UPDATE ON INDIA'S NATIONAL COMMUNICATION TO UNFCCC

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10th Workshop on GHG Inventories in Asia (WGIA10)
- Capacity building for measurability, reportability and verifiability
10-12 July 2012, Hanoi, Vietnam

THE STORY SO FAR

| Year of Publication	1992, 1997	1998	2004	2010	2012
Year of Reporting	1990	1990	1994	2007	1994 2000 2005 2007
Publication	Research Reports/pa pers GHG inventory & CH4 from rice	ALGAS India	NATCOM 1	INCCA Report- India: Greenhous e gas emissions 2007	NATCOM 2; and India-GHG emission Profile
Published by	Mitra et al., 1992 Parashar et al., 1992	ADB- MoEF	MoEF	MoEF	MoEF

India
Second National Communication to
the United Nations Framework Convention
on Climate Change

Ministry of Environment & Forests
Government of India
2012
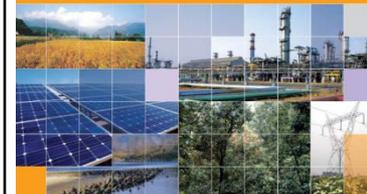
INDIA'S 2ND NATCOM- GHG EMISSIONS IN 2000

|	CO$_2$ emission (Gg)	CO$_2$ removal (Gg)	CH$_4$ (Gg)	N$_2$O (Gg)	HFC-134a (Gg)	HFC -23 (Gg)	CF$_4$ (Gg)	C$_2$F$_6$ (Gg)	SF$_6$ (Gg)	CO$_2$ # equivalent (Gg)
1. Energy	952,212.06		2,991.42	38.66						1,027,016.48
2. Industrial processes and product use	72,560.78		5.39	12.80	0.220	0.420	0.870	0.087	0.013	88,608.07
3.Agriculture			14,088.30	192.73						355,600.60
4. Waste			2,307.19	13.23						52,552.29
Total (excluding LULUCF)	**1,024,772.84**		**19,392.30**	**257.42**	**0.220**	**0.420**	**0.870**	**0.087**	**0.013**	**1,523,777.44**
Total (with LULUCF)		**236,257.43**	**552.38**	**6.74**						**1,301,209.39**
Memo items										
International bunkers	3,467.12		0.05	0.10						3,498.86
Aviation	3,194.12		0.02	0.089						3,222.13
Maritime/ navigation	273.00		0.03	0.010						276.73
CO$_2$ from biomass	376,005.00									376,005.00

Calculated using Global Warming Potential given in Box 2.1

CO$_2$ – carbon dioxide; CH$_4$ – methane; N$_2$O – nitrous oxide; HFC – hydrofluorocarbon; CF$_4$ – tetrafluoromethane; C$_2$F$_6$ – hexafluoroethane; SF$_6$ – sulphur hexafluoride

TOTAL CO$_2$ EQ EMISSION TRENDS INCLUDING LULUCF

CO$_2$ eq in Million tons
CAGR~ 2.9%
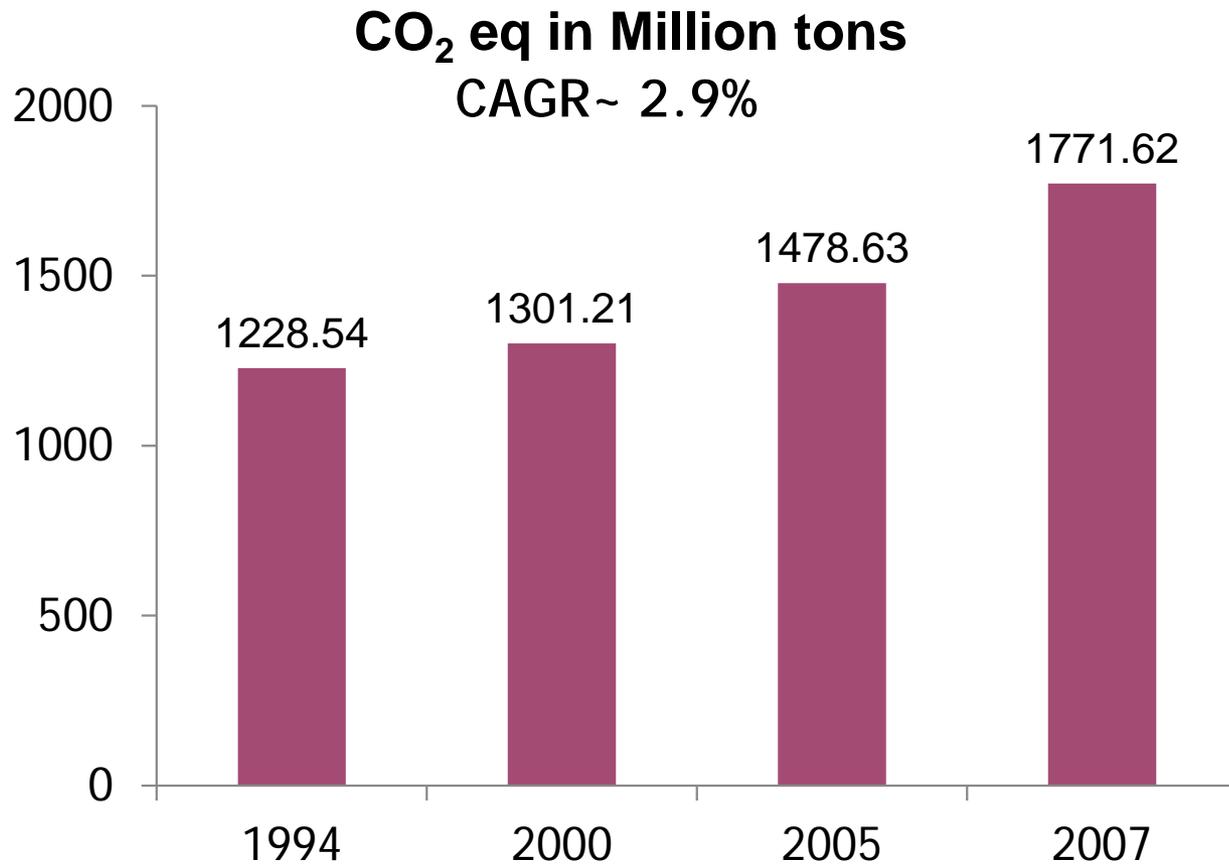
SECTORAL EMISSION TRENDS

