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Supplement of

The effects of energy paths and emission controls and standards on future trends in China’s emissions of primary air pollutants

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(c) Machinery coking plants

(d) Sintering

(e) Blast furnaces (iron production)

(f) Basic oxygen furnaces (steel making)

(g) Electric furnaces (steel making)

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(j) Brick production

(k) Lime production
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(a) Coal-fired power plants
(b) Cement production
(c) Iron & steel production
(d) Light-duty gasoline vehicles
(e) Heavy-duty diesel vehicles
(f) Rural vehicles

- BAS
- REF
- STD
- SO2
- NOx
- PM
Figure S5

(a) Coal-fired power plants

(b) Cement production

(c) Iron & steel production

(d) Light-duty gasoline vehicles

(e) Heavy-duty diesel vehicles

(f) Rural vehicles

- BAS
- REF
- STD
- SO2
- NOx
- PM
Figure S6

(a) 2010

(b) 2011

(c) 2012

(d) 2013 (averages of January-October)
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Table S1. The summary of emission standards for stationary sources included in this work.

<table>
<thead>
<tr>
<th>Sector</th>
<th>Standard</th>
<th>Issued time</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power</td>
<td>GB 13223-2011</td>
<td>July, 2011</td>
<td>Emission standard of air pollutants for thermal power plants</td>
</tr>
<tr>
<td>Iron &amp; steel production</td>
<td>GB 16171-2012</td>
<td>June, 2012</td>
<td>Emission standard of air pollutants for coking chemical industry</td>
</tr>
<tr>
<td></td>
<td>GB 28662-2012</td>
<td>June, 2012</td>
<td>Emission standard of air pollutants for sintering and pelletizing of iron and steel industry</td>
</tr>
<tr>
<td></td>
<td>GB 28663-2012</td>
<td>June, 2012</td>
<td>Emission standard of air pollutants for iron smelt industry</td>
</tr>
<tr>
<td></td>
<td>GB 28664-2012</td>
<td>June, 2012</td>
<td>Emission standard of air pollutants for steel smelt industry</td>
</tr>
<tr>
<td>Non ferrous metal smelting</td>
<td>GB 25465-2010</td>
<td>Sep, 2010</td>
<td>Emission standard of pollutants for aluminum industry</td>
</tr>
<tr>
<td></td>
<td>GB 25466-2010</td>
<td>Sep, 2010</td>
<td>Emission standard of pollutants for lead and zinc industry</td>
</tr>
<tr>
<td></td>
<td>GB 25467-2010</td>
<td>Sep, 2010</td>
<td>Emission standard of pollutants for copper, nickel, cobalt industry</td>
</tr>
<tr>
<td>Brick production</td>
<td>N/A a</td>
<td>Nov, 2009 b</td>
<td>Emission standard of air pollutants for brick industry</td>
</tr>
<tr>
<td>Cement production</td>
<td>N/A a</td>
<td>-</td>
<td>Emission standard of air pollutants for cement industry</td>
</tr>
</tbody>
</table>

*Proposed standard, not officially issued yet; a Proposed time.
Table S2. Average removal efficiencies of various air pollutant control devices (APCD) used in this work. Values are in percent.

<table>
<thead>
<tr>
<th></th>
<th>SO₂</th>
<th>NOₓ</th>
<th>PM₂.₅</th>
<th>PM₂.₅-₁₀</th>
<th>PM&gt;₁₀</th>
<th>Data sources</th>
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</thead>
<tbody>
<tr>
<td>Wet-FGD</td>
<td>80</td>
<td>-</td>
<td>53.74</td>
<td>81.21</td>
<td>92.63</td>
<td>Field survey (unpublished); filed tests and data integration (Zhao et al., 2010; 2011)</td>
</tr>
<tr>
<td></td>
<td>70</td>
<td>-</td>
<td>53.74</td>
<td>81.21</td>
<td>92.63</td>
<td>MEP (2010); filed tests and data integration (Zhao et al., 2010; 2011)</td>
</tr>
<tr>
<td></td>
<td>50</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>Field survey (unpublished); conservatively assumed</td>
</tr>
<tr>
<td>Other-FGD</td>
<td>30</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>Field tests (Zhao et al., 2010; 2011)</td>
</tr>
<tr>
<td>LNB</td>
<td>-</td>
<td>30</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>Field tests (Zhao et al., 2010; 2011)</td>
</tr>
<tr>
<td>SCR</td>
<td>-</td>
<td>60</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>Field survey (unpublished); personal communication with China Electricity Council director</td>
</tr>
<tr>
<td>SNCR</td>
<td>-</td>
<td>50</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>Field survey (unpublished); Zhao et al. (2013); conservatively assumed</td>
</tr>
<tr>
<td>FF</td>
<td>-</td>
<td>-</td>
<td>99.30</td>
<td>99.70</td>
<td>99.95</td>
<td>Field tests (Zhao et al., 2010; 2011)</td>
</tr>
<tr>
<td>ESP</td>
<td>-</td>
<td>-</td>
<td>92.31</td>
<td>96.97</td>
<td>99.46</td>
<td>Field tests and data integration (Zhao et al., 2010; 2011)</td>
</tr>
<tr>
<td>WET</td>
<td>20</td>
<td>-</td>
<td>67.40</td>
<td>85.74</td>
<td>96.51</td>
<td>Field tests (Zhao et al., 2010; 2011)</td>
</tr>
<tr>
<td></td>
<td>20</td>
<td>-</td>
<td>56.96</td>
<td>84.01</td>
<td>96.49</td>
<td>Lei et al. (2011); Zhao et al. (2011)</td>
</tr>
<tr>
<td>CYC</td>
<td>-</td>
<td>-</td>
<td>13</td>
<td>75</td>
<td>90</td>
<td>Lei et al. (2011); Zhao et al. (2011)</td>
</tr>
</tbody>
</table>

*For CPP in REF scenarios; †For CPP in BAS scenarios and other industrial sources (except for sintering); ‡For sintering process in REF scenarios; §For CPP; and ¶For sources other than CPP.
Table S3. The national time schedule of implementation of emission standards for transportation sector assumed in this work.

<table>
<thead>
<tr>
<th></th>
<th>Stage I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
<th>V</th>
<th>VI</th>
</tr>
</thead>
<tbody>
<tr>
<td>On-road vehicle (^a)</td>
<td>2000</td>
<td>2005</td>
<td>2008</td>
<td>2013</td>
<td>2016</td>
<td>2026</td>
</tr>
<tr>
<td>RV (^a)</td>
<td>2000</td>
<td>2005</td>
<td>2008</td>
<td>2013</td>
<td>2016</td>
<td>2026</td>
</tr>
<tr>
<td>RV (^b,c)</td>
<td>2000</td>
<td>2005</td>
<td>2008</td>
<td>2011</td>
<td>2014</td>
<td>2021</td>
</tr>
<tr>
<td>Motorcycle</td>
<td>2003</td>
<td>2005</td>
<td>2010</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Tractor</td>
<td>2006</td>
<td>2007</td>
<td>2014</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Machine</td>
<td>2011</td>
<td>2014</td>
<td>2016</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Train and inland ship</td>
<td>2011</td>
<td>2014</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

\(^a\) For BAS scenarios; \(^b\) For REF scenarios in Beijing; \(^c\) For REF scenarios in Tianjin, Shanghai, Jiangsu, Zhejiang and Guangdong.
REFERENCES


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