THE FINDINGS
Rating of coal-based power sector

✓ Research design – sample selection, key parameters, questionnaire – under guidance of panel of industry and academic experts
Technical advisory panel: To guide in rating methodology, data verification, analysis and provide independent assessment

Dr. B. Sengupta, Former Member Secretary, Central Pollution Control Board

Er. Umesh S. Bapat, Ex-Vice president-Operations, Tata Power

Dr. Y.P. Abbi, Ex. Director-Power Station Engineering, BHEL

Dr. Avinash Chandra, Former Professor and Head, Centre for Energy Studies, Indian Institute of Technology, Delhi
Study coverage

- Sample size: 47 plants, 54 GW
- Over half the sector's capacity when study began early 2012
- Just under half participated; non-participating also rated based on survey of plant location and stakeholders, secondary information
- Good participation by state-owned; Only 2 of 10 central ones agreed
Sample Selection

The study selected a wide range of plants to ensure they accurately represent the total sector

✓ Geographically diversified

✓ State, centre and private ones – each company was represented in proportion to its size

✓ Wide range
  • Varying unit sizes – 30% were 210MW units; 25% were 500MW units
  • Varying age – quarter each exceeding mid life and full life

✓ Rating is site specific – Coal mining and sourcing not included
Rating methodology

✓ Collect data from companies but also from other sources including pollution control boards, CEA/CERC, media, legal cases, RTI, industry publications etc.

✓ Survey of the plant to verify operation data and environment practices

✓ Interaction with local community, workers, NGOs, pollution control boards to judge on-the-ground environment impact

✓ Final company profile (report) after seeking clarifications/comments from plant

✓ Indicators, weightage and rating: finalized in consultation with external experts
## Weightages

<table>
<thead>
<tr>
<th>Segments</th>
<th>Weightage (%)</th>
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<tbody>
<tr>
<td>Resource Efficiency</td>
<td>19</td>
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<tr>
<td>Land</td>
<td>3</td>
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<tr>
<td>Water</td>
<td>16</td>
</tr>
<tr>
<td>Energy and GHG</td>
<td>29</td>
</tr>
<tr>
<td>Pollution</td>
<td>42</td>
</tr>
<tr>
<td>Water Pollution</td>
<td>8</td>
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<tr>
<td>Solid Waste</td>
<td>15</td>
</tr>
<tr>
<td>Air Pollution</td>
<td>19</td>
</tr>
<tr>
<td>Policy, compliance and stakeholder 's survey</td>
<td>10</td>
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</tbody>
</table>

- **Resource Efficiency**: 19%
- **Land**: 3%
- **Water**: 16%
- **Energy and GHG**: 29%
- **Pollution**: 42%
- **Water Pollution**: 8%
- **Solid Waste**: 15%
- **Air Pollution**: 19%
- **Policy, compliance and stakeholder 's survey**: 10%
Key indicators

✓ Technology & performance
  ▪ Gross efficiency
  ▪ Deviation from design efficiency
  ▪ Technology (Steam parameters, reheat)
  ▪ Availability
  ▪ GHG

✓ Resource use
  ❏ Water
    ▪ Water consumption index
    ▪ Sourcing
    ▪ Water stress index
Key indicators

✓ Pollution
  ❑ Solid waste
    ▪ Gainful ash utilization
    ▪ Ash pond maintenance
  ❑ Air pollution
    ▪ Coal storage and handling practices
    ▪ PM index
    ▪ SOx and NOx emission rates

❑ Water pollution
  ▪ Water pollution index
  ▪ ETP, STP; Coal storage runoff; Lab results

✓ Policy, Compliance, Stakeholder survey
What we found?
Among the least efficient in the world. GRP study average was just 32.8%
Impact on GHG – around 3% per %age point efficiency
Dated technology - SC offer 3-4% higher efficiency
Subcritical 90%, SC 10% ; China subcritical 75%, SC/USC – 25%
USC not even introduced
Less than 10 years and >300MW – less than fifth; China – 60%+
No policy push to close inefficient plants, to allow new only SC
14 plants below 32%; Almost all state-owned
Overall, merely 12 plants had efficiency in excess of 36%, around the Chinese average
All except two in top category use domestic coal
JSEB Patratu at the bottom at 21%
Efficiency: Actual vs. design

- Efficiency 10% lower than design poor O&M - more than half the plants in the study
- Age is factor, but huge variations in study; Newer plants such MPPGCL Birsinghpur – 20%+
- State-owned old plants were the worst performers
- Efficiency and deviation from design vs. PLF (Adani Mundra)

![Bar chart showing number of plants with efficiency lower than design.](chart.png)
Availability

- Just one plant had less than 15 days average outage during study period.
- 11 plants had average outages of more than 2.5 months.
- Average outages were 47 days in 2012-13.
- Irregular maintenance schedules and bad operational practices increase outages.
PLF (in %)

- Overall demand slow down; excess capacity during night time decline in demand
- Stagnant coal production, evacuation bottlenecks in railways have constrained supply
- State discoms weak financial position limited their power purchasing capability
**CO₂ emissions**

- Coal plants responsible for over half of GHG emissions
- Sample average was 1.08 tCO₂/MWh; 45% higher than the global best; 14% higher than Chinese average
- Improving efficiency key to cutting GHG

<table>
<thead>
<tr>
<th>Specific CO₂ emission (tCO₂/MWh)</th>
<th>India (Study average)</th>
<th>USA</th>
<th>Germany</th>
<th>Japan</th>
<th>China</th>
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<tbody>
<tr>
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Resource use - land

- Average around 2 acres/MW, CEA’s latest guidelines suggest 1.09 acre/MW; Worst performer: Mahagenco Chandrapur uses 10.8 acres/MW
- Over 40% was used for ash disposal
- Old state-owned plants posses nearly 4 times more land per MW than new private plants
Resource use - water

- Inefficient water users; global best 1.6 m³/MWh
- Annual water draw (around 22 BCM), is over half of India’s total domestic water needs
- Two thirds of the plants located in water stress areas
Not paying for water

Range – 10 paisa/m³ to Rs 20/m³; Rajasthan charges only 70 paisa/m³
Tariff impacts use
Waste water

- Power plants can easily be a zero-liquid-discharge; less than a third were even recycling.

- 20 plants were discharging ash slurry into water bodies, a serious violation

- Effluent samples taken by CSE show 39 percent violated total suspended solid norm
Second largest solid waste stream of the country.
Average utilisation during 2010-13 was only 53 per cent for plants in study. However, one-third of this was not beneficial.
Three fourths not meeting 2013 target
Unused ash dumped in poorly maintained ponds (around 80% non compliance – lining, leakage, piezometers)
Air Pollution - PM

- National PM emission norms lax (150-350 mg/Nm³), China: 30 mg/Nm³.
- More than half violating, of which 85 per cent were state plants
- No national NOₓ, SO₂, and Hg standards
- Ambient Air Quality – only 7 monitor continuously
Show cause notices – but enforcement is poor
PCBs noted violations but unable to act – power needs
Summary

✓ 2 years of rigorous assessment
✓ 60 key parameters were selected - technology, process performance, efficiency, pollution, compliance, management systems etc.
✓ With hope that this will drive the power sector towards better social and environmental practices