1994

- IPPU 7%
- Waste 2%
- Agriculture 29%
- Energy 62%

2000

- IPPU 6%
- Waste 4%
- Agriculture 23%
- Energy 67%

2005

- IPPU 7%
- Waste 4%
- Agriculture 20%
- Energy 69%

2007

- IPPU 7%
- Waste 3%
- Agriculture 19%
- Energy 71%
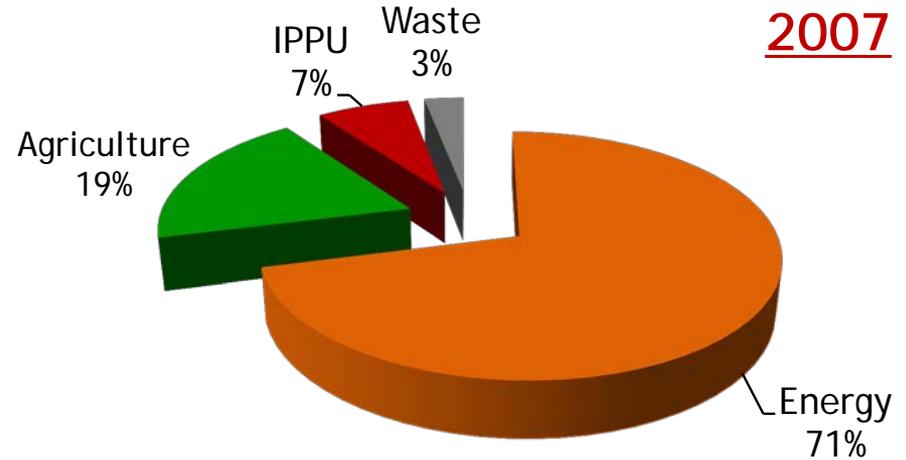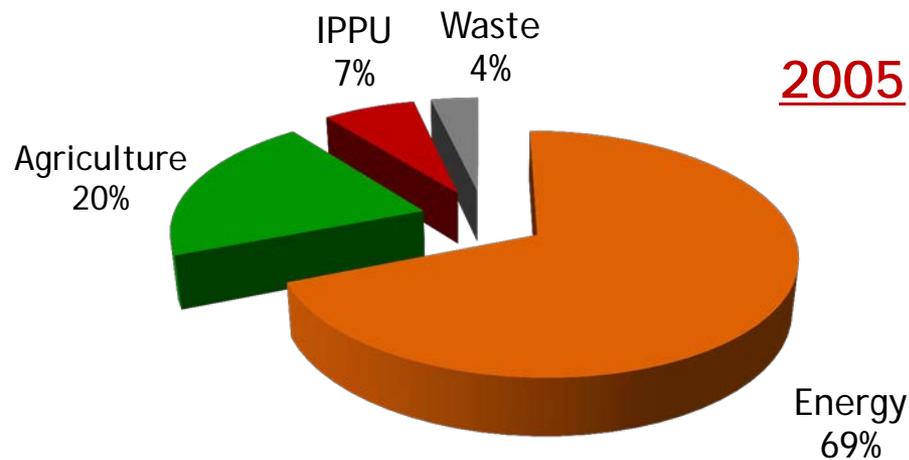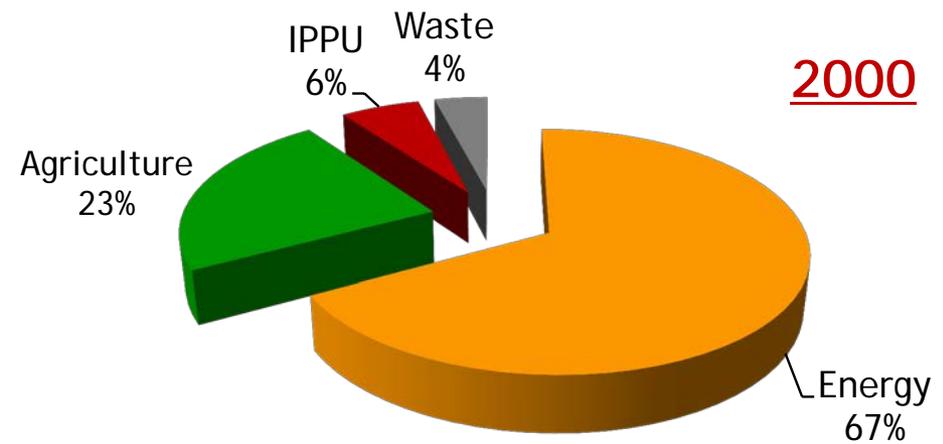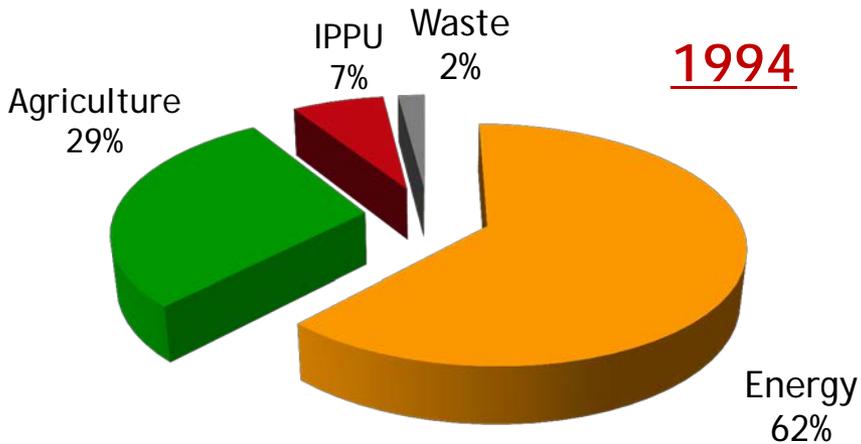
ENERGY SECTOR

CO2 eq emissions in Million tons
CAGR~ 4.4%

INDUSTRIAL PROCESSES

CO$_2$ eq emissions (million tons)
CAGR~ 4.8%

AGRICULTURE

CO$_2$ eq emissions (million tons)

