

Biofuel emissions in India

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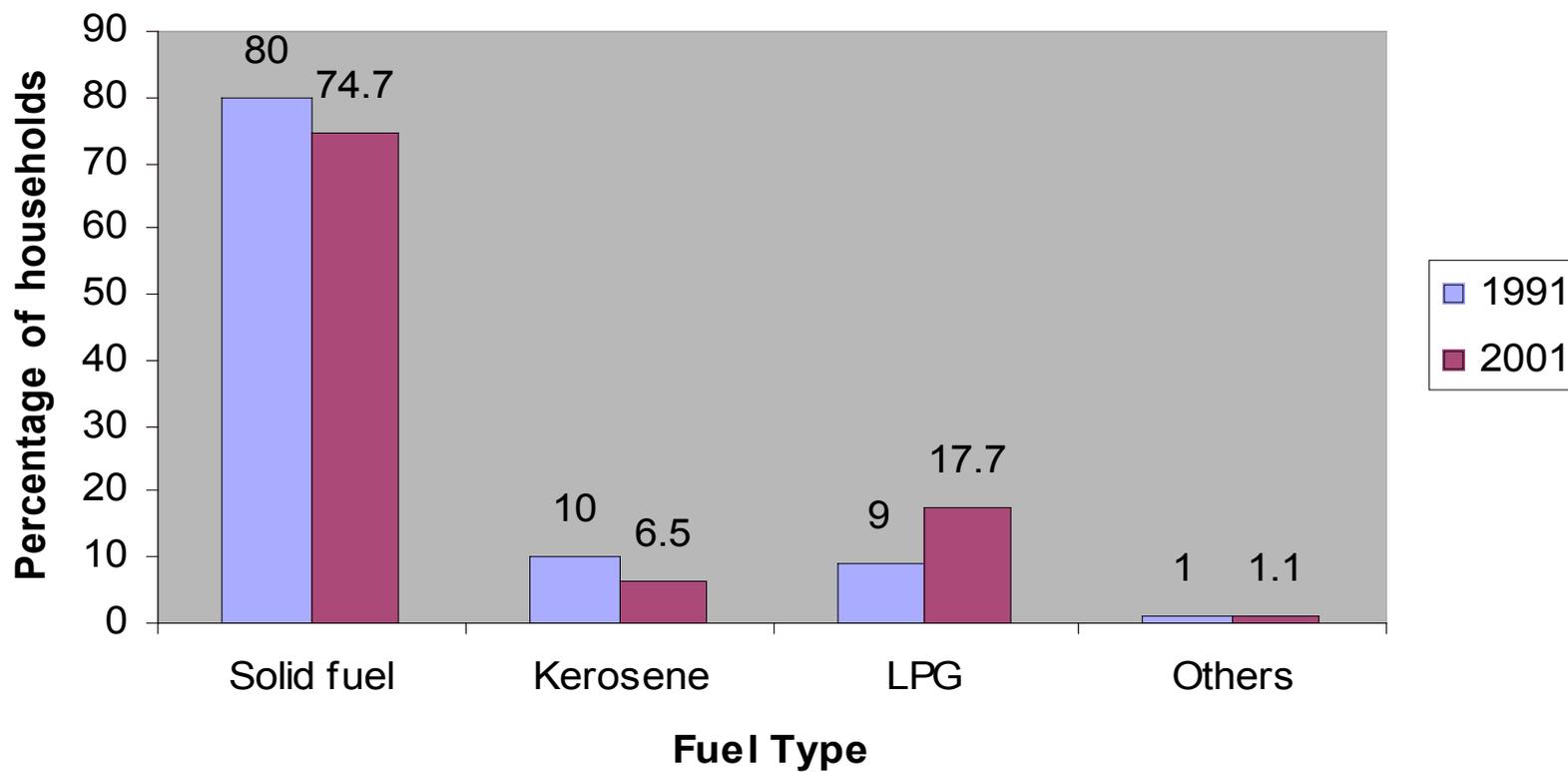
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Household fuels in India



