

# **Preparing GHG Inventory for Energy Sector**

## **An Overview**

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# Content

- Trends of consumption of fossil fuel
- CO<sub>2</sub> Emissions – Emerging trends by top down approach
- Categories included in Sectoral/ bottom up approach
- CO<sub>2</sub> emissions – Emerging trends by Sector
- Developing Country specific emission factors
- Future directions for reducing uncertainties in estimates
- Institutions involved in these activities

# Categories included

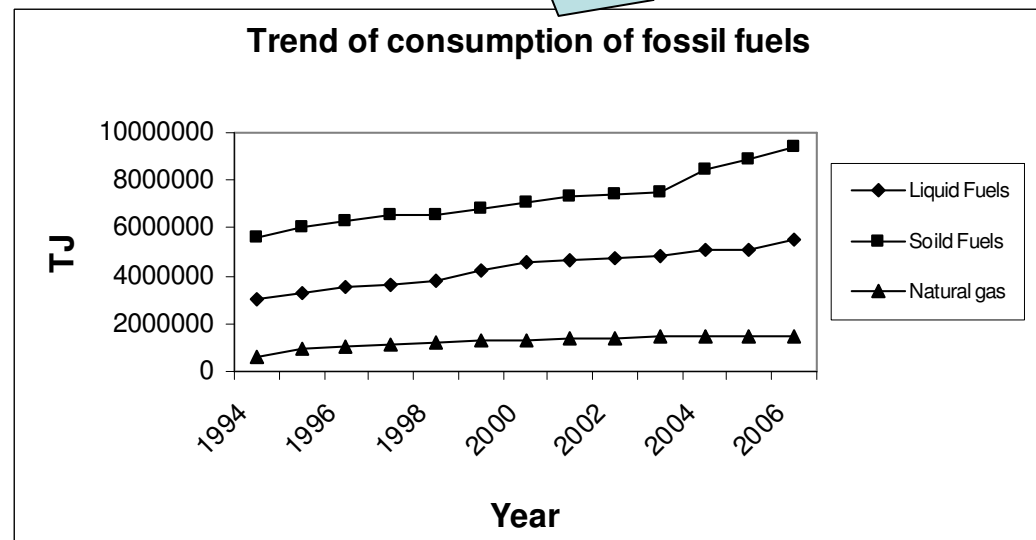
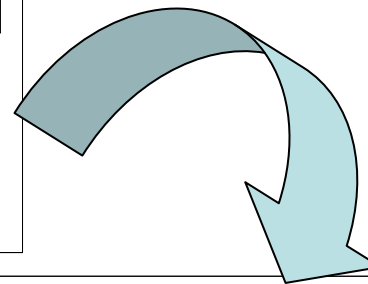
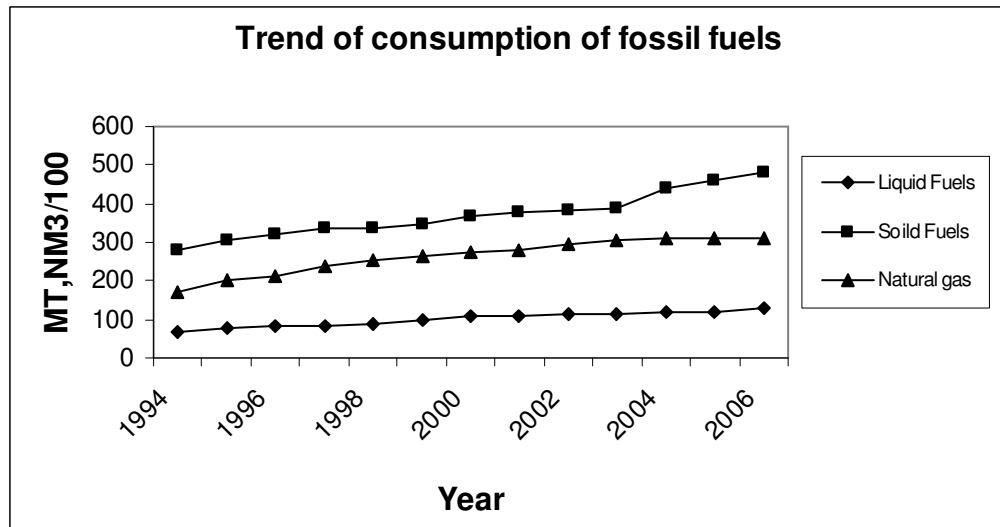
## GHG emissions from combustion of fossil fuel