CAGR~ 0.6%
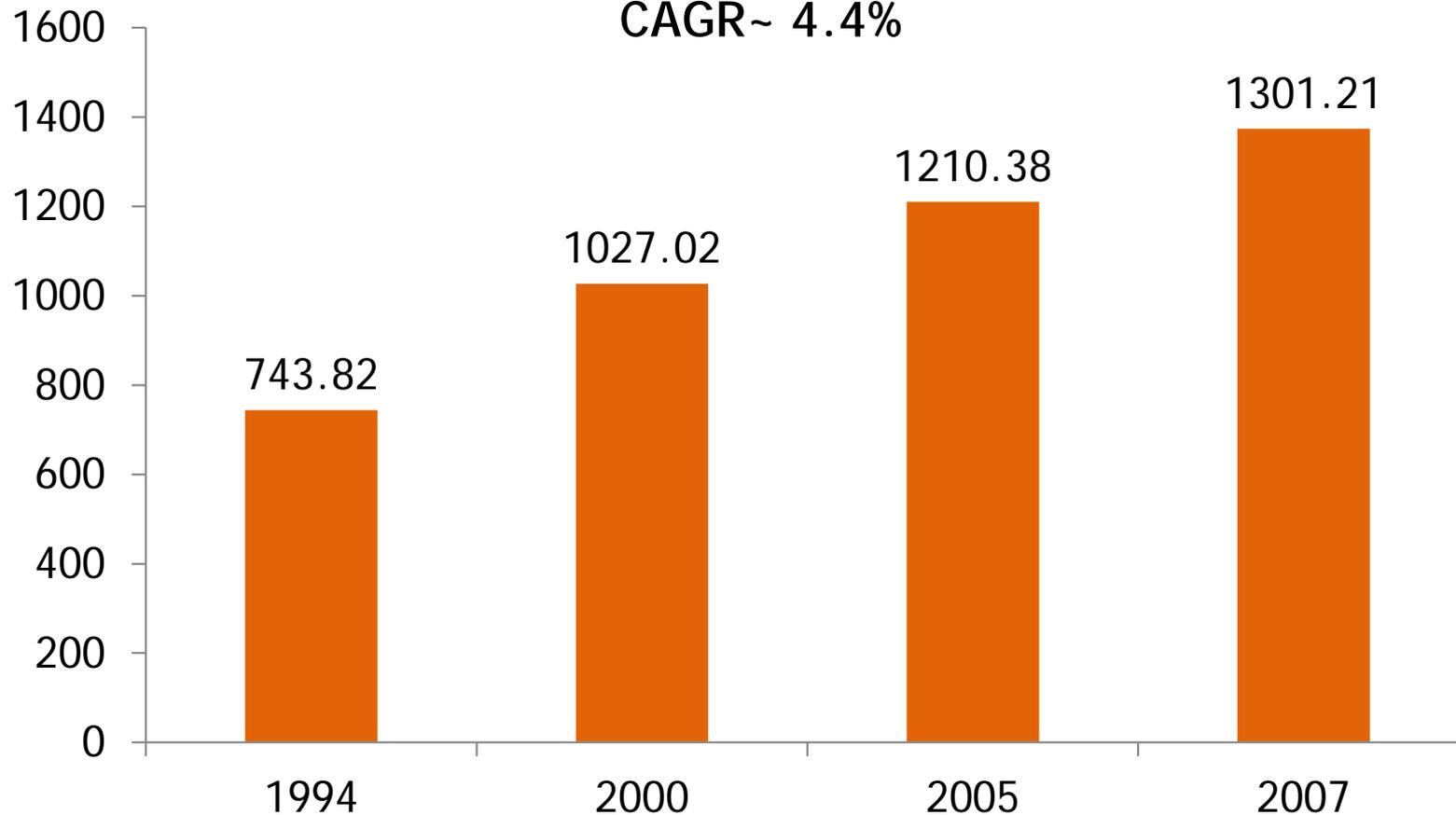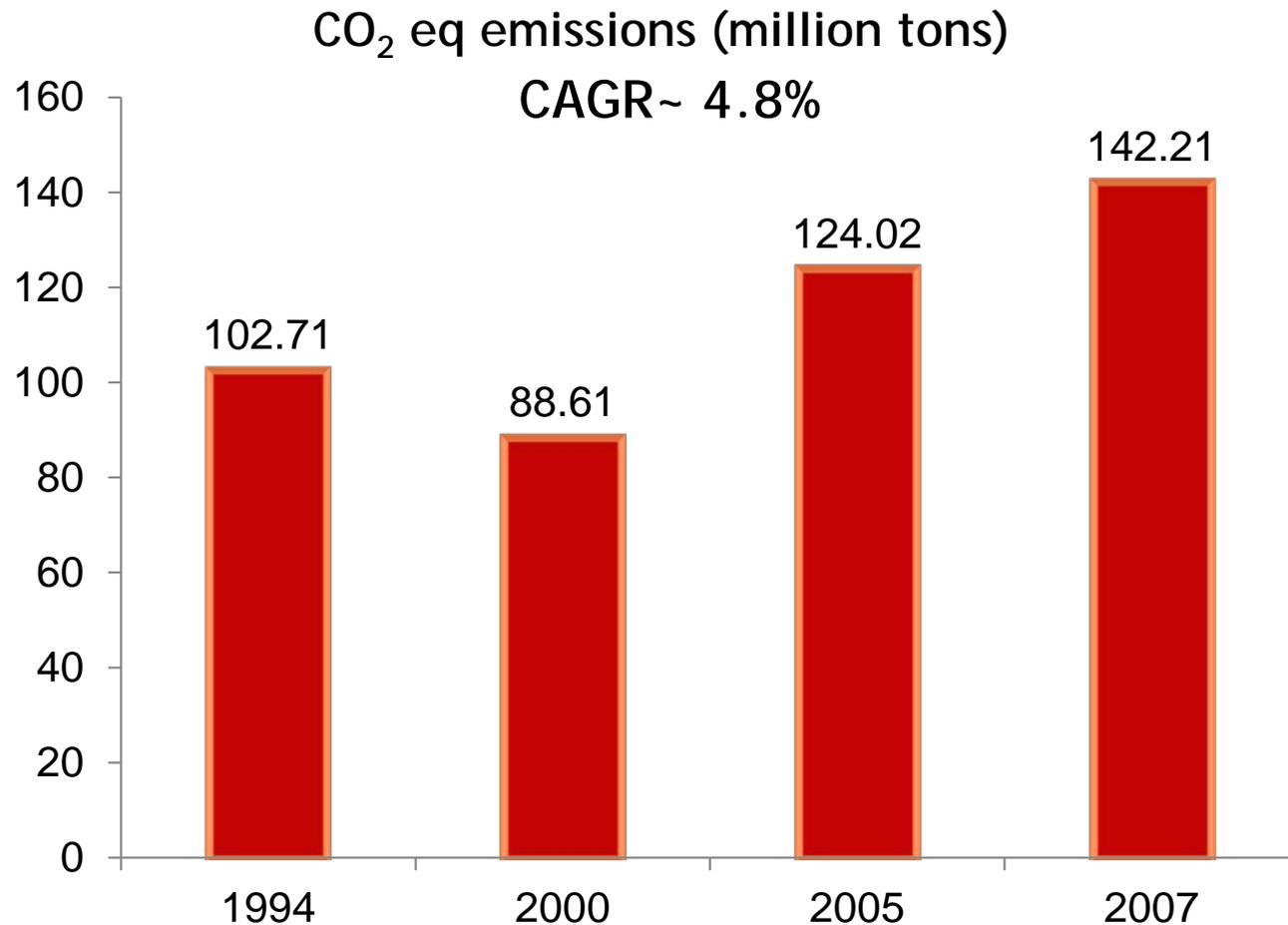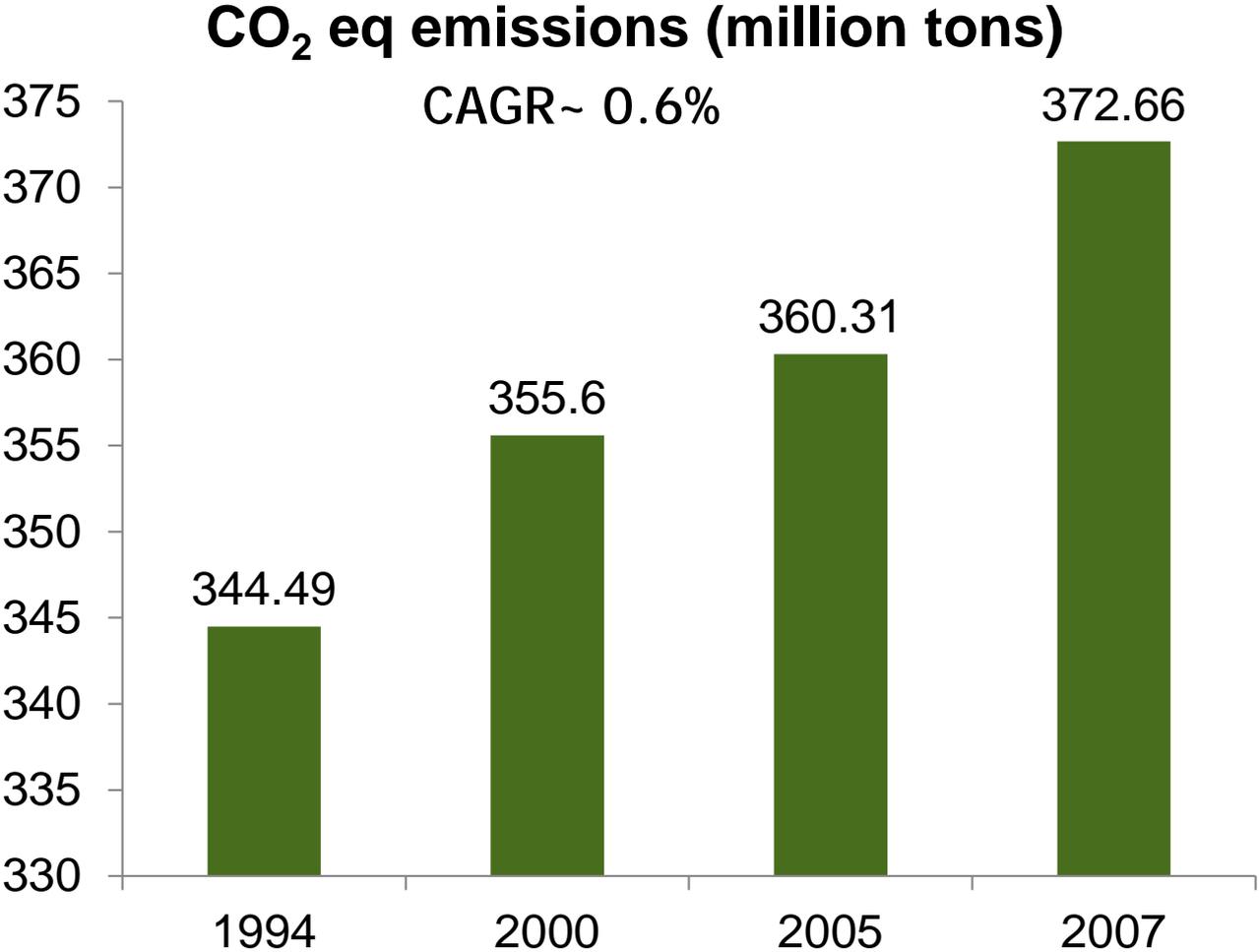
LAND USE LAND USE CHANGE AND FORESTRY

CO2 equivalent (million tons)

