

India: Greenhouse Gas Emissions 2007

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Outline

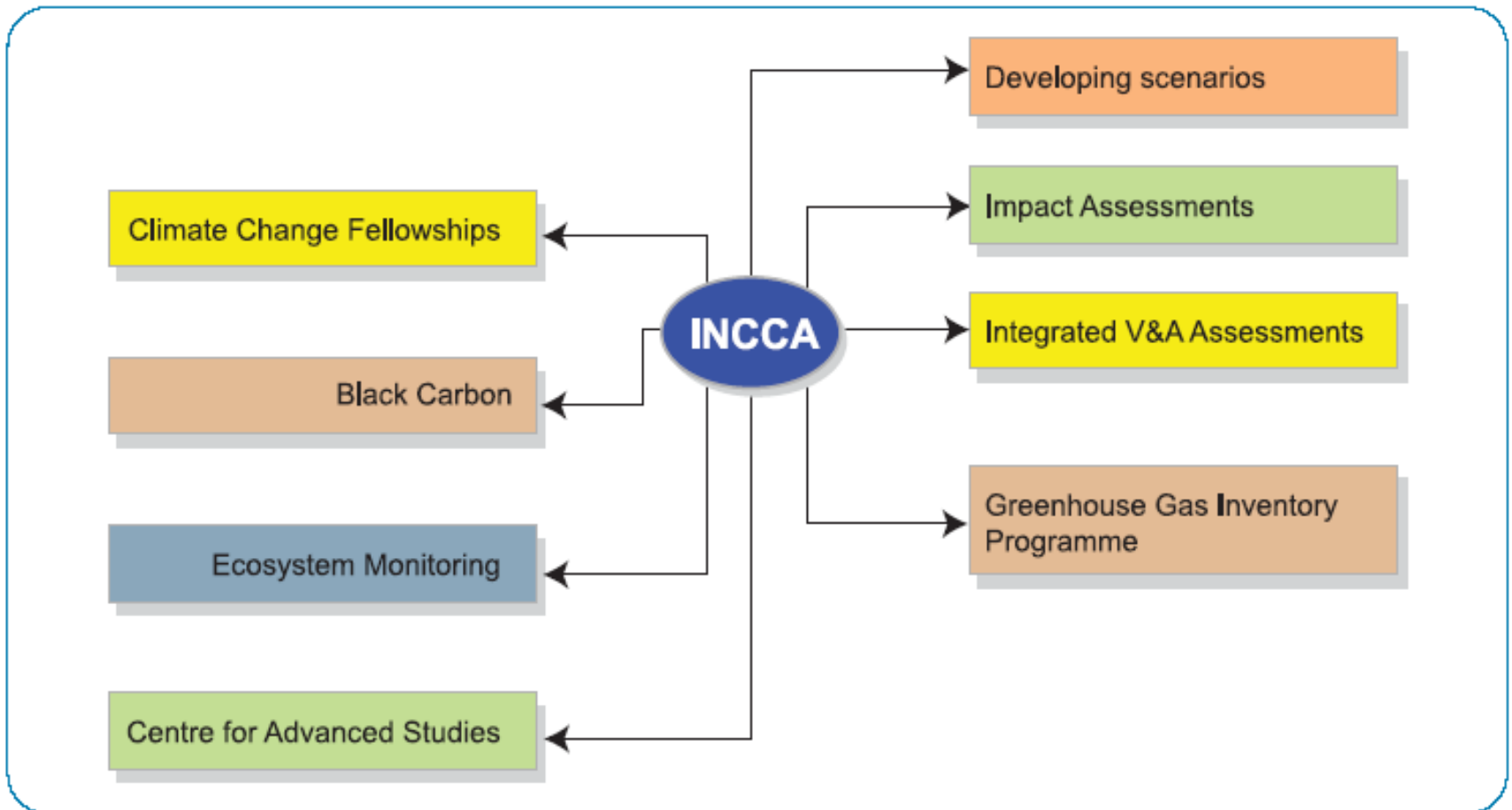
- About INCCA
- GHG emissions 2007
- Scientific Rigour
- Path ahead