- **Energy Industries**  
(electricity, petroleum refining, manufacturing of solid fuels)
- **Manufacturing Industries**  
(Iron & steel, non-ferrous metals, chemicals, pulp& paper, food processing, non-metallic minerals, mining & quarrying, construction, textile/leather, others)
- **Transport** (Civil aviation, Road, Rail, Water borne navigation)
- **Other Sectors** (Commercial, institutional, residential, agriculture, forestry, fishing)

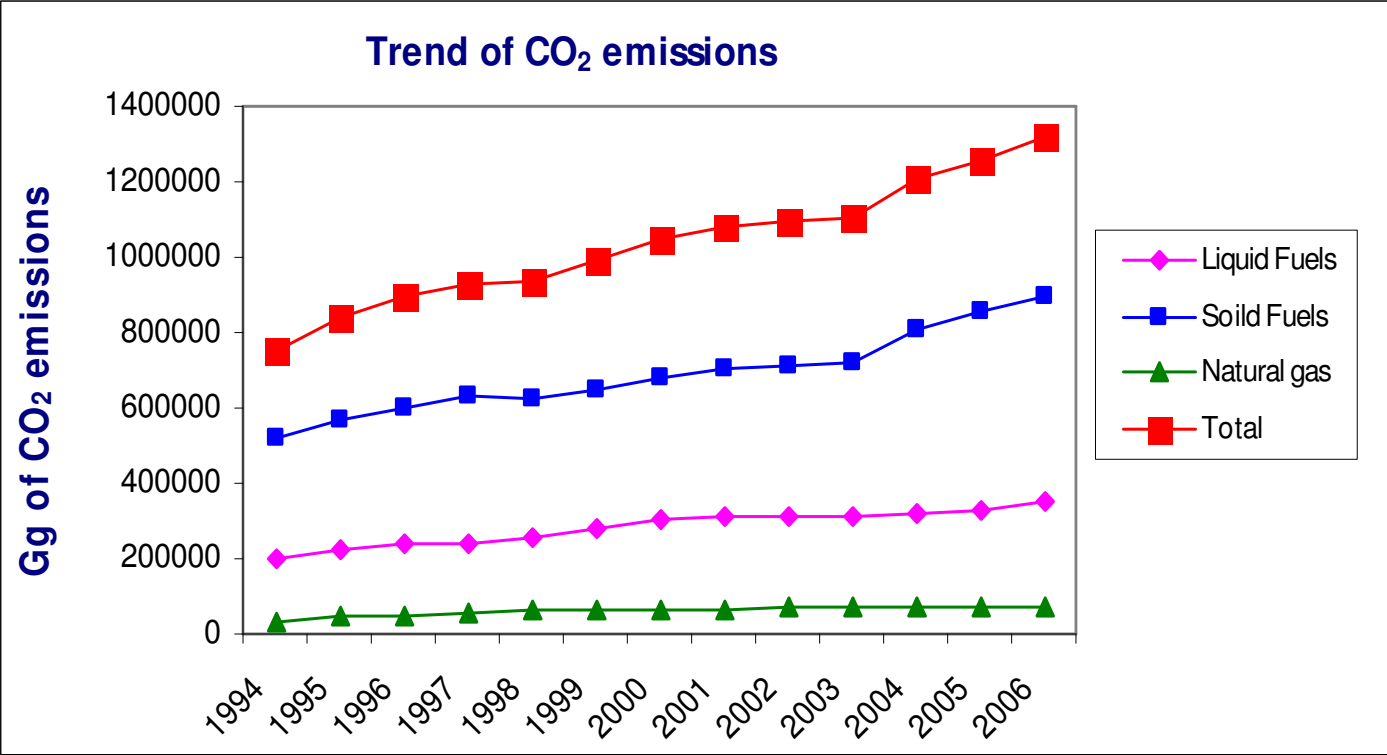
## Fugitive emissions

(solid fuel, oil & natural gas)

