



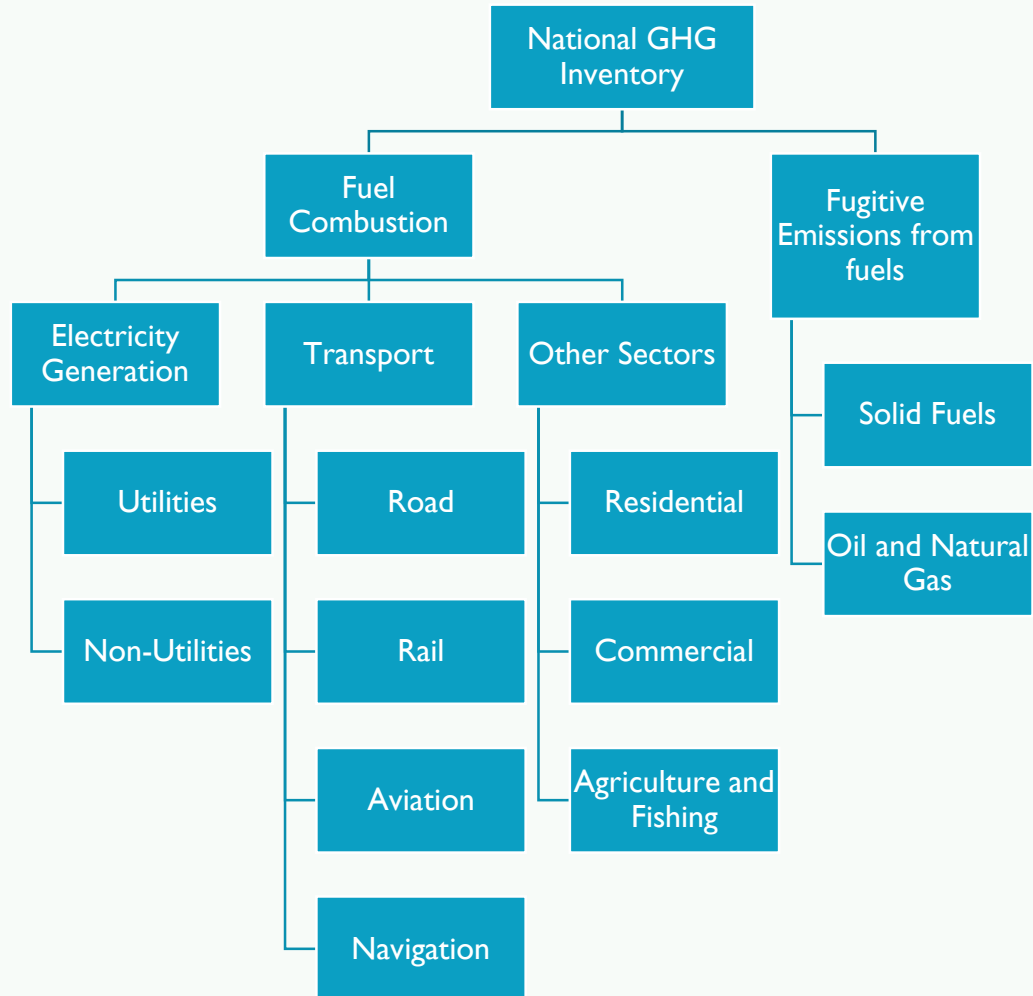
## Trends in Emissions from Energy Sector

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 (CO<sub>2</sub>)
  - Methane (CH<sub>4</sub>)
  - Nitrous Oxide (N<sub>2</sub>O)



# Methodology

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

$$\text{Emissions}_{\text{Gas}} = \sum \text{Category Activity data (AD)} * \text{Emission Factor (EF)}_{\text{Gas}}$$

For example CO<sub>2</sub> emissions are estimated as:

$$\text{CO}_2 \text{ Emissions} = \text{Fuel consumption} * \text{Net Calorific Value} * \text{CO}_2 \text{ emission factor}$$