Indian Network for Climate Change Assessment

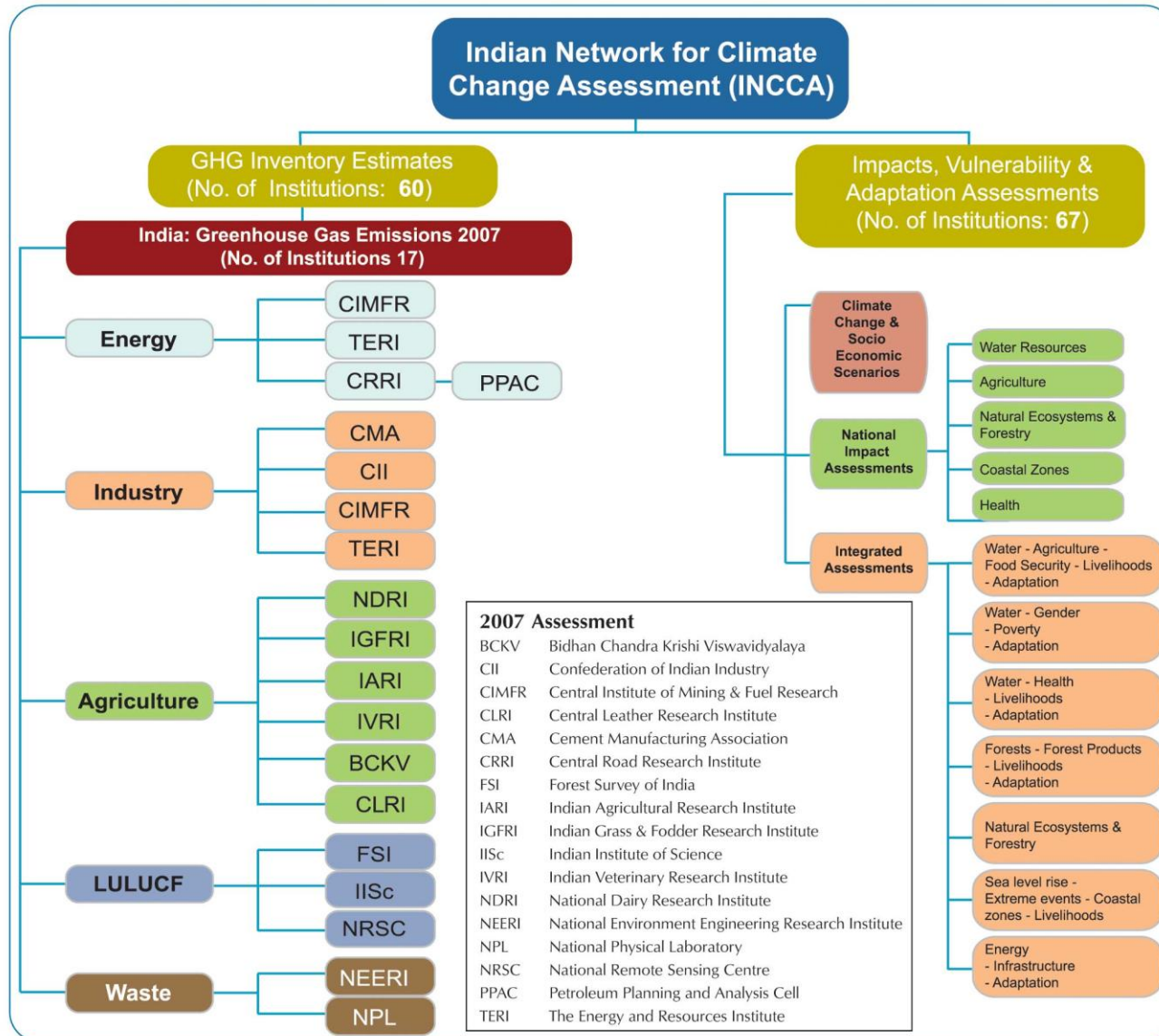
Launched on October 14, 2009, the network comprises of 127 institutions and 228 scientists across India

- Assess the drivers and implications of climate change through scientific research
- Prepare climate change assessments once every two years (GHG estimations and impacts of climate change, associated vulnerabilities and adaptation)
- Develop decision support systems
- Build capacity towards management of climate change related risks and opportunities