# Trends of Consumption of fossil fuel



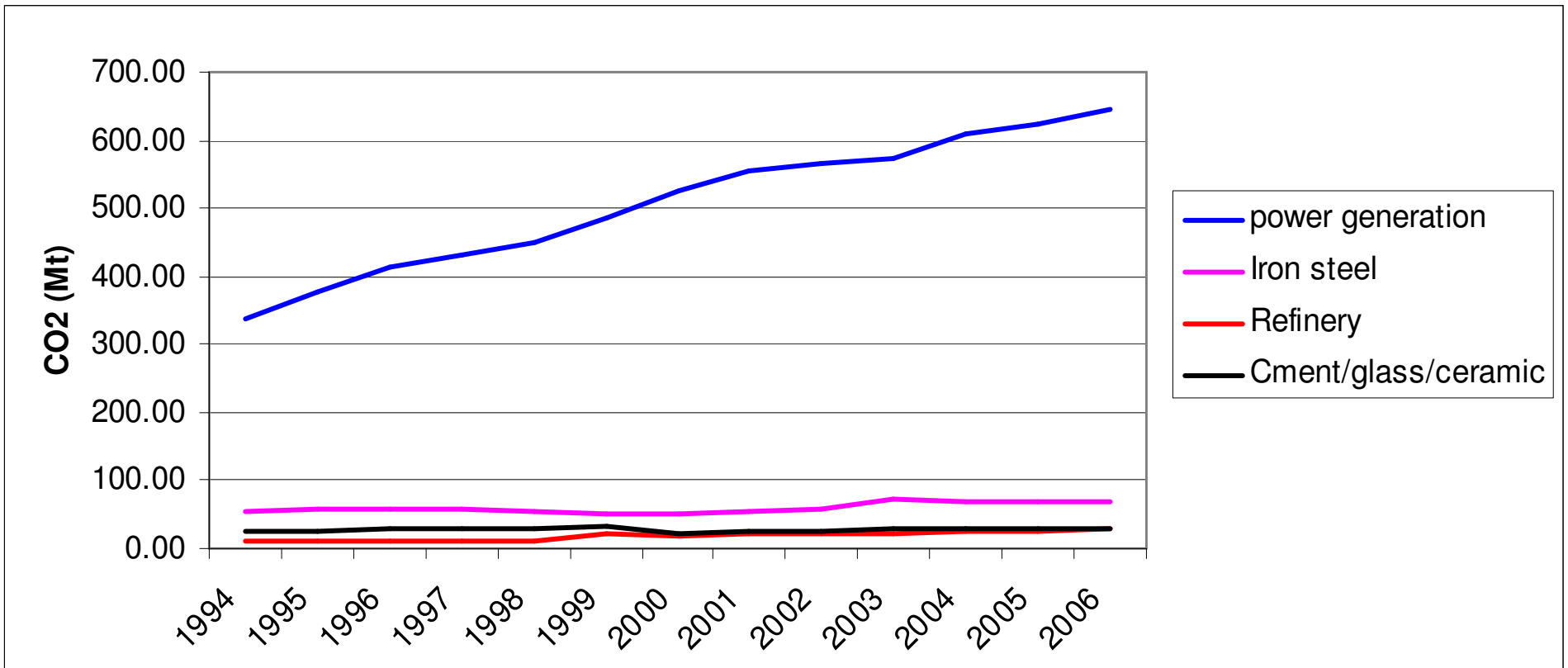
# CO2 emission : Emerging trends (top down)