- 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%*

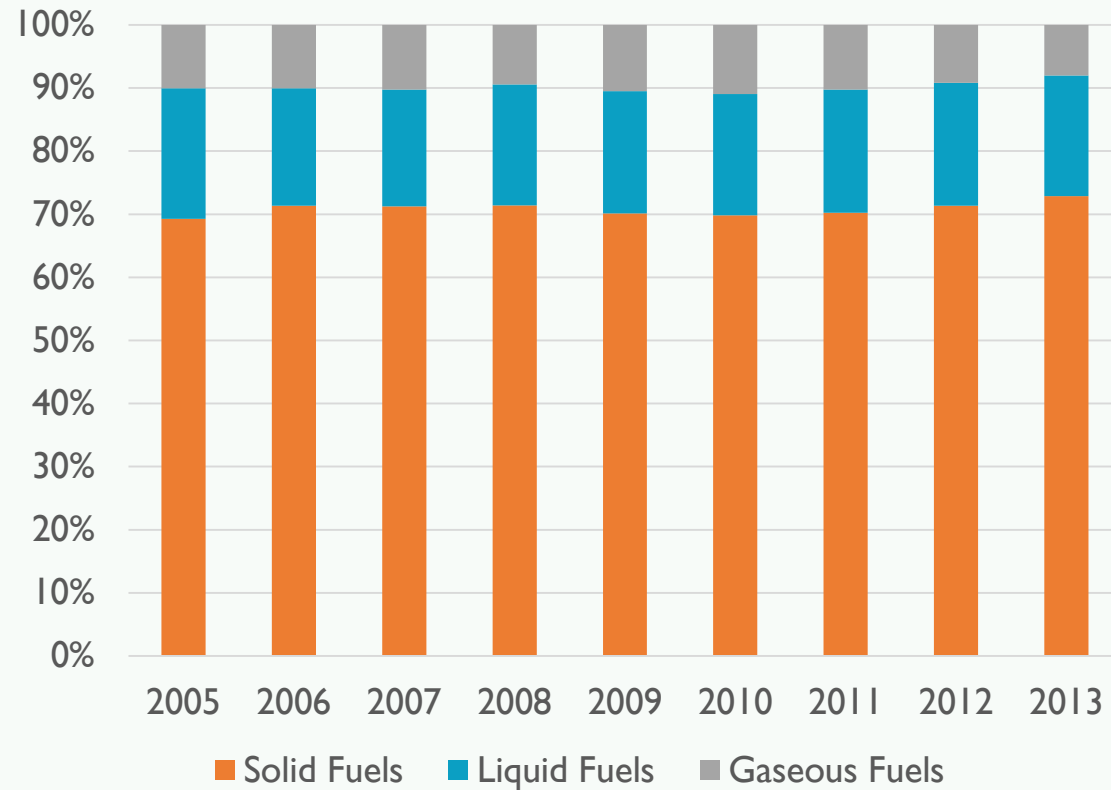
*Transport: 6.96%*

*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

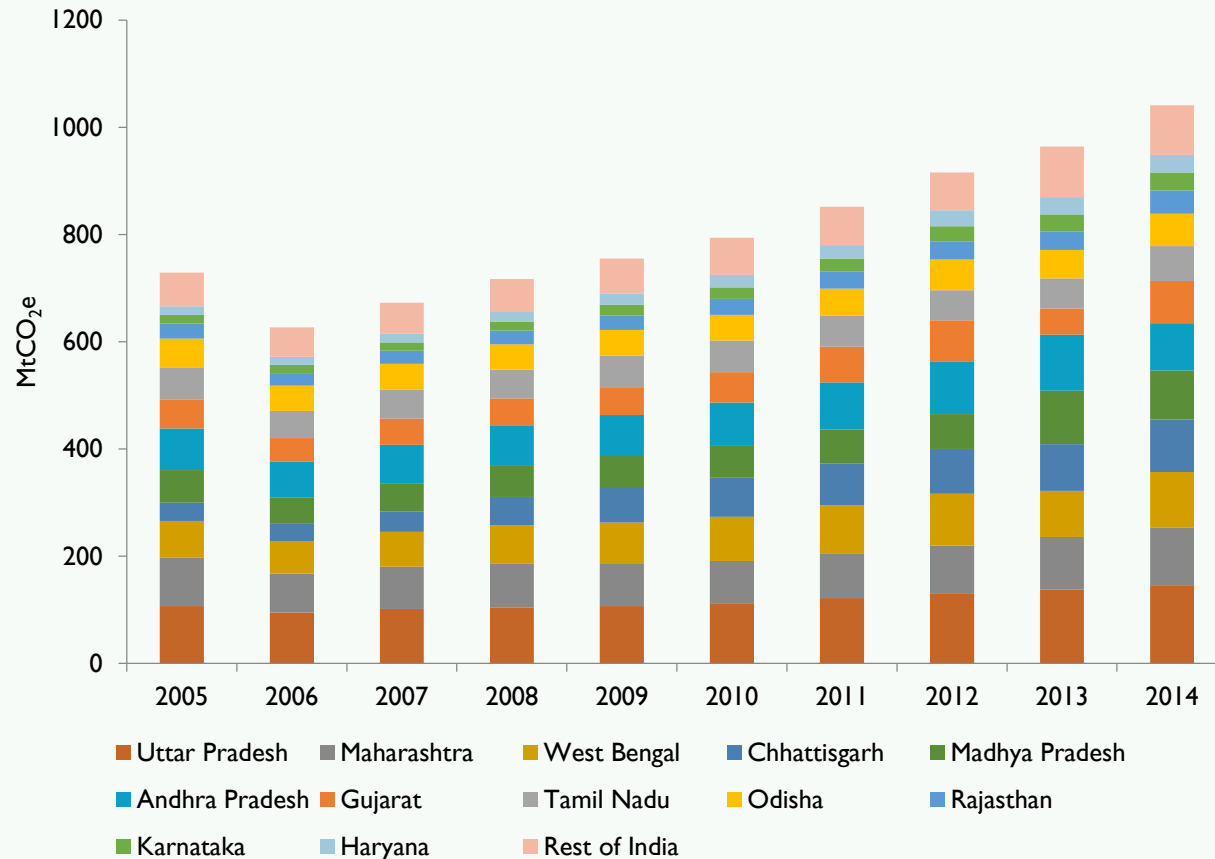
- Electricity Generation – 1.14%
- Transport – 90.39%
- Others – 44.21%
- Fuel Production – 0.79%