INCCA Programmes



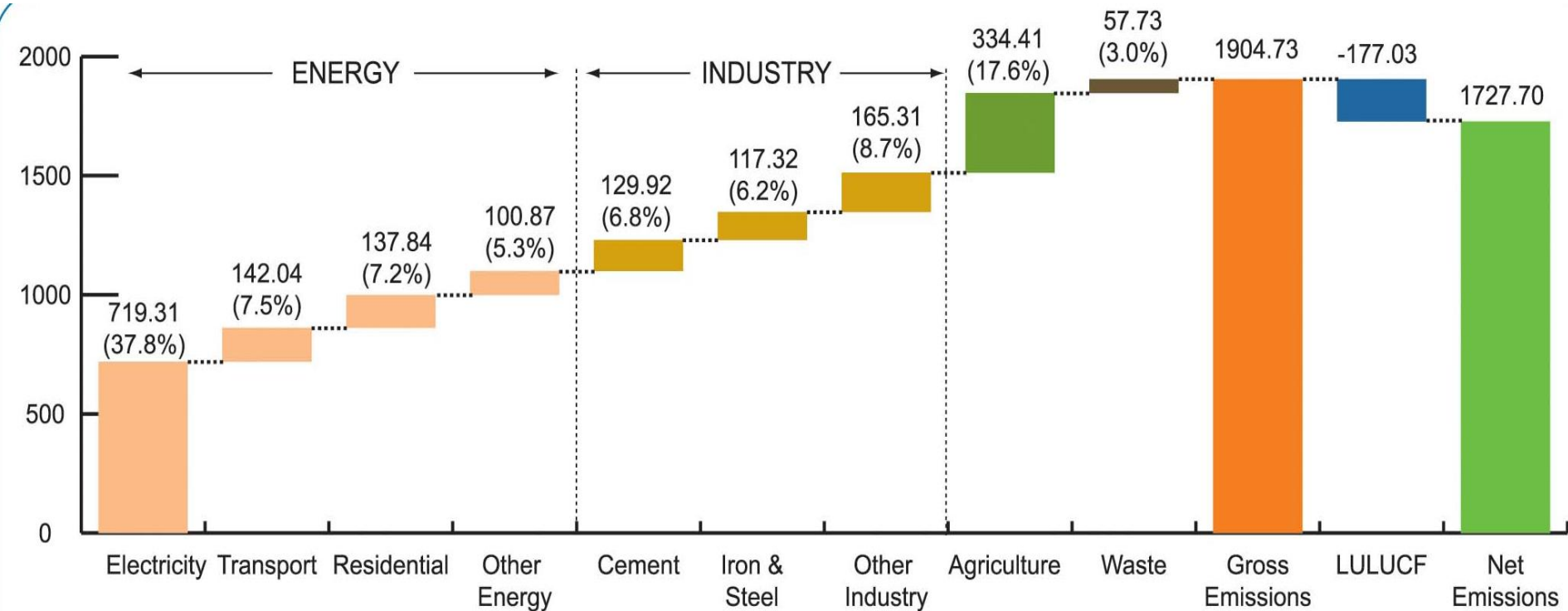
INCAA & Network for preparation of GHG inventories 2007