WASTE

CO2 eq emissions (million tons)
CAGR~ 7.2%

GAS BY GAS TRENDS

1994

N2O 5%

CH4 32%

CO2 63%

2000

N2O 5%

HFC+PFC +SF6 1%

CH4 26%

CO2 68%

2005

N2O 5%

HFC+PFC +SF6 1%

CH4 25%

CO2 69%

2007

N2O 5%

HFC+PFC s+SF6 2%

CH4 22%

CO2 71%
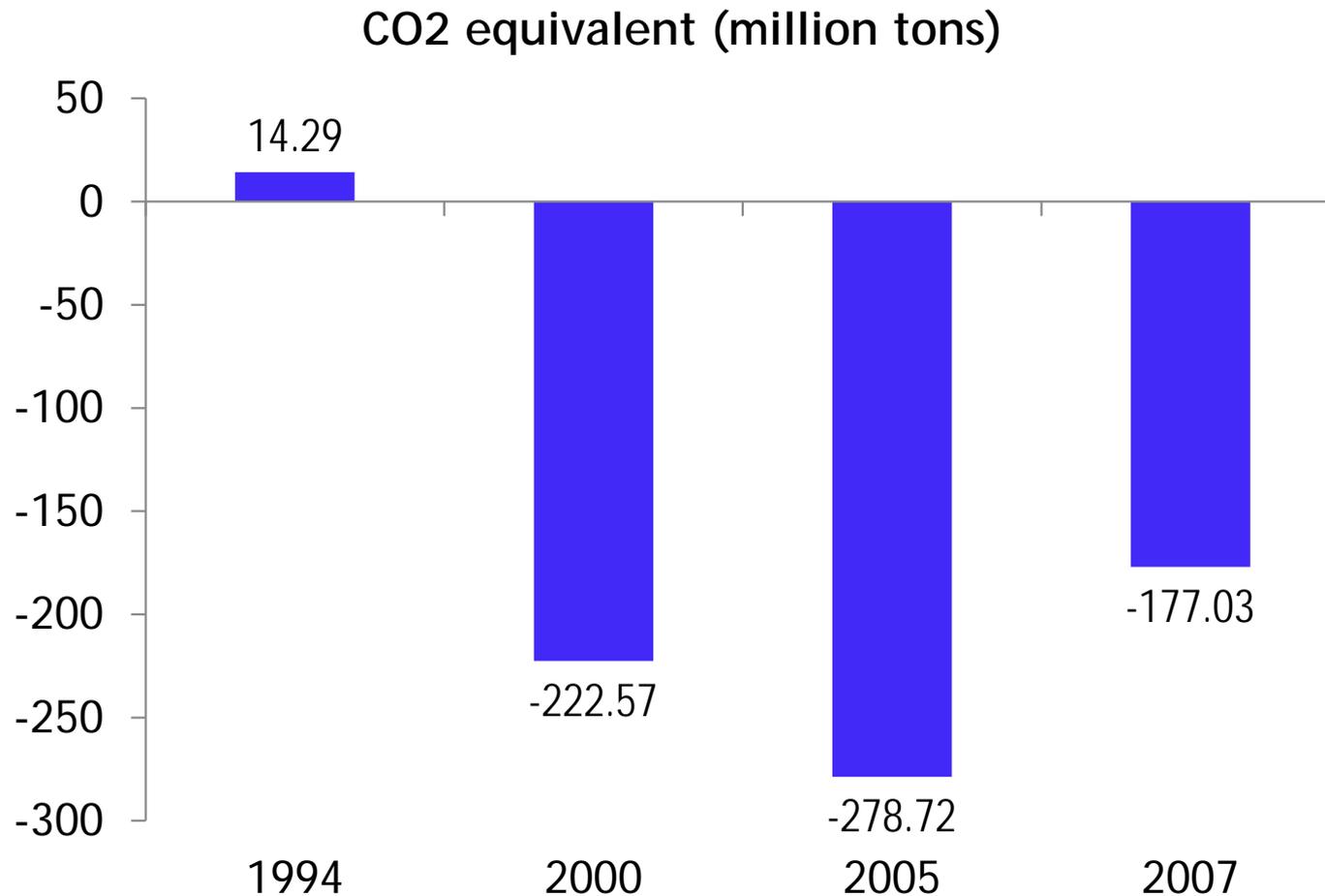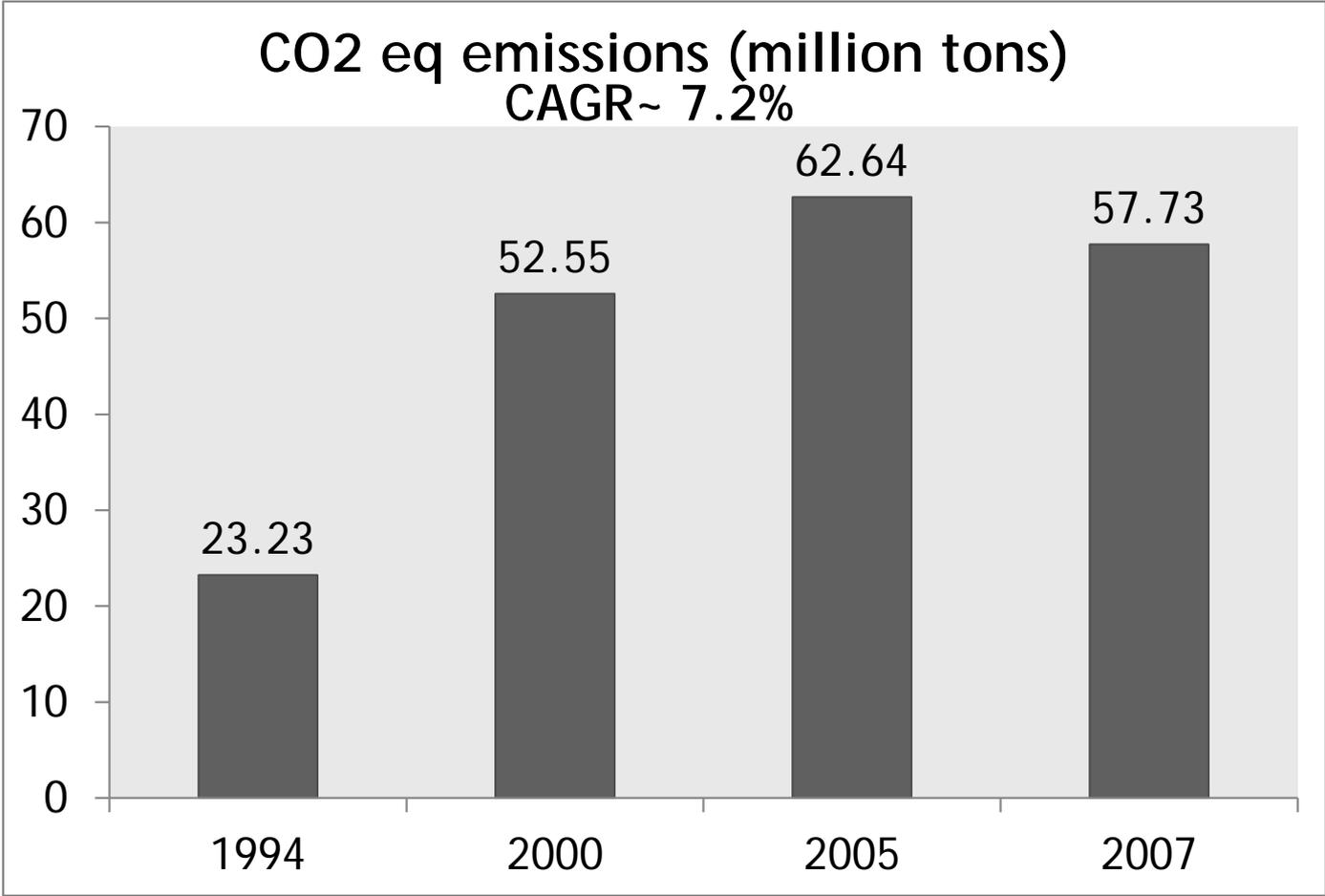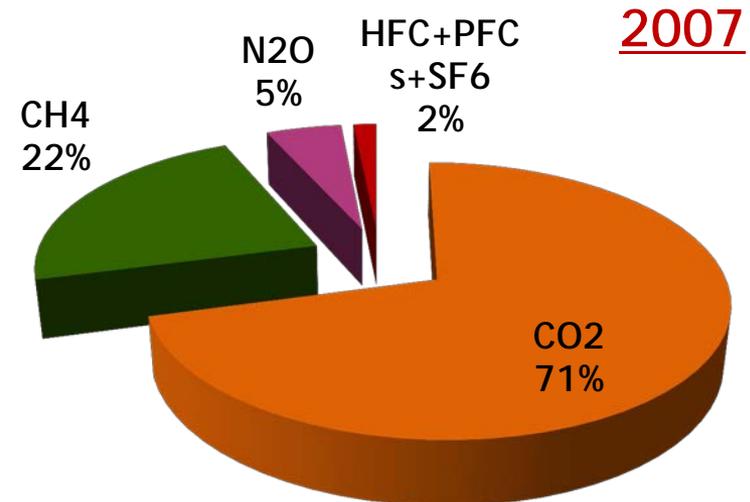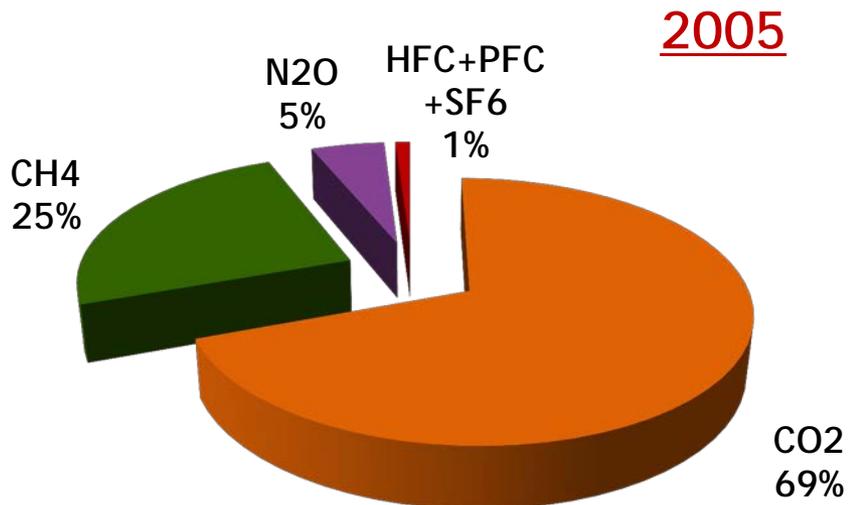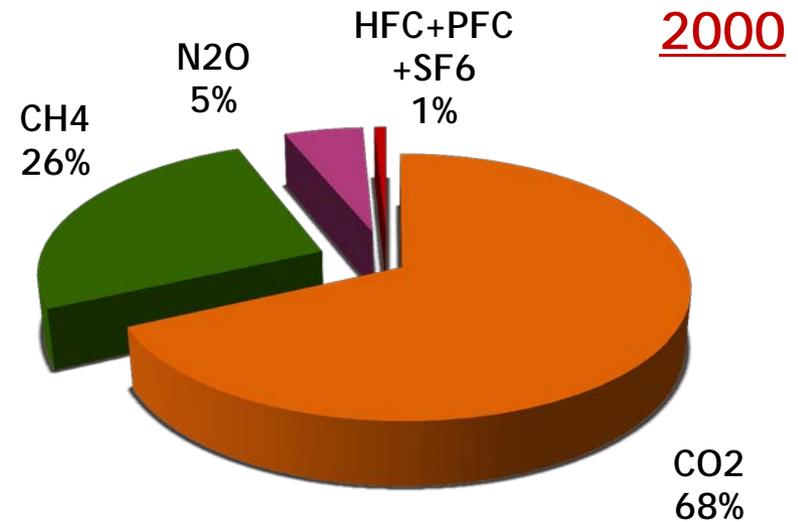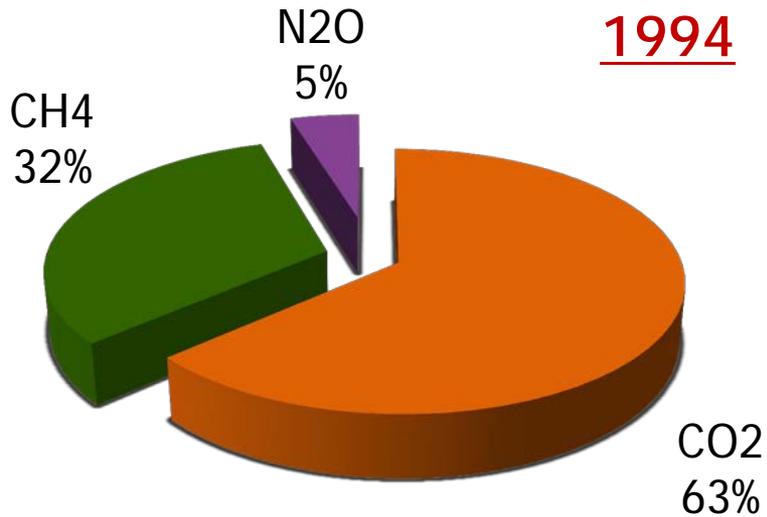
GHG EMISSION TRENDS

