Trends in Emissions from Energy Sector

Date: September 28, 2017
Venue: New Delhi
Sectoral Break-up & Approach

- Key Sub-sectors in ENERGY
  - Electricity Generation
  - Transport
  - Other sectors
  - Fugitive Emissions from Fuel Production

- Tier 1: Default (Fuel based)
  - Quantity of fuel
  - Global Average emission factors
  - Emissions from combustion

- Tier 2: Country – Specific (Fuel Based)
  - Quantity of fuel
  - Country – specific emission factors
  - Emissions from combustion

- GHGs accounted for:
  - Carbon Dioxide (CO₂)
  - Methane (CH₄)
  - Nitrous Oxide (N₂O)
Methodology

The basic equation used in for calculating the GHG emission is:

\[ \text{Emissions}_{\text{Gas}} = \sum \text{Category Activity data (AD)} \times \text{Emission Factor (EF)}_{\text{Gas}} \]

For example CO\(_2\) emissions are estimated as:

\[ \text{CO}_2 \text{ Emissions} = \text{Fuel consumption} \times \text{Net Calorific Value} \times \text{CO}_2 \text{ emission factor} \]

- Activity data sourced from various Ministry reports
- Emission Factors are default factors from IPCC guidelines and country-specific estimates.
- Other data sets include: Fuel calorific values and liquid and gaseous fuels, density assumptions
Trends in Energy Emissions

**CAGR**

**ENERGY: 5.96%**
- Electricity Gen: 6.58%
- Transport: 6.96%
- Others: 2.18%
- Fugitive Emissions: 1.05%
Fuel Use

Sector wise emissions based on fuel type

- **Solid Fuels**
  - Electricity Generation – 95.61%
  - Transport – 0.001%
  - Others – 23.98%
  - Fuel Production – 53.42%

- **Liquid Fuels**
  - Electricity Generation –1.14%
  - Transport – 90.39%
  - Others – 44.21%
  - Fuel Production – 0.79%

- **Gaseous Fuels**
  - Electricity Generation – 3.25%
  - Transport – 9.60%
  - Others – 31.80%
  - Fuel Production – 45.79%
Electricity Generation

CAGR
Electricity Gen: 6.58%
PEG: 6.2%
Captive: 9.1%

12 states contributed to 90% of the emissions from PEG in 2013
**Transport**

**CAGR**
- Transport: 6.96%
  - Road: 9.23%
  - Railways: 4.63%
  - Aviation: 7.46%
  - Navigation: 1.24%

**Modal Share in 2013:** Road (87%), Railways (4%), Aviation (8%) and Navigation (1%)

<table>
<thead>
<tr>
<th>Sub sector</th>
<th>States</th>
</tr>
</thead>
<tbody>
<tr>
<td>Road</td>
<td>Maharashtra, Tamil Nadu, Andhra Pradesh</td>
</tr>
<tr>
<td>Railways</td>
<td>Uttar Pradesh, Karnataka, Rajasthan</td>
</tr>
<tr>
<td>Aviation</td>
<td>Delhi, Maharashtra, Tamil Nadu</td>
</tr>
<tr>
<td>Navigation</td>
<td>Maharashtra, Kerala, Gujarat</td>
</tr>
</tbody>
</table>
Residential, Commercial, Fisheries & Agriculture

CAGR
Other: 2.18%
Residential: 1%
Commercial: 9%
Agriculture: 8%
Fisheries: 5%

Sub sector | States
-----------|------------------
Residential | West Bengal, Uttar Pradesh, Maharashtra
Commercial   | Maharashtra, Uttar Pradesh, Tamil Nadu
Agriculture  | Uttar Pradesh, Punjab, Haryana
Fisheries    | Gujarat, Maharashtra, Tamil Nadu

Share in 2013: Residential (73%), Commercial (6%), Agriculture (18%) and Fisheries (3%)
Fugitive Emissions from Fuel Production

CAGR
Fugitive Emissions: 1.05%
Coal: 0.53%
Oil: 2.63%
Natural Gas: 2.64%

<table>
<thead>
<tr>
<th>Sub sector</th>
<th>States</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coal</td>
<td>Chhattisgarh, Andhra Pradesh, West Bengal, Maharashtra, Jharkhand</td>
</tr>
<tr>
<td>Oil</td>
<td>Maharashtra, Rajasthan, Gujarat</td>
</tr>
<tr>
<td>Natural Gas</td>
<td>Maharashtra, Andhra Pradesh, Gujarat, Assam</td>
</tr>
</tbody>
</table>
Comparison with Official Inventory

<table>
<thead>
<tr>
<th>Emissions (MtCO$_2$e)</th>
<th>INCCA 2007</th>
<th>CSTEP 2007</th>
<th>% Deviation</th>
<th>BUR 2010</th>
<th>CSTEP 2010</th>
<th>% Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electricity Generation</td>
<td>719</td>
<td>758</td>
<td>5%</td>
<td>820</td>
<td>913</td>
<td>11%</td>
</tr>
<tr>
<td>Transport</td>
<td>142</td>
<td>138</td>
<td>-3%</td>
<td>188</td>
<td>190</td>
<td>1%</td>
</tr>
<tr>
<td>Others</td>
<td>173</td>
<td>131</td>
<td>-24%</td>
<td>92</td>
<td>138</td>
<td>50%</td>
</tr>
<tr>
<td>Fugitive</td>
<td>32</td>
<td>36</td>
<td>13%</td>
<td>49</td>
<td>47</td>
<td>-4%</td>
</tr>
<tr>
<td>TOTAL</td>
<td>1066</td>
<td>1063</td>
<td>-0.28%</td>
<td>1149</td>
<td>1288</td>
<td>12%</td>
</tr>
</tbody>
</table>

**Deviations**
- Fiscal Year to Calendar Year
- Data Gaps in Activity data
- Inclusion of DG sets
- Inclusion of Captive Power Generation
- Rounding off Error
- Lack of disaggregated data based on coal mining
Assumptions

- **Electricity Generation**
  - Data for the Financial Year (FY) 2011-12 interpolated
  - Heat rates in captive plants taken to be 5% higher than utilities for each fuel type
  - Fuel properties for HHS not available, properties for LSHS used

- **Transport**
  - Petrol & Diesel demand from PPAC
  - Average zone share for HSDO consumption in road for select states
  - Linear Interpolation for missing years

- **Others**
  - Linear interpolation applied to calculate the number of Diesel Generator (DG) sets and fuel consumed in DG sets
  - DG sets of capacities <75 kW in residential sector
  - DG sets of capacities between 75 to 800 kW in commercial sector

- **Fugitive Emissions**
  - Degree of Gassiness in UG Mines (Deg I, II and III at 33.33%)
  - Proxy variable’s Performance applied to relevant variables
  - Leakage rate assumed as 1.65% of NG production