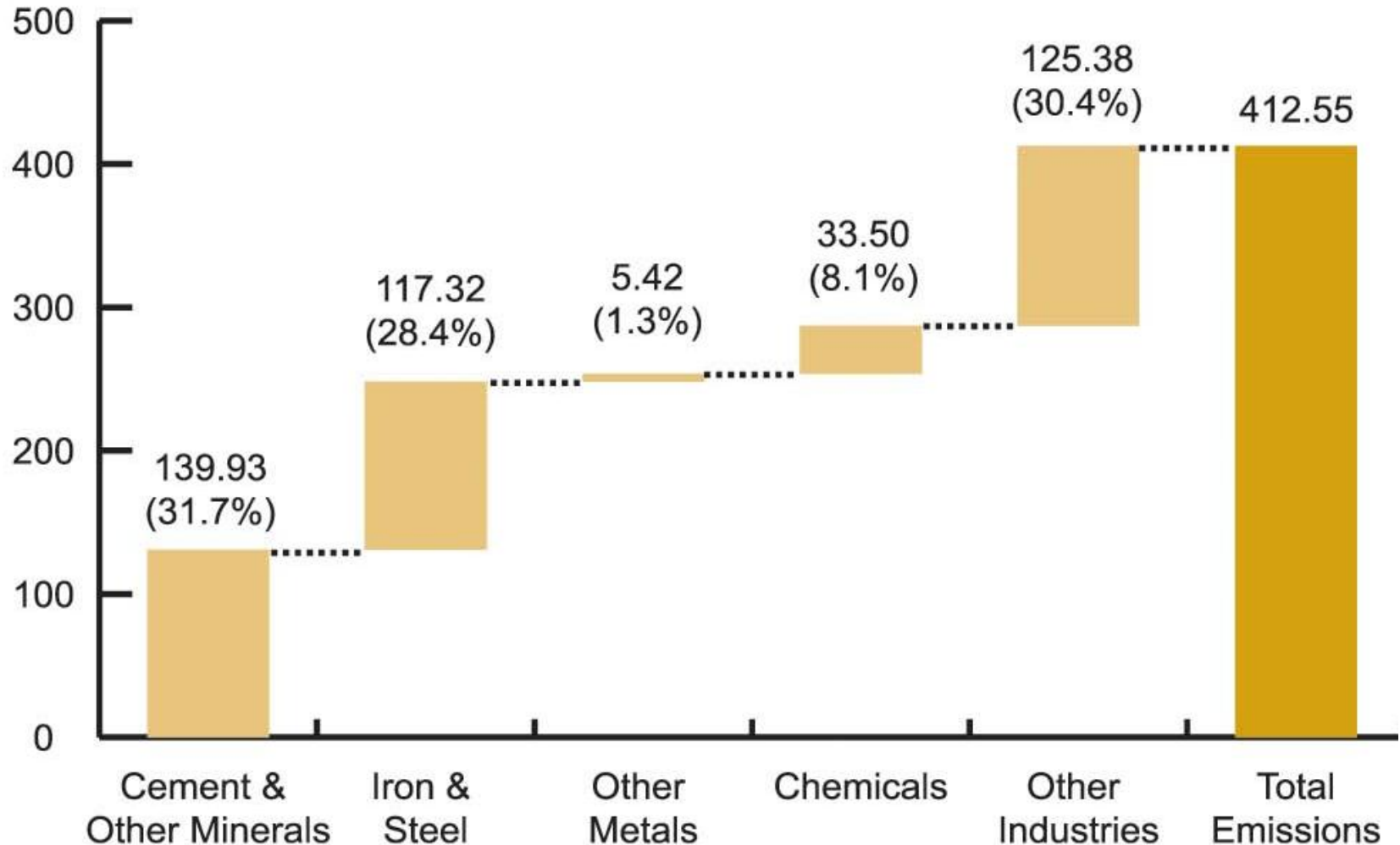
Key Results

- The total net Greenhouse Gas (GHG) emissions from India in 2007 were 1727.71 million tons of CO₂ equivalent (eq) of which
 - CO₂ emissions were 1221.76 million tons;
 - CH₄ emissions were 20.56 million tons; and
 - N₂O emissions were 0.57 million tons
- GHG emissions from Energy, Industry, Agriculture, and Waste sectors constituted 58%, 22%, 17% and 3% of the net CO₂ eq emissions respectively.
- Energy sector emitted 1100.06 million tons of CO₂ eq, of which 719.31 million tons of CO₂ eq were emitted from electricity generation and 142.04 million tons of CO₂ eq from the transport sector.
- Industry sector emitted 412.55 million tons of CO₂ eq. LULUCF sector was a net sink. It sequestered 177.03 million tons of CO₂.
- India's per capita CO₂ eq emissions including LULUCF were 1.5 tons/capita in 2007.

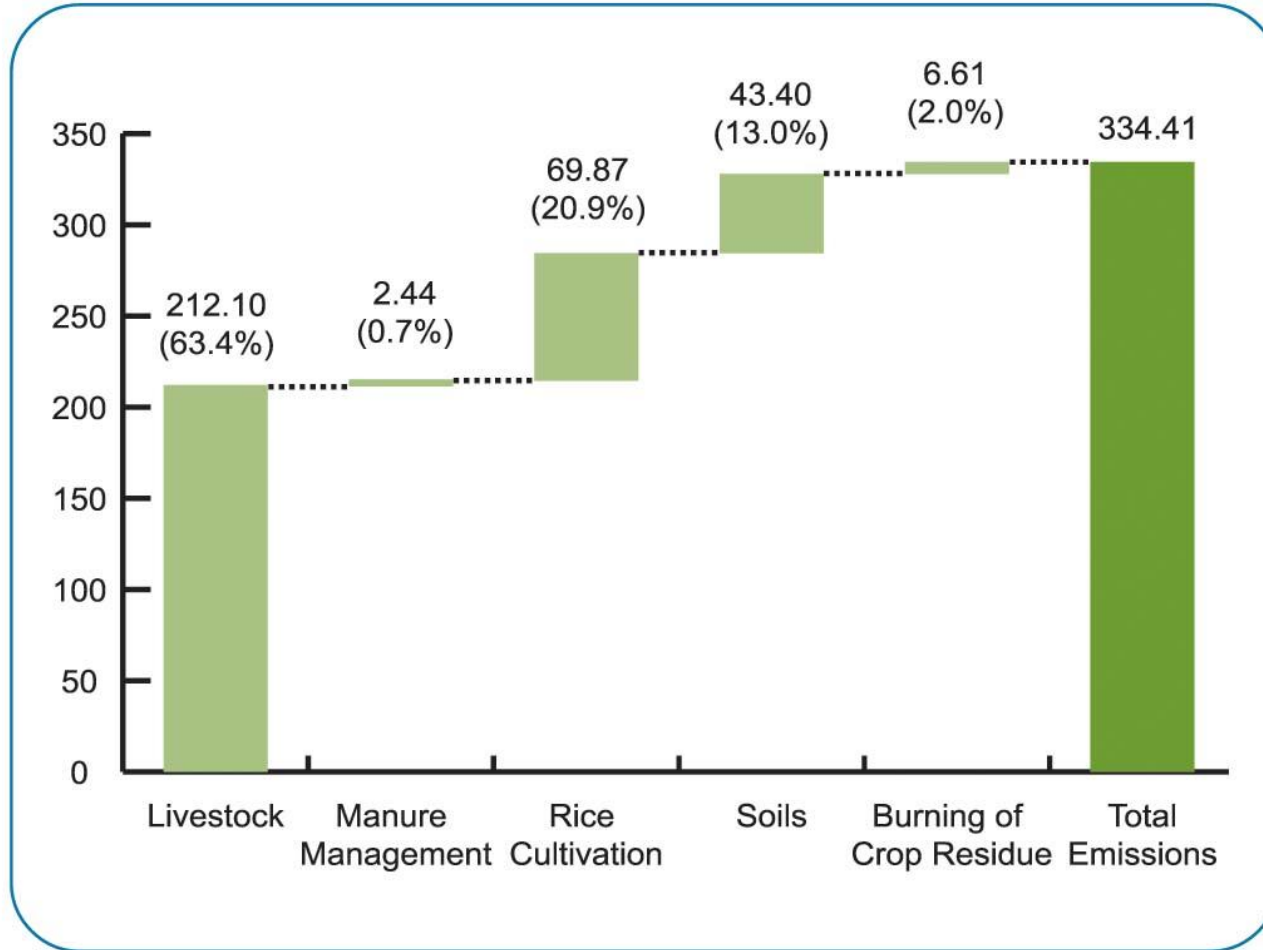
GHG Emissions by Sector 2007 (in CO₂ equivalent)