### • Gaseous Fuels

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



# Electricity Generation



## CAGR

**Electricity Gen: 6.58%**

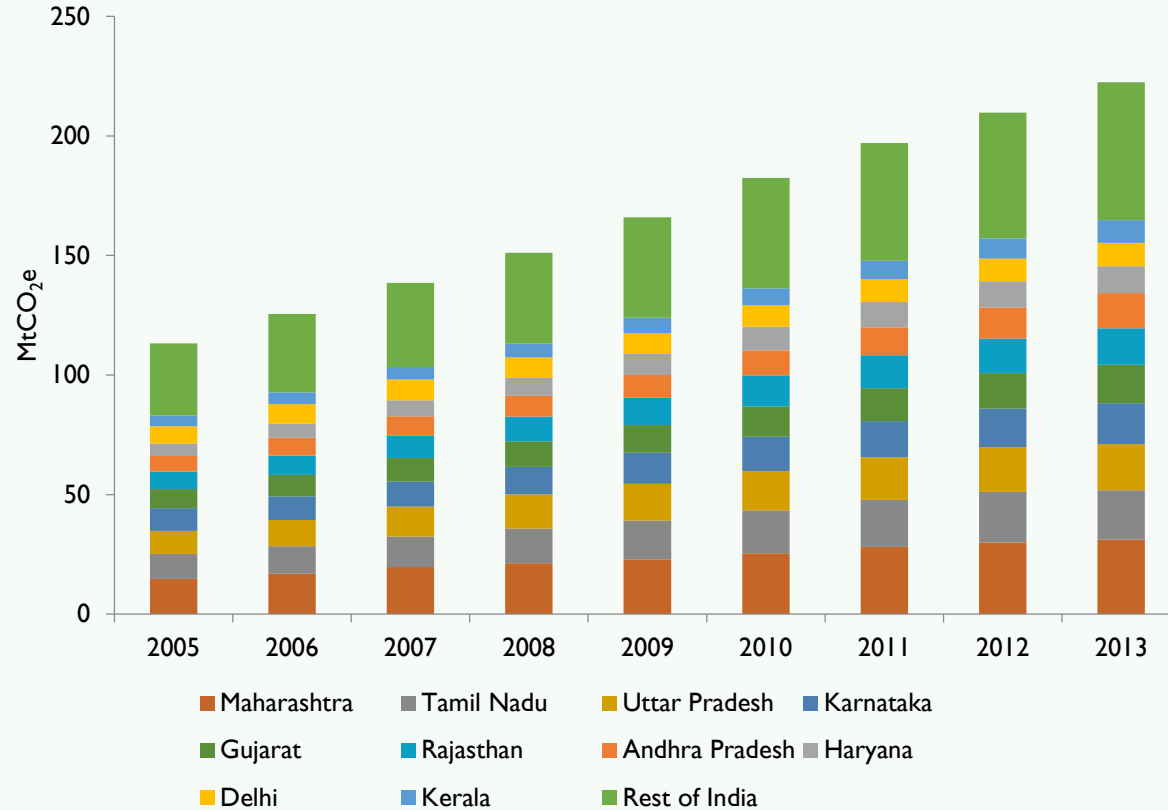
*PEG: 6.2%*

*Captive: 9.1%*

Sub sector	States
Public Electricity Generation	Uttar Pradesh, Maharashtra, Andhra Pradesh, Madhya Pradesh, Chhattisgarh
Captive Power Plants	Chhattisgarh, Gujarat, Karnataka, Odisha, Uttar Pradesh