CO2 emissions in million tons
CAGR 4.7%

Year	Value
1994	817.02
2000	1024.77
2005	1218.13
2007	1476.36

CH4 emissions in million tons
CAGR 1.1%

Year	Value
1994	18.08
2000	19.94
2005	21.02
2007	20.89
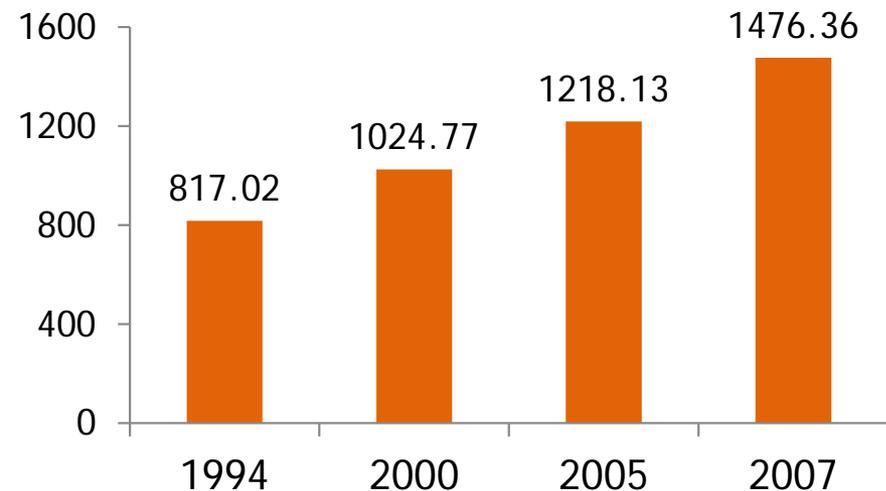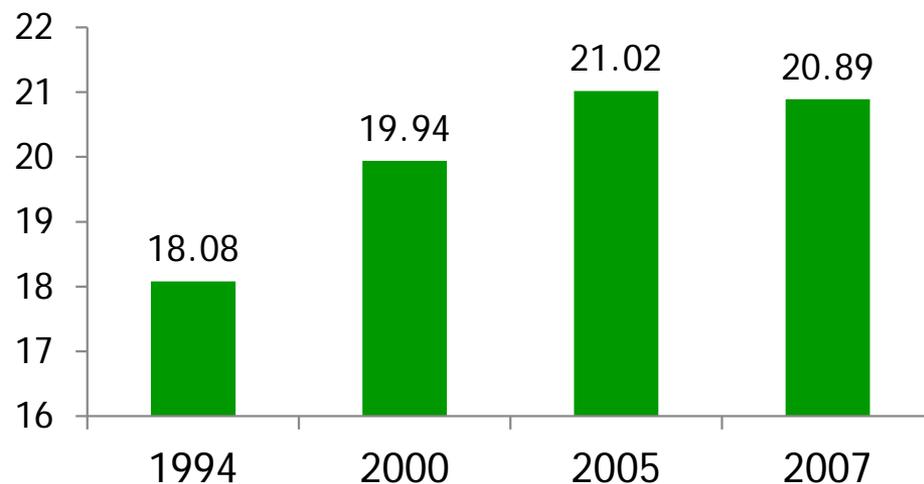
N2O emission trends '000 tons
CAGR 4.6%

Year	Value
1994	178
2000	264
2005	296
2007	320
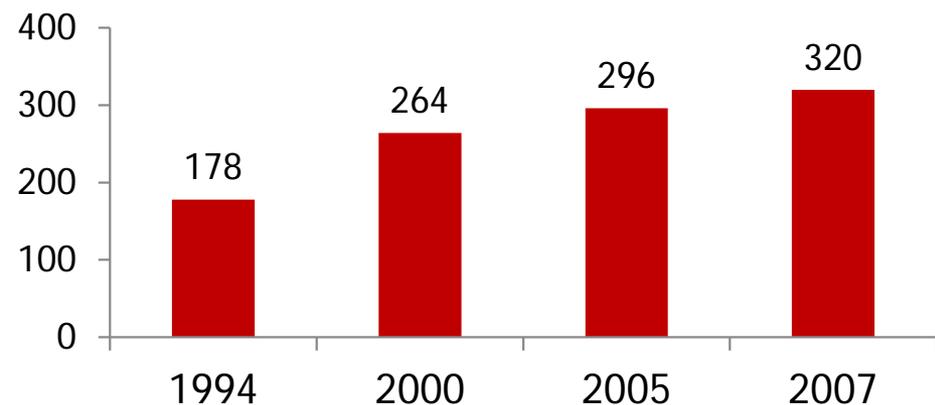
HFCs+PFCs+SF6 emission trends in '000 tons
CAGR 8.5%