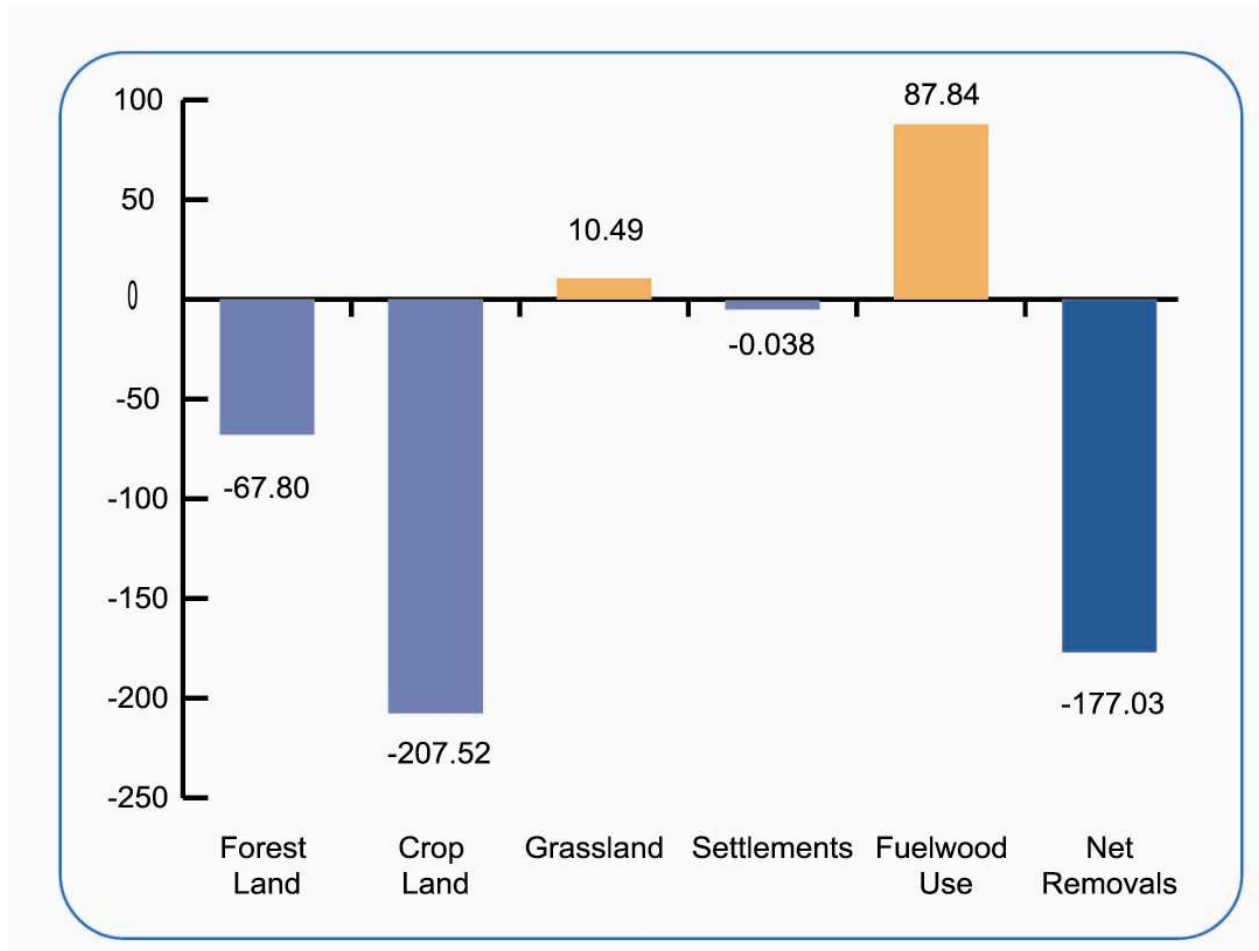
GHG emissions from Industry (CO₂ eq.)



