The Impact of Power Generation Emissions on Ambient PM$_{2.5}$ Pollution and Human Health in China and India

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Michael B. McElroy

HARVARD-CHINA PROJECT on Energy, Economy and Environment

John Evans    Yang Liu

and many others

Source: IRENA
Power Plant Emissions in China and India

MIX emission inventory 2010

**China**

- **SO₂**
  - Power: 58.52%
  - Industry: 28.49%
  - Residential: 12.17%
  - Transportation: 0.82%

- **NOₓ**
  - Power: 38.59%
  - Industry: 32.52%
  - Residential: 24.96%
  - Transportation: 7.4%

- **PM₂.₅**
  - Power: 59.14%
  - Industry: 31.96%
  - Residential: 10.12%
  - Transportation: 7.4%

**India**

- **SO₂**
  - Power: 50.62%
  - Industry: 17.85%
  - Residential: 10.17%
  - Transportation: 16.15%

- **NOₓ**
  - Power: 31.96%
  - Industry: 25%
  - Residential: 10.12%
  - Transportation: 15.38%

- **PM₂.₅**
  - Power: 38.83%
  - Industry: 49.68%
  - Residential: 4.17%
  - Transportation: 7.32%
Mortality Estimation Equations

\[ RR(C) = \{1 + \alpha(1 - e^{-(C - C_0)})\gamma\} \], \quad C \geq C_0 \text{ 1}, \quad C < C_0 \]

\[ PAF = RR(C) - 1/RR(C) \]

\[ \Delta M = PAF \times \text{Base} \times \text{Pop} \]

PAF = Population Attributable Fraction

GBD 2015
1000 pairs of IER (Integrated Exposure Response model) parameters

Burnett et al., EHP, 2014
Cohen et al., Lancet, 2017
PM$_{2.5}$ Concentrations

(a) All Emissions Included
(b) Power Emissions Excluded

[Annual Mean Surface PM$_{2.5}$, $\mu$g/m$^3$]
### Mortality due to Power Plants in China and India

#### Total

<table>
<thead>
<tr>
<th>Cause</th>
<th>Stroke</th>
<th>IHD</th>
<th>COPD</th>
<th>LC</th>
<th>LRI</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>All</td>
<td>366k</td>
<td>388k</td>
<td>345k</td>
<td>150k</td>
<td>82k</td>
<td>1.3m</td>
</tr>
<tr>
<td>Power</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.5m</td>
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</tbody>
</table>

#### Power

<table>
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<tr>
<th>Cause</th>
<th>Stroke</th>
<th>IHD</th>
<th>COPD</th>
<th>LC</th>
<th>LRI</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>All</td>
<td>123k</td>
<td>191k</td>
<td>301k</td>
<td>18k</td>
<td>170k</td>
<td>0.8m</td>
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<tr>
<td>Power</td>
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<td>0.27m</td>
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</tbody>
</table>

(×1000 deaths)
Collaborative Clean Air Policy Centre, New Delhi

Policy Paper, edited by Kirk R. Smith

Where Does Ambient PM$_{2.5}$ Come from in China?: A Comparison and Synthesis of Recent Estimates

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