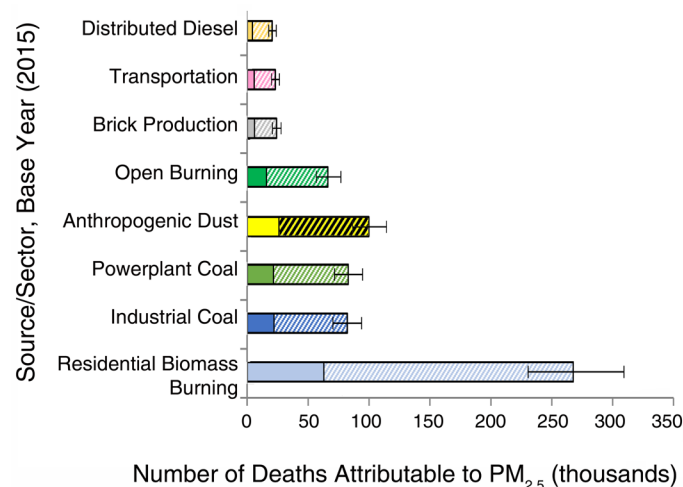
Sources of Air Pollution Linked to Human Activity Are Also the Largest Overall Contributors to the 2015 Burden of Disease in India, and the Rural Population Faces the Highest Burdens.

Consistent with their contribution to exposure, sources associated with human activity contributed to nearly 70% of all PM_{2.5}-attributable mortality in 2015. Summary Figure 5 shows that the PM_{2.5}-attributable mortality estimates for India as a whole in 2015 were dominated by the mortality estimates for the rural population (as defined by the 2011 Indian Census and indicated by the hatched portion of the bars); that is, about 75% of the deaths in India occur among the rural population. This result reflects the fact that a large proportion of the Indian population lives in rural areas (about two-thirds in 2015) and that there are differences in mortality rates and age structures in these populations. Unlike the situation in many other countries, where urban exposures dominate, this study found that the PM_{2.5} exposure levels in rural and urban areas in India were similar (i.e., both more than 70 µg/m³).

[‡] Note that, although it was not included in the set of sources related to human activities, windblown dust also arguably results in part from human activities that contribute to desertification, for example, either directly through agricultural or forestry practices or indirectly through impacts on climate.



Summary Figure 4. Contribution by selected sources to average population exposure to PM_{2.5} in India for 2015 (see Table 3 in the main report).



Summary Figure 5. Contributions (including 95% uncertainty intervals) by selected sources to mortality burden in India in the baseline year, 2015. Hatched bars indicate rural population, and solid bars indicate urban populations.

Residential biomass burning is the largest individual contributor to the burden of disease in India. Among all sources related to human activities, residential biomass burning was responsible for 267,700 deaths or nearly 25% of the deaths attributable to PM_{2.5}, making it the most important single anthropogenic source related to mortality in 2015. These burden estimates do not include the additional substantial burden from indoor exposure to biomass burning.

Coal combustion and open burning are also substantial contributors to disease burden. Coal combustion, roughly evenly split between industrial sources and thermal power plants, was responsible for 169,300 deaths (15.5%) in 2015. The open burning of agricultural residue was responsible for 66,200 PM_{2.5}-attributable deaths (6.1%).

Transport, distributed diesel, and brick production are also important contributors to disease burden. Compared with other sources in this nationwide analysis, transportation, brick kilns, and distributed diesel have relatively small percentage