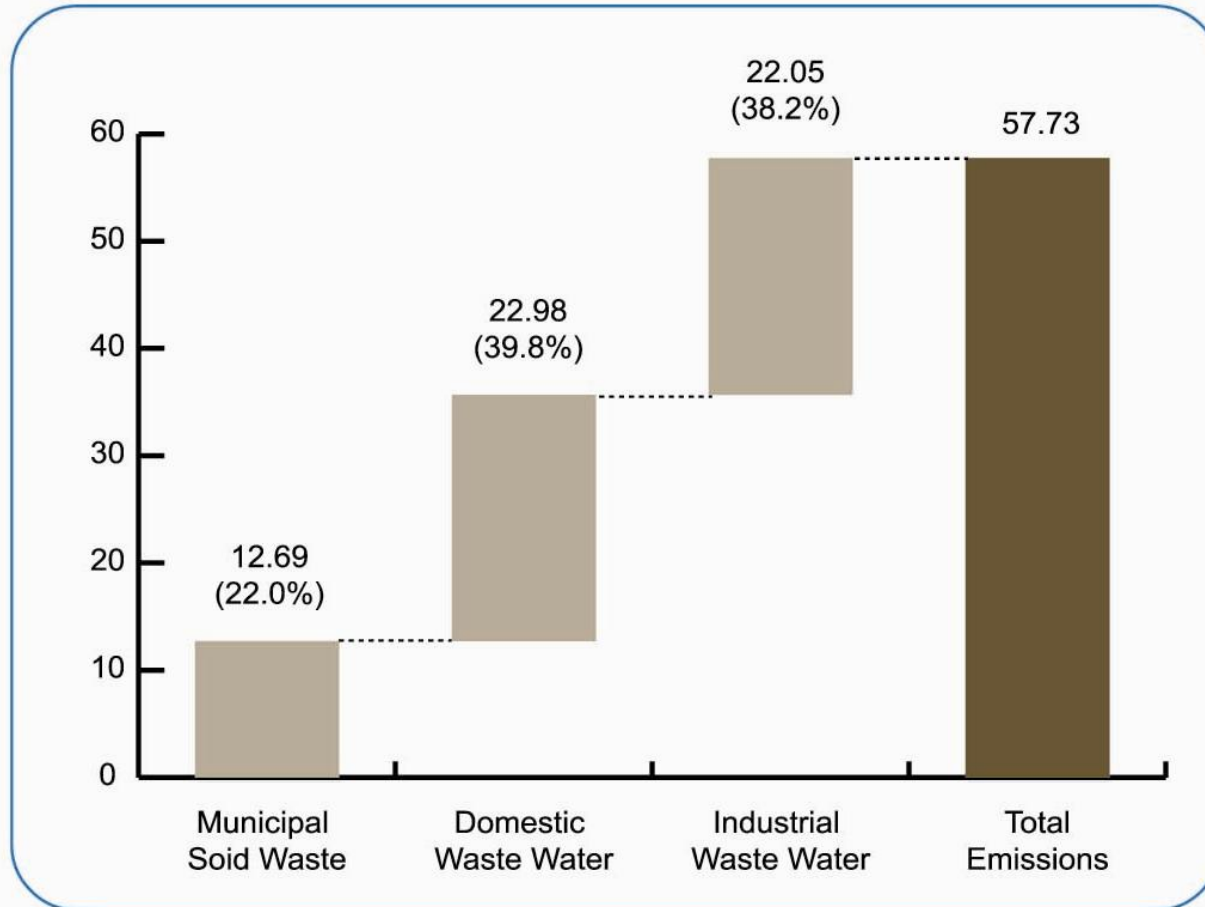
GHG emissions from the Agriculture sector



GHG emissions from the LULUCF sector (million tons of CO₂ eq.)



GHG emissions from Waste sector



Greenhouse gas emissions by sources and removal by sinks from India in 2007 (thousand tons)

	CO ₂ emissions	CO ₂ removals	CH ₄	N ₂ O	CO ₂ equivalent
GRAND TOTAL	1497029.20	275358.00	20564.20	239.31	1727706.10
ENERGY	992836.30		4266.05	56.88	1100056.89
Electricity generation	715829.80		8.14	10.66	719305.34
Other energy industries	33787.50		1.72	0.07	33845.32
Transport	138858.00		23.47	8.67	142038.57
<i>Road transport</i>	<i>121211.00</i>		<i>23.00</i>	<i>6.00</i>	<i>123554.00</i>
<i>Railways</i>	<i>6109.00</i>		<i>0.34</i>	<i>2.35</i>	<i>6844.64</i>
<i>Aviation</i>	<i>10122.00</i>		<i>0.10</i>	<i>0.28</i>	<i>10210.90</i>
<i>Navigation</i>	<i>1416.00</i>		<i>0.13</i>	<i>0.04</i>	<i>1431.13</i>
Residential	69427.00		2721.94	36.29	137838.49
Commercial / Institutional	1657.00		0.18	0.04	1673.18
Agriculture/ Fisheries	33277.00		1.20	1.15	33658.70
Fugitive emissions			1509.40		31697.30
INDUSTRY	405862.90		14.77	20.56	412546.53
Minerals	130783.95		0.32	0.46	130933.27
Cement production	129920.00				129920.00
Glass & ceramic production	277.82		0.32	0.46	427.14
Other uses of soda ash	586.12				586.12
Chemicals	27888.86		11.14	17.33	33496.42
Ammonia production	10056.43				10056.43
Nitric acid production				16.05	4975.50
Carbide production	119.58				119.58
Titanium dioxide production	88.04				88.04
Methanol production	266.18		0.91		285.37
Ethylene production	7072.52		9.43		7270.64
EDC & VCM production	198.91				198.91
Ethylene Oxide production	93.64		0.19		97.71
Acrylonitrile production	37.84		0.01		37.98
Carbon Black production	1155.52		0.03		1156.07
caprolactam				1.08	336.22
Other chemical	8800.21		0.56	0.20	8873.97
Metals	122371.43		0.95	1.11	122736.91
Iron & Steel production	116958.37		0.85	1.09	117315.63
Ferroalloys production	2460.70		0.08		2462.29