Year	Value
1994	
2000	1.61
2005	3.084
2007	4.65
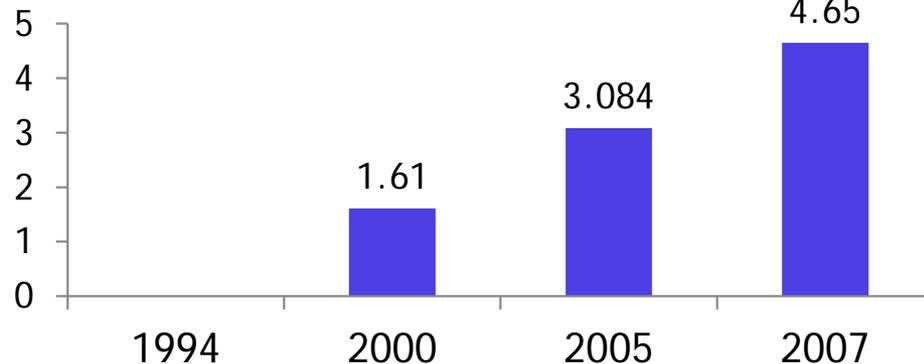
GHG EMISSIONS AND SECTORAL CONTRIBUTION (2000)
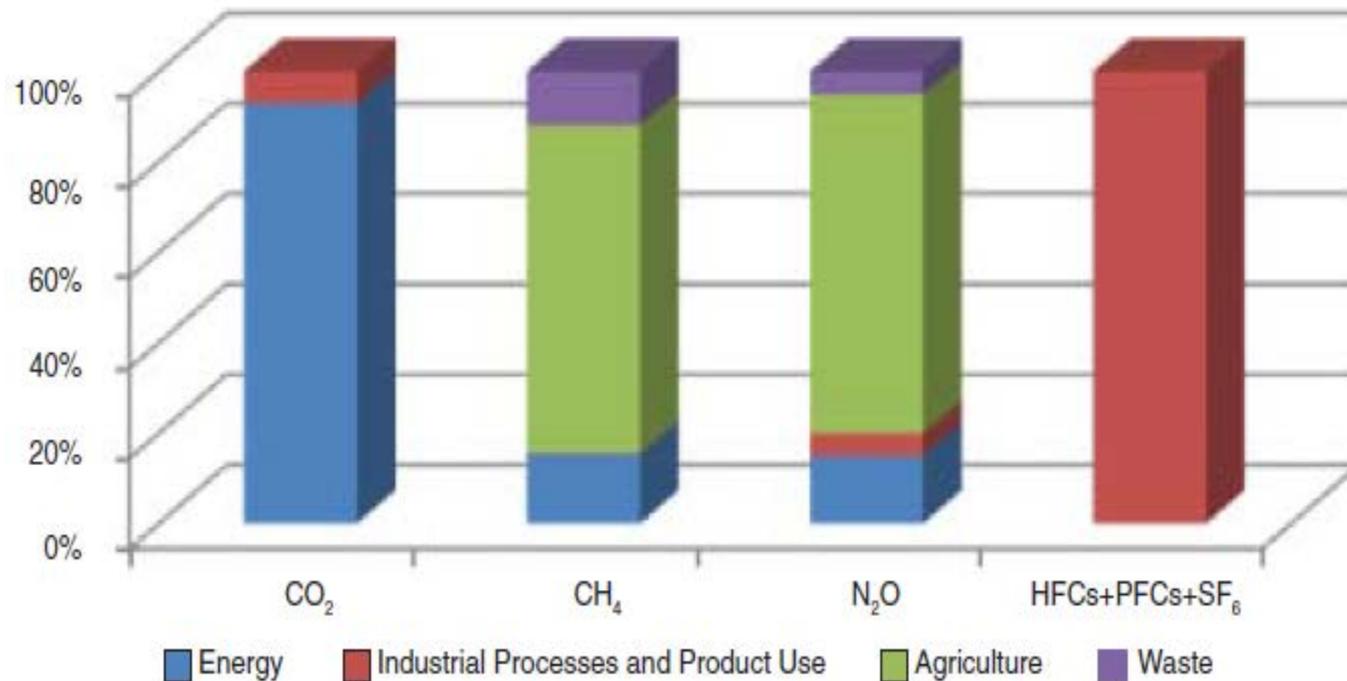
KEY SOURCE ANALYSIS – YR. 2000

Level Analysis	Trend Analysis
25 sources out of 64 sources emitting 95% of the total CO2 eq emissions	15 sources out of 64 sources emitting 95% of total CO2 eq emissions
Electricity prod: 34.3% Enteric ferement:13.9% Road transport: 5.6% Rice cultivation:4.8% Non specific Ind.: 3.9% Agri soils: 3.8% Residential 3.6% Iron and steel: 3.4% Cement prod: 2.9% Cement (fossil): 2.6% Chemicals:2.3% Residential:2.2% Agri/fisheries:1.9% Food & Beverage:1.6% Industrial Waste water:1.5% Refineries: 1.2% + 9 more (others, share ranging from 0.3 to 0.9%)	Only the 1st 15 identified through trend analysis

Level analysis of total CO_2 eq emissions (represented in % of total emissions)
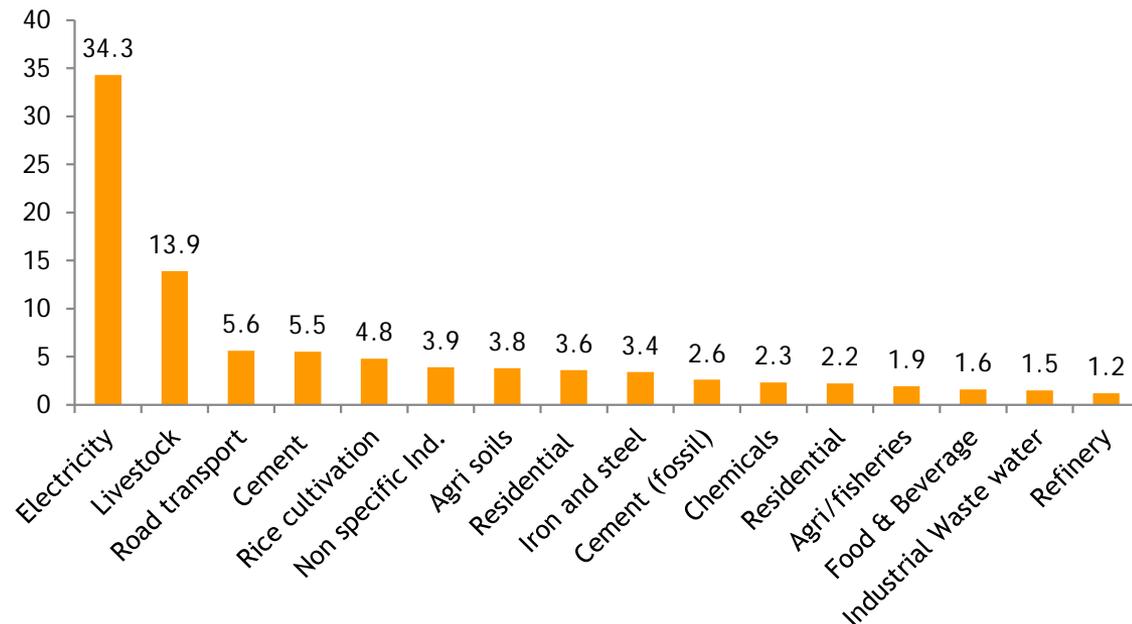
UNCERTAINTY ANALYSIS

o Carried out for CO2, CH4 and N2O for the common 15 sources as deduced from the level and trend analysis

oThe uncertainty in activity data have been assumed on the basis of discussions with the researchers who have been collecting data for the last 10-15 yrs

oEmission factor uncertainties are based on literature survey

oCombined uncertainty estimated using IPCC good practice guidance

EXAMPLE OF SOME KEY EFFORTS MADE TO IMPROVE THE GHG ESTIMATES

ENERGY SECTOR

- Updation of CO_2 EF from coal, measured using larger samples including new samples
- Updation of CH_4 EF from fugitive emissions from coal mines
- Fossil fuel based CO_2 Efs measured from selected power, steel and cement plants
- Transport-revised IPCC 2006 EFs
- Bridging data gaps- Estimating diesel consumption in DG sets in Bengaluru, Lucknow and Gurgaon

SPACE BASED MEASUREMENT OF CH_4 FROM RICE

CH4 emissions range from <25 kg/ha/yr to as much as 300 kg/ha/yr

CH4 emissions range from 1.6 to 5.2 million tons annually.

The average methane emission is around 3.8 million tons

Max emissions are in the month of September.

Emission(kg/ha/yr)
- <25
- 25 – 50
- 51 – 75
- 76 – 100
- 101 – 125
- 126 – 150
- 151 – 200
- 201 – 300
- > 300
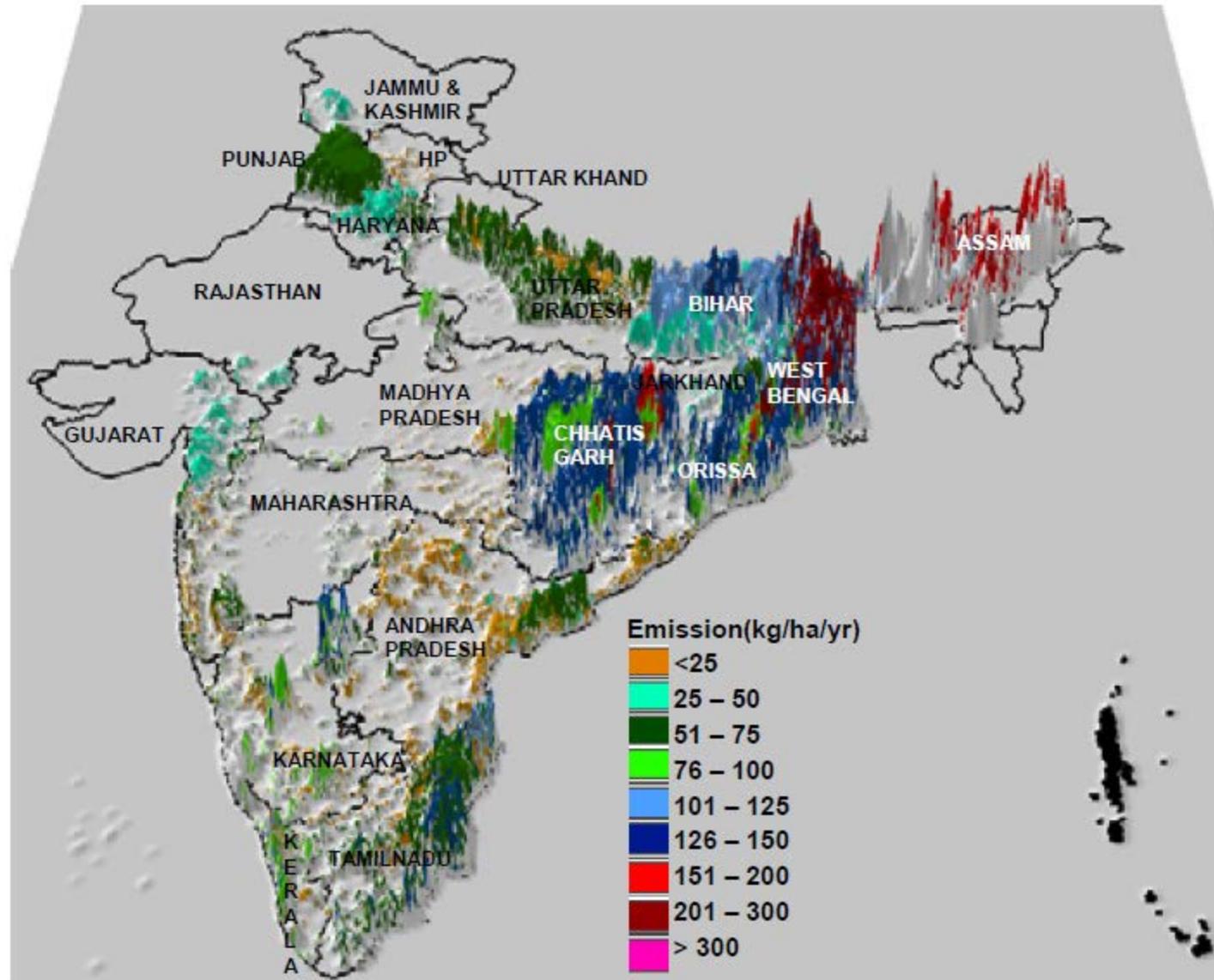
AGRICULTURE – OTHER EFFORTS