**Compounded annual growth rate is 4.8%**

# CO2 emission: Emerging trends

## Some key Energy and Manufacturing industries



Power: 5.6%

Refinery: 9%

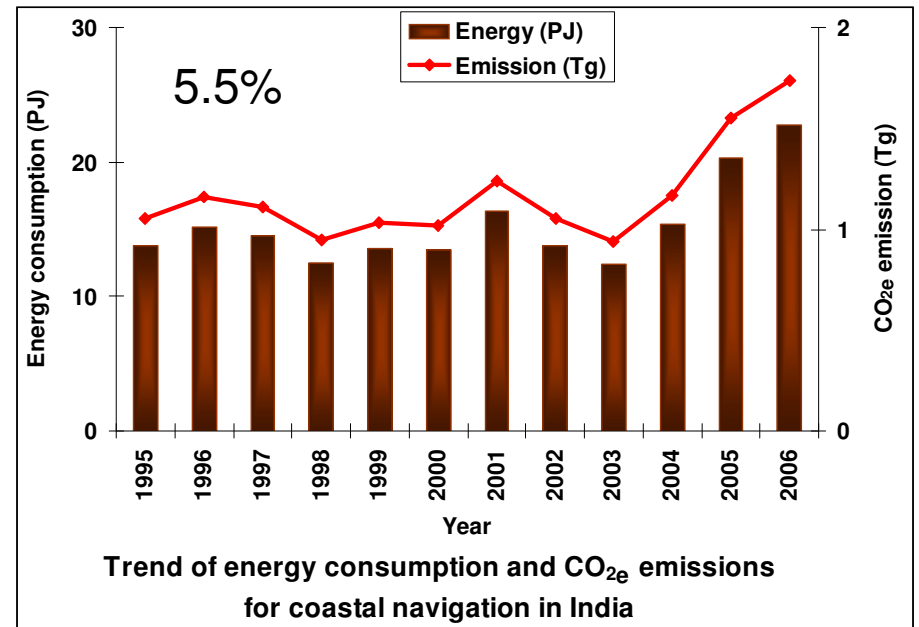
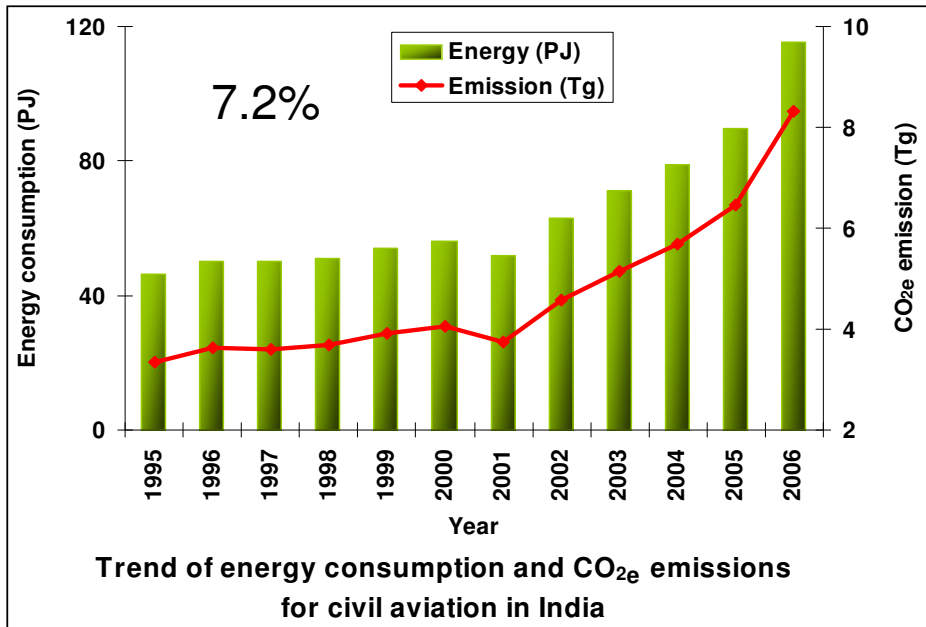
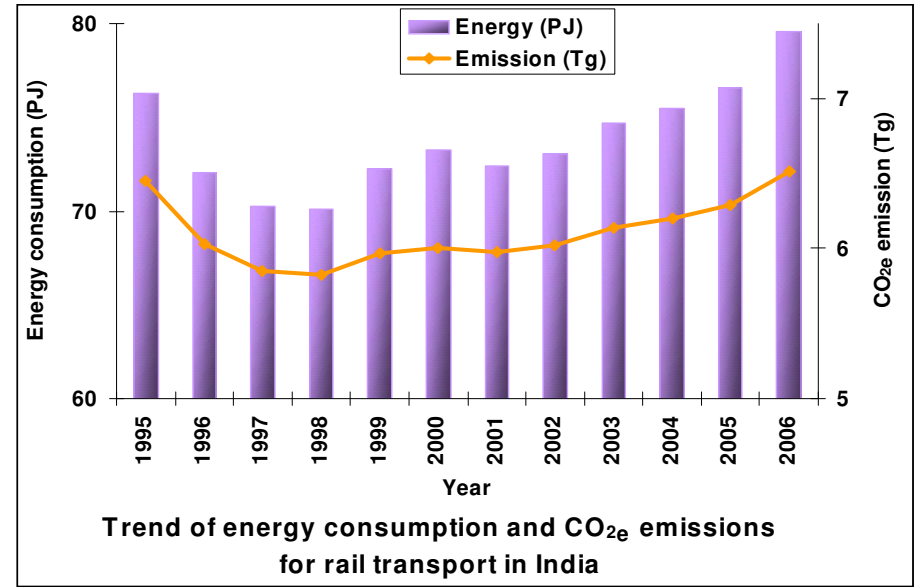
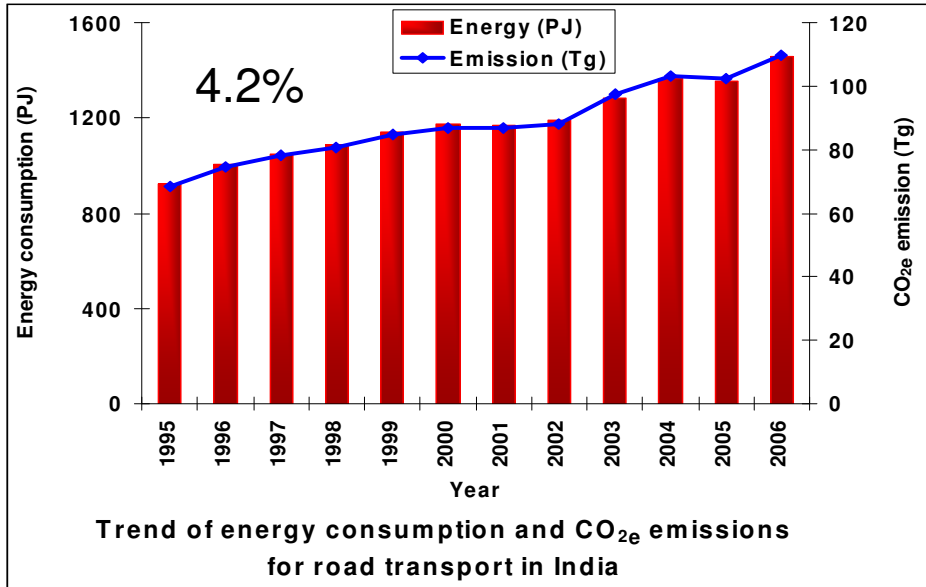
Iron & steel 1.8%