	CO ₂ emissions	CO ₂ removals	CH ₄	N ₂ O	CO ₂ equivalent
Aluminium production	2728.87		0.01	0.00	2729.91
Lead production	84.13		0.00	0.01	86.38
Zinc production	76.11		0.00	0.01	77.99
Copper	63.25		0.01	0.00	64.70
Other Industries	123969.17		2.37	1.65	124530.44
Pulp and paper	5222.50		0.05	0.08	5248.35
Food processing	27625.53		1.12	0.22	27717.25
Textile and leather	1861.11		0.03	0.02	1867.94
Mining and quarrying	1460.26		0.06	0.01	1464.62
Nonspecific industries	87799.77		1.11	1.32	88232.28
Non energy product use	849.49				849.49
Lubricant	776.75				776.75
Paraffin wax	72.75				72.75
AGRICULTURE			13767.80	146.07	334405.50
Enteric fermentation			10099.80		212095.80
Livestock Manure management			115.00	0.07	2436.70
Rice cultivation			3327.00		69867.00
Soils				140.00	43400.00
Burning of crop residue			226.00	6.00	6606.00
LULUCF	98330.00	275358.00			-177028.00
Forestland		67800.00			-67800.00
Cropland		207520.00			-207520.00
Grassland	10490.00				10490.00
Settlement		38.00			-38.00
Wetland	NE				NE
Other land	NO				NO
Fuel wood use in forests	87840.00				87840.00
Waste			2515.58	15.80	57725.18
Municipal Solid waste			604.51		12694.71
Domestic waste water			861.07	15.80	22980.47
Industrial waste water			1050.00		22050.00
Bunkers*	3454		0.03	0.10	3484.45
Aviation Bunkers	3326		0.02	0.09	3355.31
Marine bunkers	128		0.01	0.003	129.14

Note: LULUCF: Land Use Land Use Change & Forestry

*Not included in the national totals.

NE: Not estimated; NO: Not occurring

A comparison of GHG emissions by sector between 1994 & 2007

(in million tons of CO₂ eq)

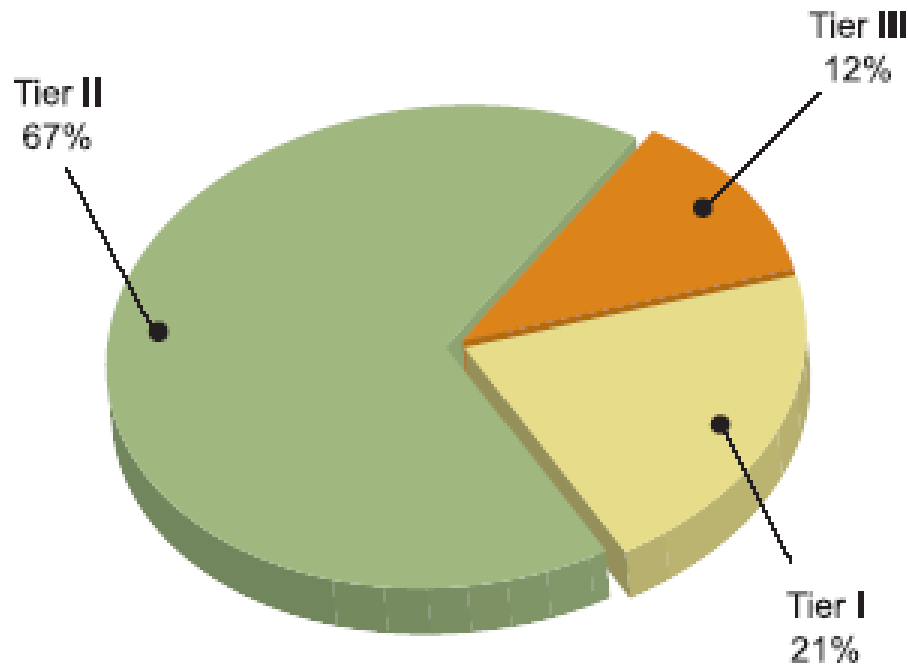
	1994	2007	CAGR (%)
Electricity	355.03 (28.4%)	719.30 (37.8%)	5.6
Transport	80.28 (6.4%)	142.04 (7.5%)	4.5
Residential	78.89 (6.3%)	137.84 (7.2%)	4.4
Other Energy	78.93 (6.3%)	100.87 (5.3%)	1.9
Cement	60.87 (4.9%)	129.92 (6.8%)	6.0
Iron & Steel	90.53 (7.2%)	117.32 (6.2%)	2.0
Other Industry	125.41 (10.0%)	165.31 (8.7%)	2.2
Agriculture	344.48 (27.6%)	334.41 (17.6%)	-0.2
Waste	23.23 (1.9%)	57.73 (3.0%)	7.3
Total without LULUCF	1251.95	1904.73	3.3
LULUCF	14.29	-177.03	
Total with LULUCF	1228.54	1727.71	2.9