- Feed based CH4 emission factors developed
- CH4 Efs from dung estimated
- Measurements of GHG emissions from crop residue burning – with a focus on Punjab using satellite

wheat

Rice

Burnt area
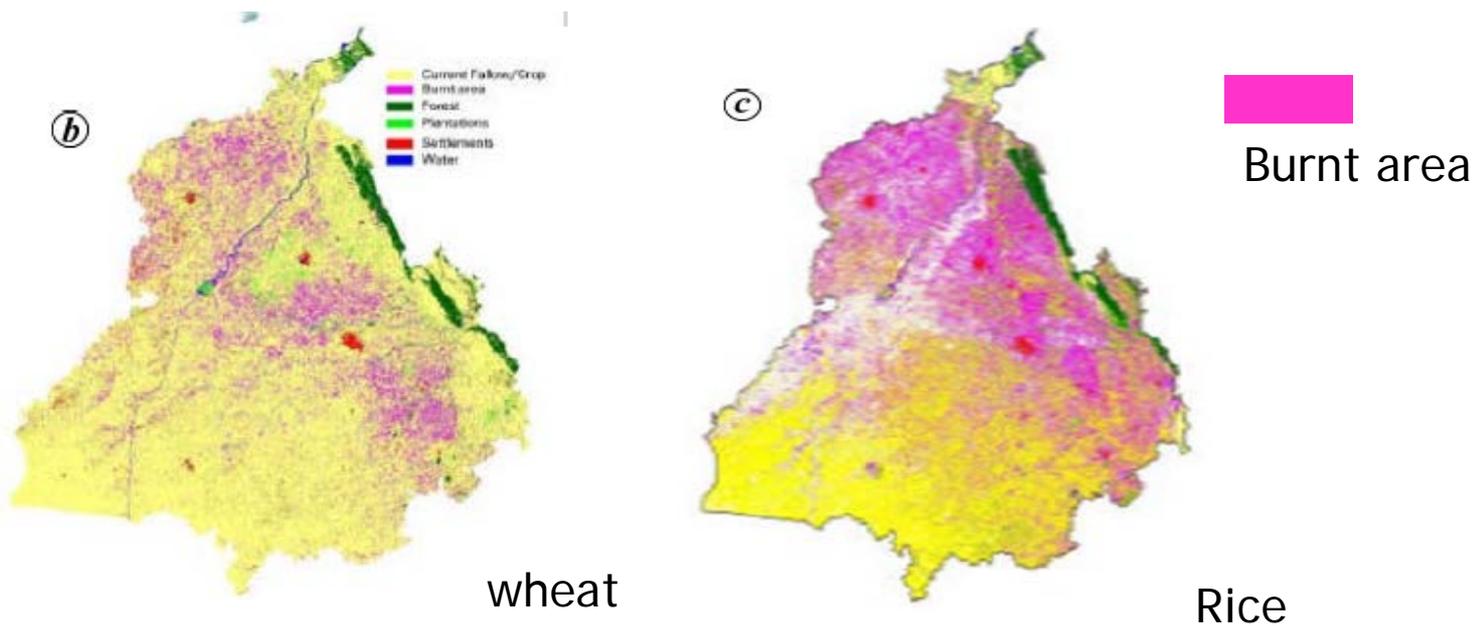
LULUCF : IPCC GPG 2003

Land categories considered

Forest Land   FL-FL
              L-FL
Crop Land   CL-CL
              L-CL
Grass land   GL-GL
              GL-Ol
Settlement   SL-SL
              L-SL
Other land   OL-OL

Land Use	Forest land remaining forest land (km²)	Land converted to forest land (km²)
VDF	78,770	4702
MDF	301,926	18,022
OF	270,599	16,152
Total	651,294	38,877

Forest GHG inventory based on satellite based forest cover mapping between 1994 and 2004; Change in C stock method for GHG emission estimates from forest land

Other Land use taken from Agriculture ministry, urban develop., ISRO maps for wet lands etc

MoEF

INSTITUTIONAL ARRANGEMENT

31 Institutions

Final Inventory vetted by concerned line ministries such as MoA, MP, MoNg, MoC, Mferti, MoEF, MRTShip, Min Aviation etc.