Cement/glass/ceramics 1.2%

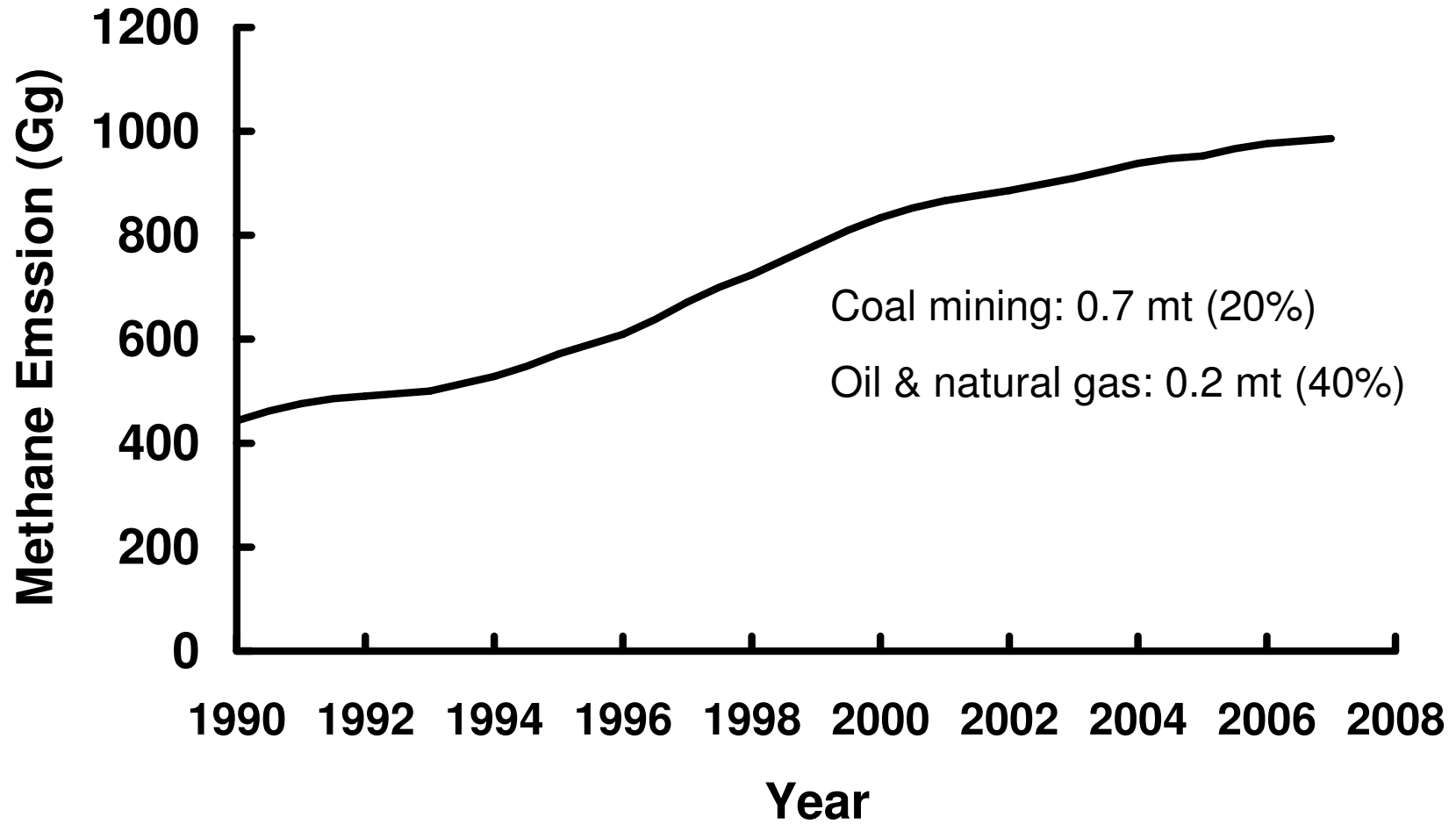
Av: 4.4%

# Transport

80 mt in 1995 to 110 mt in 2006 (4.2%)