Note: Figure in brackets indicate percentage emissions from each sector with respect to total GHG emissions without LULUCF in 1994 and 2007 respectively

Key Methodological Features and Improvements

1994 Assessment	2007 Assessment
<ul style="list-style-type: none"> Estimates made using only revised 1996 IPCC guidelines. 	<ul style="list-style-type: none"> Estimates made using revised IPCC 1996 guidelines (1997), IPCC Good Practice Guidance (2000), the LULUCF Good Practice Guidance (2003).
<ul style="list-style-type: none"> LULUCF included emissions from changes in forest land. 	<ul style="list-style-type: none"> Carbon pools in addition to forests have been considered in the LULUCF sector (crop land, grass land, settlements).
<ul style="list-style-type: none"> Emission factors were a mix of default factors taken from IPCC and country specific (CS) emission factors. 26% of the source categories used CS factors. 	<ul style="list-style-type: none"> Emission factors were also a mix of default and CS but leading to improved accuracy as more number of CSs have been used in this assessment (35% of the source categories used CS factors).
<ul style="list-style-type: none"> The 1994 assessment splits the emissions from industry in to two parts - fossil fuel and process. The fossil fuel emissions are reported in Energy and process emissions in Industry. 	<ul style="list-style-type: none"> The 2007 assessment reports both fossil fuel related and process based emissions from Industry as a part of the Industry sector.
<ul style="list-style-type: none"> In 1994, 7% of the total CO₂ eq emissions were made using Tier III approach. 	<ul style="list-style-type: none"> In 2007, 12% of the emissions are made using Tier III approach, implying greater accuracy.

Tiers of methodology used for 2007 GHG emission profile



Tier I : approach employs activity data that are relatively coarse, such as nationally or globally available estimates of deforestation rates, agricultural production statistics, and global land cover maps.

Tier 2 use the same methodological approach as Tier 1 but applies emission factors and activity data which are defined by the country.

Tier 3 approach uses higher order methods are used including models and inventory measurement systems tailored to address national circumstances, repeated over time, and driven by disaggregated levels.

Key categories Identified

	CO ₂ eq	Cumulative CO ₂ eq	% of total	Tier Used	Emission factors used
Electricity generation	719305.34	719305.34	37.12065	Tier II	CS+D
Enteric fermentation	212095.8	931401.14	48.06611	Tier III	CS+D
Residential	137838.487	1069239.627	55.17944	Tier I	D
Cement production	129920	1199159.627	61.88412	Tier III	CS+D
Road transport	123554	1322713.627	68.26028	Tier II	CS+D
Iron & Steel production	117315.631	1440029.257	74.3145	Tier II	CS+D
Non-specific industries	88232.28	1528261.537	78.86784	Tier I	CS+D
Rice cultivation	69384	1597645.537	82.44849	Tier III	CS
Soils	43400	1641045.537	84.6882	Tier II	CS+D
Other energy industries	33845.32	1674890.857	86.43483	Tier I	CS+D
Agriculture/ Fisheries	33658.7	1708549.557	88.17183	Tier I	CS+D
Fugitive emissions	31697.295	1740246.852	89.8076	Tier III	CS
Food processing	27717.25	1767964.102	91.23799	Tier I	CS+D
Domestic waste water	22980.47	1790944.572	92.42392	Tier I	D
Industrial waste water	22050	1812994.572	93.56184	Tier II	CS+D
Municipal Solid waste	12694.71	1825689.282	94.21697	Tier II	CS+D
Aviation	10210.9	1835900.182	94.74391	Tier I	D
International aviation and shipping	10000.0	1845900.182	95.14391	Tier I	D

Future Directions

- Riding the Tier Ladder
- Establishing a National GHG Management System
 - Undertake data management and collection on an annual basis;
 - Devise strategies for data generation and improvement;
 - Establish systems for data archiving and record keeping;
 - Ensure mechanisms for synchronization and cross feeding between emission inventories, national energy balances and relevant sector surveys;
 - Establish procedures for QA/ QC and uncertainty management
- Building capacity at institutional and individual level