*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%*

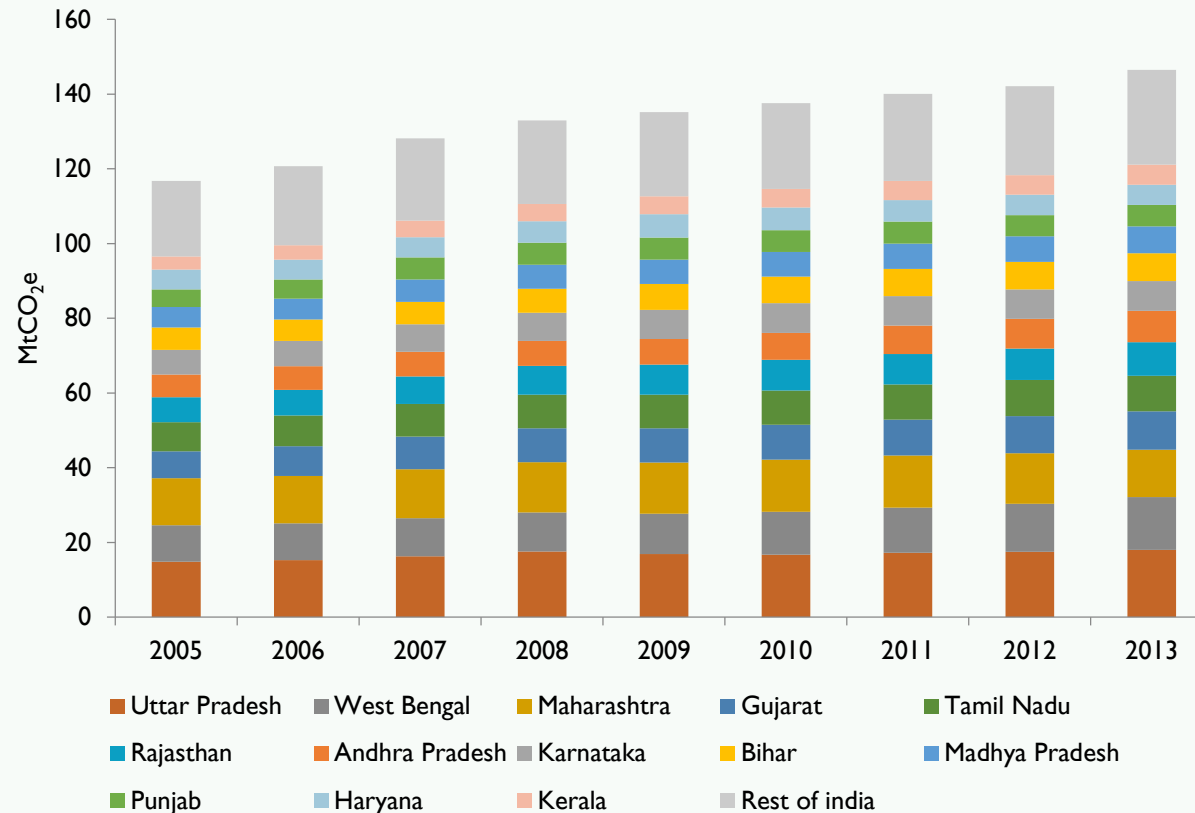
*Navigation: 1.24%*

Sub sector	States
Road	Maharashtra, Tamil Nadu, Andhra Pradesh
Railways	Uttar Pradesh, Karnataka, Rajasthan
Aviation	Delhi, Maharashtra, Tamil Nadu
Navigation	Maharashtra, Kerala, Gujarat