# Fugitive emissions Oil & Natural Gas



**CAGR (1994-2006): 5.2%:**



# Developing Country Specific Emission factors

- NCV & CEF of different coal types

Reason & rationale : changing over the years

- Estimation of plant specific emission factors of CO<sub>2</sub>, SO<sub>x</sub>, NO<sub>x</sub> from the coal based thermal power plants by stack measurement and input-output material balance
- Estimation of CO<sub>2</sub> emission factors in Integrated Steel Plants - Pig iron production, Crude steel production, Crude steel production, Sinter production, Calcined lime production for BOF use, t/ t of calcined lime

Reason and Rationale : Plants specific EFs reduce uncertainty in emission estimates

- CO<sub>2</sub>, CO, NO<sub>x</sub>, CH<sub>4</sub> emm factors for different types of vehicles using diesel and gasoline

## NCV & CEF for non coking Coals

Grade	Mean NCV	Mean CEF	Production (MT) Year		
			1994	2000	2006
A	25.63	25.70	2.974	3.548	4.958
B	23.92	25.81	21.417	20.694	20.815
C	22.37	25.78	46.742	51.728	53.059
D	20.34	26.06	33.853	37.067	42.439
E	18.26	26.28	41.603	62.708	98.079
F	15.87	26.51	63.771	101.824	165.673
G	13.70	26.82	0.358	0.458	7.733
Estimated		NCV(TJ/kt)	19.63	19.08	18.45
		CEF(tC/TJ)	26.13	26.20	26.27

**IPCC Default Values**

**NCV = 18.9-25.8;**

**CEF= 25.8-26.2**

## NCV & CEF of coking Coals

Grade	Mean NCV	Mean CEF	Production (MT)		
			Year		
			1994	2000	2006
Steel Gr. I	28.83	25.39	0.388	0.195	0.127
Steel Gr. II	28.13	25.40	1.267	0.675	0.559
Washery Gr. I	27.09	25.45	2.2960	1.0350	0.2910
Washery Gr. II	26.08	25.49	4.487	3.374	3.171
Washery Gr. III	24.73	25.53	10.491	6.889	6.737
Washery Gr. IV	22.95	25.56	22.770	18.507	20.999
Semi coking Gr. I	26.39	25.71	0.271	0.215	0.182
Estimated		NCV(TJ/kt)	24.18	24.00	23.80
		CEF(tC/TJ)	25.53	25.54	25.55

**IPCC Default Values NCV = 28.2; CEF= 25.8**

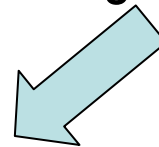
# Future directions

- Annual assessment of NCV & CEF as per the grades of different coal types used in each power plant & other industries
  - Can be done through regular sampling of the coal and the coal mix being used in each plant
- CO<sub>2</sub> estimations made as per Coal grade used has the potential to reduce the CO<sub>2</sub> emission from India
  - for this we need to have the grades of different coal types being fed to the industries

(~18% overall)

This is mainly because the trend is towards more and more non coking coal utilisation with lower NCVs in our industries

Coking coal:	9%
Non-coaking coal:	86%
Lignite:	5%



## Future directions

- Transport – can use the latest models available that generate GHG emission factors based on driving cycles, fuel utilisation and engine technologies

# **Institutes Undertaking these studies**

**Combustion of Fossil fuel related emissions**

**Central Institute of Mining and Fuel Research Institute**

**The Energy Resources Institute**

**Determination of NCV and CEF's by coal types**

**Central Institute of Mining and Fuel Research**

**Developing plant specific CO<sub>2</sub> Emission factors – power & Steel**

**Jadavpur University**

**Central Institute of Mining and Fuel Research**

**GHG emission estimates from transport sector**

**Central Road Research Institute**

**Co<sub>2</sub> emission coefficient from road transport sector**

**Indian Institute of Petroleum**

**CH<sub>4</sub> emission from fugitive emissions – coal minin & handling, Oil & natura gas**

**Central Institute of Mining and Fuel Research**

**Thank You**