Total No. of household in 1991 : 170 million

Total No. of household in 2001 : 192 million

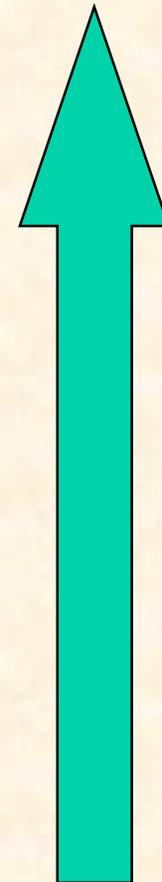
National aggregates of biofuel use in the rural domestic sector (in air dry million tons/year)*

Source	Firewood	Dung cakes	Crop residues
<u>Consumption</u>			
NCAER	93.3	83.2	36.7
REDB	252.1	106.9	99.2
IREP	169.0	54.2	62.8

* Source: Sinha, Sinha & Joshi, "Energy use in the rural areas of India: setting up a Rural Energy Data Base", Biomass & Bioenergy, Vol. 14, No. 5/6, pp. 489-503, 1998

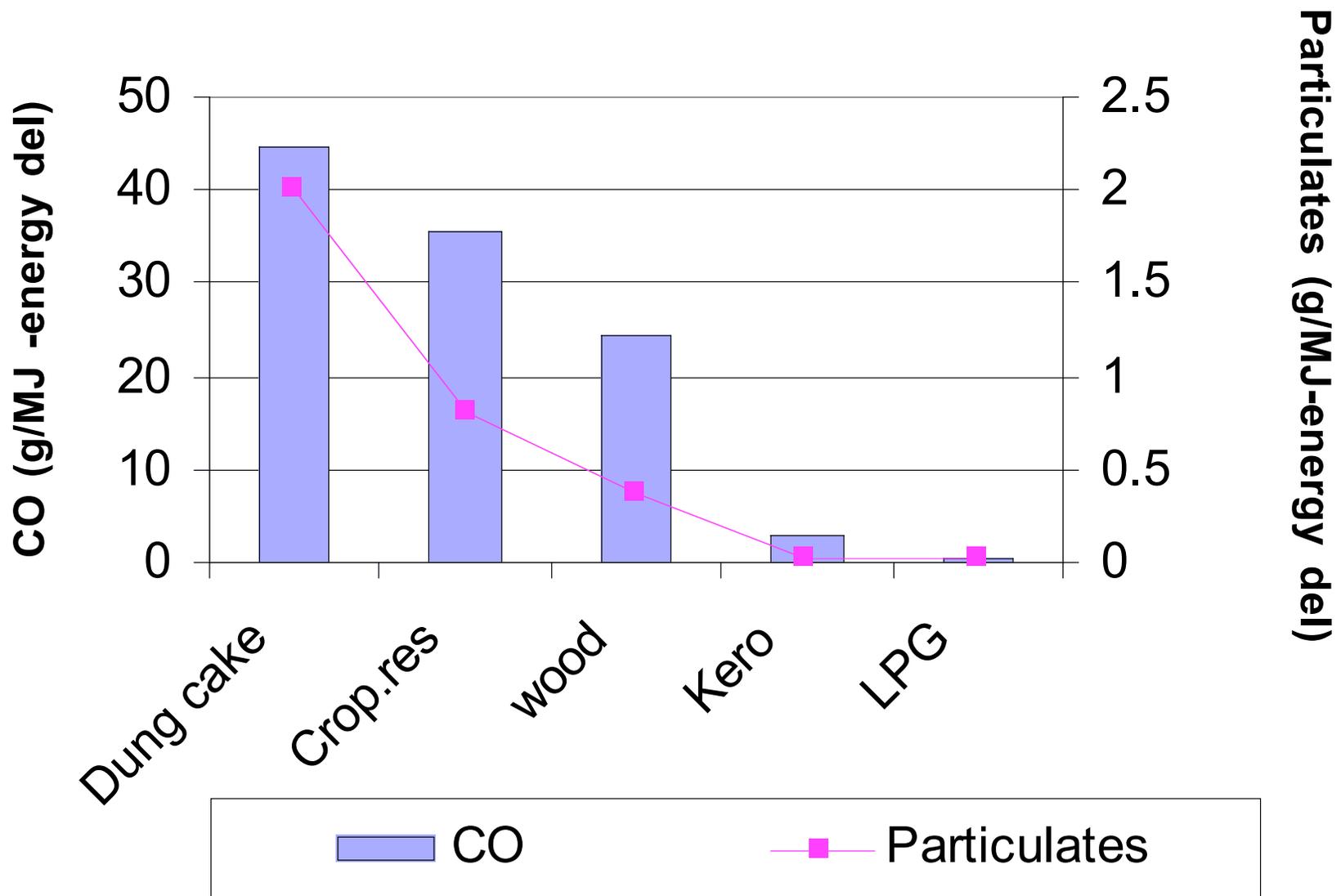
- LPG
- Biogas
- Kerosene
- Charcoal
- Wood - 2 species
- Root Fuel
- Crop Residues - 2 species
- Cow Dung