Energy
- CIMFR
- CRRI — PPAC
- IIP
- JU
- TERI

IPPU
- CIMFR
- CMA
- CII
- JU
- NEERI
- TERI

AGRI
- BCKVV
- CLRI
- IARI
- IGFRI
- IVRI
- NDRI

LULUCF
- FSI
- ICFRE
- IISc
- NRSA
- AFRI
- ARCBR
- CFRHRD
- CSFER
- FRC
- HFRI
- IFGTB
- IFP
- IWST
- RFRI
- TFRI

Waste
- NEERI
- NPL
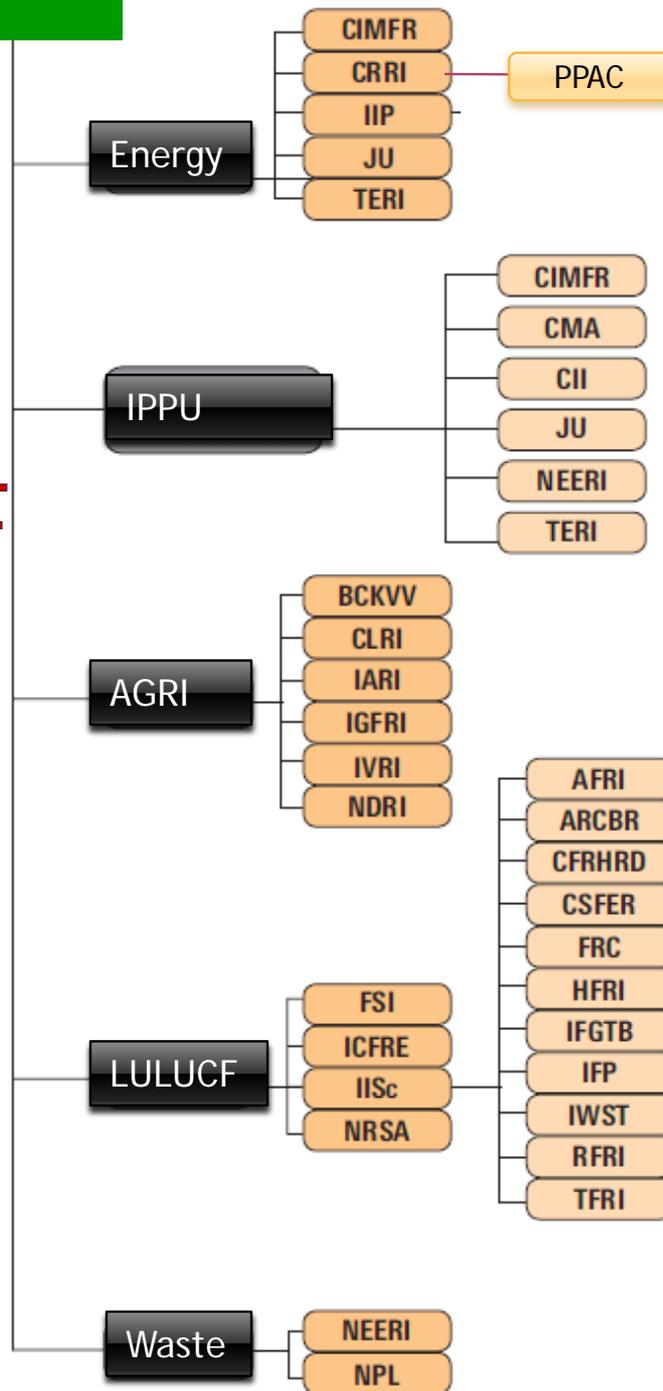
ACRONYMS

AFRI	:	Arid Forest Research Institute
ARCBR	:	Advanced Research Centre for Bamboo and Rattans
BCKVV	:	Bidhan Chandra Krishi Vishwa Vidyalaya
CFRHRD	:	Centre for Forestry Research and Human Resource Development
CII	:	Confederation of Indian Industry
CIMFR	:	Central Institute of Mining and Fuel Research
CLRI	:	Central Leather Research Institute
CMA	:	Cement Manufacturers Association
CRRI	:	Central Road Research Institute
CSFER	:	Centre for Social Forestry and Eco-Rehabilitation
FSI	:	Forest Survey of India
FRC	:	Forest Research Centre
HFRI	:	Himalayan Forest Research Institute
IARI	:	Indian Agricultural Research Institute
ICFRE	:	Indian Council of Forestry Research and Education
IFGTB	:	Institute of Forest Genetics and Tree Breeding
IFP	:	Institute of Forest Productivity
IGFRI	:	Indian Grassland and Fodder Research Institute
IIP	:	Indian Institute of Petroleum
IISc	:	Indian Institute of Science
IVRI	:	Indian Veterinary Research Institute
IWST	:	Institute of Woods Science and Technology
JU	:	Jadavpur University
NDRI	:	National Dairy Research Institute
NEERI	:	National Environmental Engineering Research Institute
NPL	:	National Physical Laboratory
NRSA	:	National Remote Sensing Agency
PPAC	:	Petroleum Planning and Analysis Cell
RFRI	:	Rain Forest Research Institute
TERI	:	The Energy and Resources Institute
TFRI	:	Tropical Forest Research Institute

IMPLEMENTATION ARRANGEMENT

GHG emission Inventory – NATCOM

Energy Inventory Expert Group	IPPU Inventory Expert Group	Agriculture Inventory Expert Group	LULUCF Inventory Expert Group	Waste Inventory Expert Group

Collect Activity Data
Generate/ Use existing Emission Factors
Prepare GHG inventory

Research Institutions, Industry Associations, Private sector, NGOs, Line ministries, Departments, etc,

GHG INVENTORY PREPARATION CYCLE

I. Inventory Planning → II. Institutions contracted → III. Initial Status Report → IV. Interim Report → V. Draft Report → VI. Draft Final Report → VII. Collation of information for inclusion in National Communication → VIII. Identification of gaps → I. Inventory Planning

Peer Review → III. Initial Status Report / IV. Interim Report

Peer Review

Review by National Steering Committee

Review by scientific advisory committee and 3rd Party review

Presently the cycle covers 3 yrs

METHODOLOGICAL IMPROVEMENTS MADE SO FAR

	1994 GHG inventory	2000, 2005 and 2007 GHG inventory
Guidelines used	Only revised 1996 IPCC Guidelines.	Revised IPCC 1996 Guidelines +IPCC Good Practice Guidance (2000)+ LULUCF Good Practice Guidance (2003) + IPCC 2006 guidelines
Sectors Reported	LULUCF - only emissions due to changes in forest land	Carbon pools in addition to forests have been considered in the LULUCF sector
Default vs CS EFs used	Emission factors were a mix of default factors taken from IPCC and CS emission factors; 26% of the source categories used CS factors.	Emission factors were also a mix of default and CS but leading to improved accuracy as more number of CS emission factors been used in this assessment (35% of the source categories used CS factors).
EFs Measured	CO_2 EF of coal CO_2 EF measured from one steel plant CO_2 EF measured from 2 power plants N_2O EF from nitric acid production CH_4 EF from enteric fermentation CH_4 EF from rice cultivation CH_4 EF from MSW in two cities CO_2, CH_4, and N_2O EF of fossil fuel other than coal taken from IPCC 1996 Guidelines	CO_2 EF from ammonia meaured Updated CO_2 EF of coal CO_2 EF measured from 2 more steel plants CO_2 EF measured in 1 more power plant N_2O emission from nitric acid production CH_4 EF from enteric fermentation CH_4 EF from rice cultivation CH_4 EF from MSW in 2 new cities CO_2, CH_4, and N_2O EF of fossil fuel other than coal updated from IPCC 2006 Guidelines
Gases Reported	CO_2, CH_4, and N_2O	CO_2, CH_4, N_2O , HFC-132a, HFC-23, CF_4, C_2F_6, SF_6
Tiers Used	Tier III: 7% of CO_2 eq emissions	Tier III: 12% of CO_2 eq emissions

GAPS AND CONSTRAINTS

Gaps and constraints	Details	Possible approach
Data organization	Data not available in IPCC formats/ user friendly formats for inventory reporting	Consistent reporting formats
	Mismatch in top-down and bottom-up data sets for same activities	Regular monitoring and consistency check on collected data
	Mismatch in sectoral details across different published documents	Consistent reporting formats
Non-availability of relevant data	Time series data for some specific inventory sub-categories, for example, municipal solid waste sites	Generate and maintain relevant data sets
	Data for informal sectors of economy	Data surveys
	Data for refining inventory to higher tier levels	Data depths to be improved

GAPS AND CONSTRAINS

Gaps/Constrains	Details	Possible Approach
Data non-accessibility	Proprietary and trade secret data for inventory reporting at Tier-III level	Involve industry, industry associations, and monitoring institutions
	Data not in electronic formats	Standardize data reporting and centralize data in usable electronic format
	Security concerns	Protocols to access data
Technical and institutional capacity needs	Training the activity data generating institutions in inventory methodologies and data formats	Extensive training programmes
	Institutionalize linkages of inventory estimation and climate change research	Wider dissemination activities
Non-representative emission coefficients	Inadequate sample size for representative emission coefficient measurements in many sub-sectors	Conduct more measurements, statistical sampling

SUGGESTED WAY FORWARD FOR GHG INVENTORY PREPARATION

- Establishment of National GHG Inventory Management System. This will enable
  - Development of Consistent Reporting formats
  - Enable annual updation of data, recalculation, and track the trends of emissions
  - Identify data gaps and guide relevant agencies to undertake surveys for the same
  - Fix time lines of activities for GHG preparation
  - Keep track of development of methodologies – internationally and domestically
  - Develop EFs as per the requirement identified
  - Establishe standard and transparent QA/QC operations
  - Maintain network of institutions that develop the inventory and generate CS- EFs thereby retaining and creating capacity
  - Make ready the inventory for International Consultation and Assessment process as standardized systems of peer review and third party review within the country are strengthened
  - Track the domestic target for emission intensity by initiating processes / regular studies to assess the achievements of various programmes undertaken by the government

SUGGESTED WAY FORWARD...CONTD

- Direct involvement of agencies in inventory reparation at the outset that are keepers of activity data or generate the same such as the different line ministries/their departments/ and their agencies like the NSSO, Deptt of animal husbandry etc.

- Integrate the efforts of other agencies within the Indian Union, to enrich the GHG inventory data base such as

  - Use of data generated from the PAT programme to estimate the emissions from large point sources that cover about 9 industries and almost 90% of GHG emissions from energy sector

  - GHG emissions estimates of the CEA (for power)

OTHER EFFORTS BY GOI

- National Action Plan on CC – 8 missions
  Relevant missions
  - Solar mission : Add 20 GW solar energy capacity by 2022
  - Mission on Enhanced Energy Efficiency: Save 19598 MW by 2017 (PAT in energy intensive industries as well demand side management of energy)
  - National emission on Urban Habitats – eg. Replacement of conventional lamps by fluorescent lamp to achieve 10,000 MW saving
  - Green India Mission – Increase forest area by 20 million ha in next 10 yrs and increase GHG removal by 6.35% of India's total GHG emissions by 2020
- State Action plans on CC
- Low C strategy document (Draft being finalised)
  - Power – increase efficiency, increase renewable energy mix
  - Building – energy saving – green building codes
  - Transport – dedicated freight corridors, strengthening of urban mass transport system, fuel use efficiency measures
  - Industry – Market mechanism based improvement in energy efficiency
  - Biomass combustion in domestic sector: improved chulhas and sustainable forestry, and large scale penetration of LPG