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



# Residential, Commercial, Fisheries & Agriculture



## CAGR

**Other: 2.18%**

*Residential: 1%*

*Commercial: 9%*

*Agriculture: 8%*

*Fisheries: 5%*

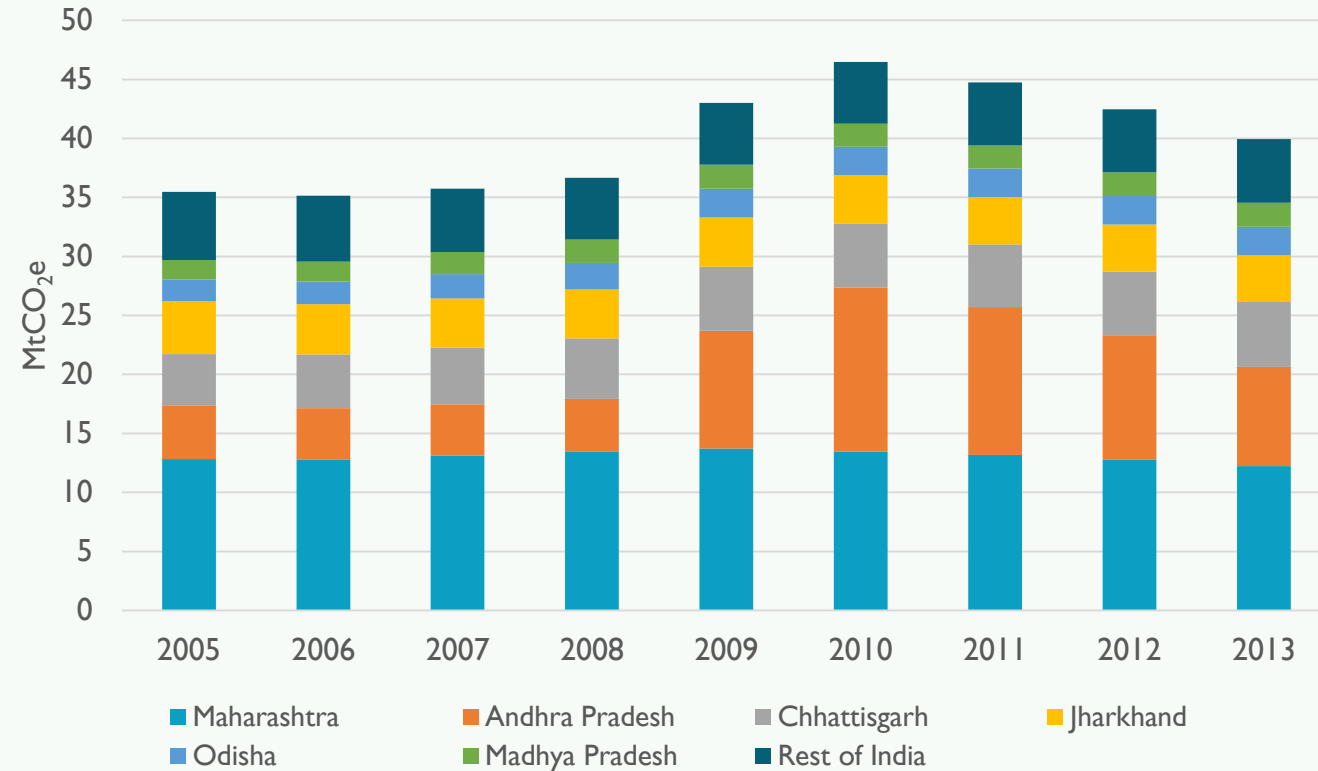
Sub sector	States
Residential	West Bengal, Uttar Pradesh, Maharashtra
Commercial	Maharashtra, Uttar Pradesh, Tamil Nadu
Agriculture	Uttar Pradesh, Punjab, Haryana
Fisheries	Gujarat, Maharashtra, Tamil Nadu

*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%*

Sub sector	States
Coal	Chhattisgarh, Andhra Pradesh, West Bengal, Maharashtra, Jharkhand
Oil	Maharashtra, Rajasthan, Gujarat
Natural Gas	Maharashtra, Andhra Pradesh, Gujarat, Assam



# Comparison with Official Inventory

Emissions (MtCO <sub>2</sub> e)	INCCA 2007	CSTEP 2007	% Deviation	BUR 2010	CSTEP 2010	% Deviation
Electricity Generation	719	758	5%	820	913	11%
Transport	142	138	-3%	188	190	1%
Others	173	131	-24%	92	138	50%
Fugitive	32	36	13%	49	47	-4%
<b>TOTAL</b>	<b>1066</b>	<b>1063</b>	<b>-0.28%</b>	<b>1149</b>	<b>1288</b>	<b>12%</b>

## **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



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