Nominal
“Energy
Ladder”
Ranking



Source: EPA report on GHGs from household stoves in India, Smith, Uma, et. al. 2000, EPA-600/R-00-052

Emissions along the energy ladder



Source: EPA report on GHGs from household stoves in India, Smith, Uma, et. al. 2000, EPA-600/R-00-052

Inventory of GHG emissions(Tg/Yr) from India (1990 -91)

Fuel	CO₂	CO	CH₄	TNMOC	N₂O
Biofuel	418.9	20.7	1.92	3.41	0.033
LPG	6.48	0.032	0.0001	0.039	0.0003
Kerosene	11.9	0.152	0.0025	0.068	0.0004
Biogas	0.96	0.001	0.0007	0.0004	0.00006

Source: EPA report on GHGs from household stoves in India, Smith,Uma, et. al. 2000, EPA-600/R-00-052

Study findings

- Emission factors generally follow energy ladder
- Diversion of fuel carbon to products of incomplete combustion (PIC) ranges from 5-20% for solid fuels
- New comprehensive database of emission factor
- Need for future studies on aerosol characterization from biomass

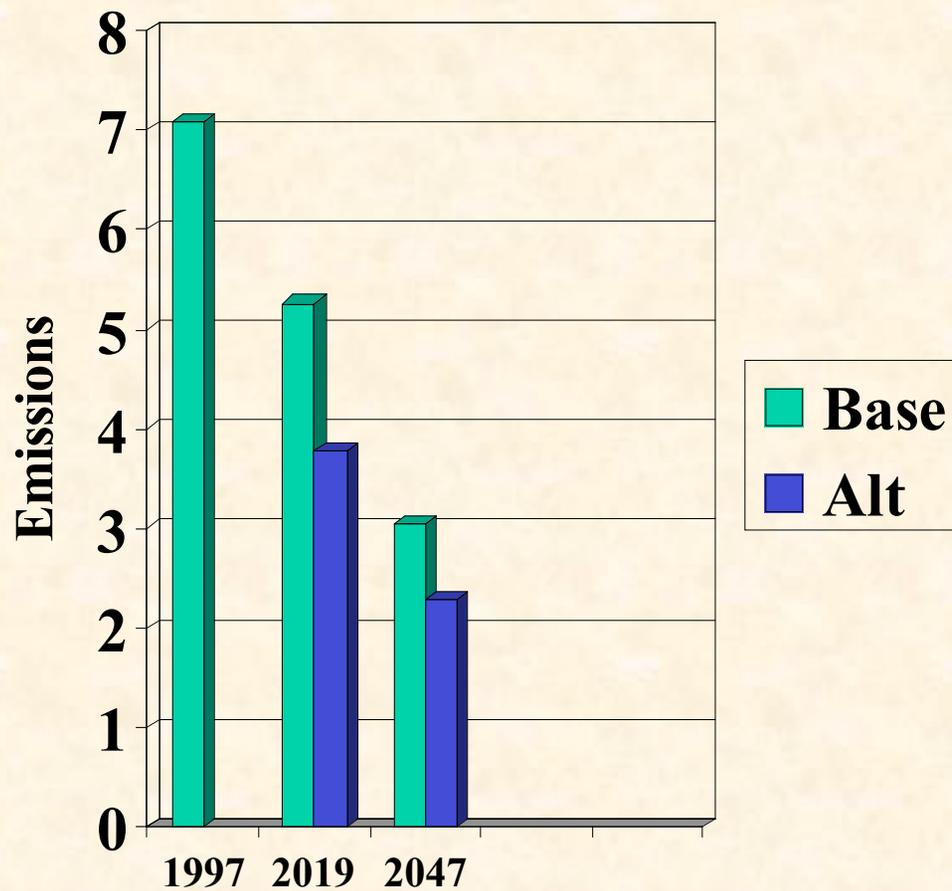
Source: EPA report on GHGs from household stoves in India, Smith, Uma, et. al. 2000, EPA-600/R-00-052

DISHA Study: Residential Sector

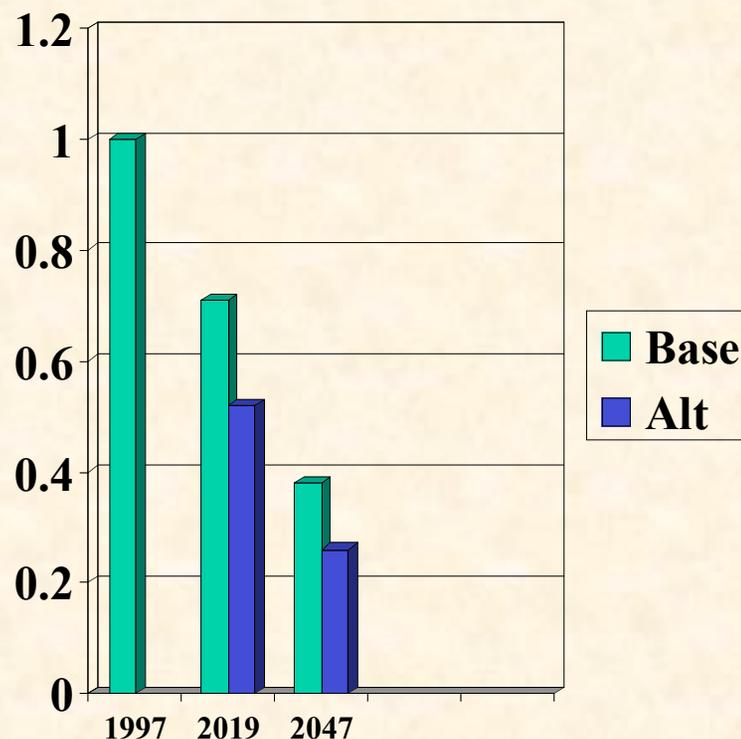
Year	Rural HH Traditional Fuels(%)	Penetration of improved cook stoves(%)	Fuel wood (mt)	LPG:kerosene To bridge E_gap
1997	96	10	169.7	-
2019 Base	75	10	100	25:75
2019 Alt.	75	25	50	25:75
2047 Base	50	10	50	50:50
2047 Alt.	50	50	50	50:50

Other assumptions also made to compute energy requirements

Emissions (mt) CO from Residential sector

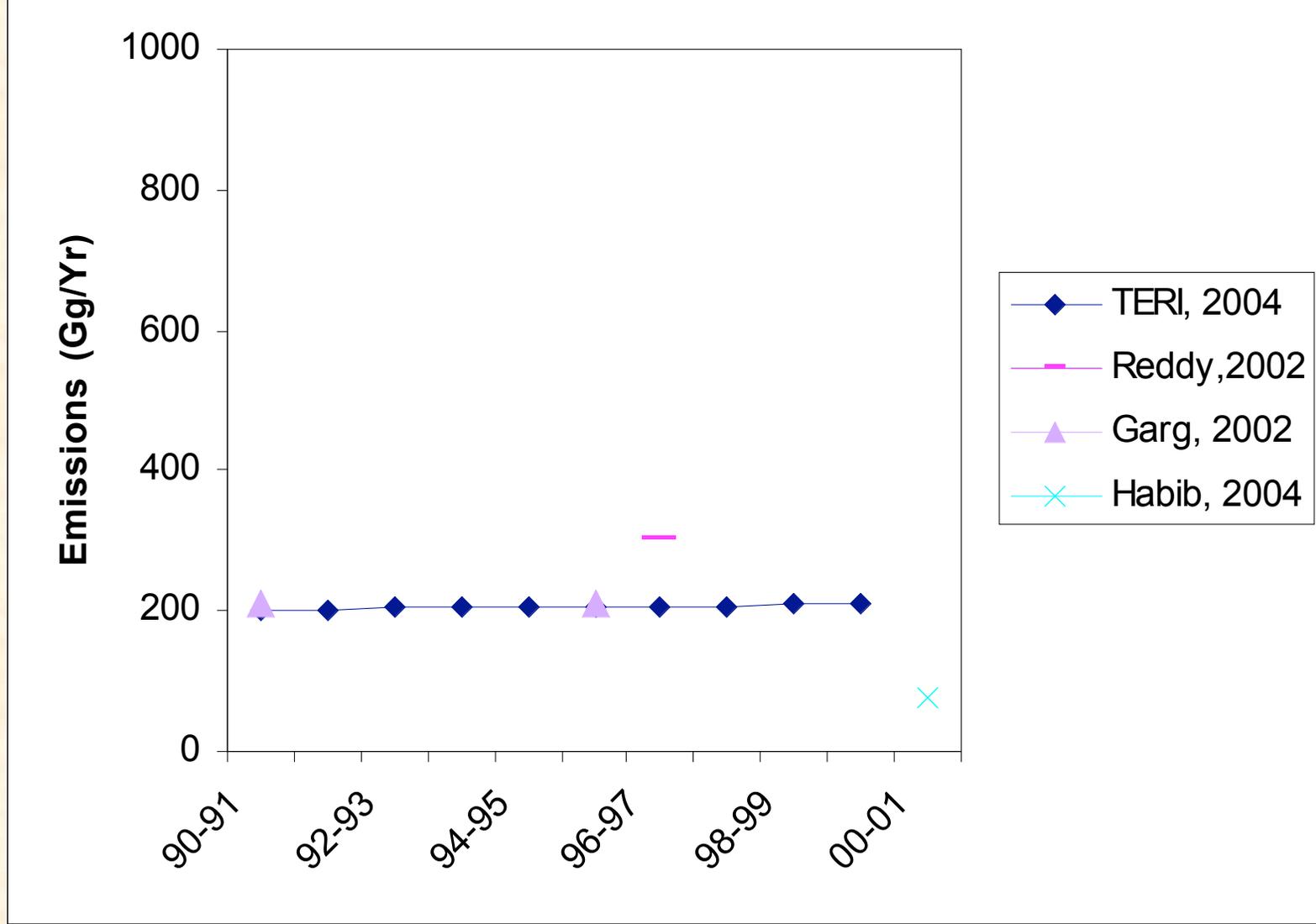


Emissions (mt) SPM from Residential sector



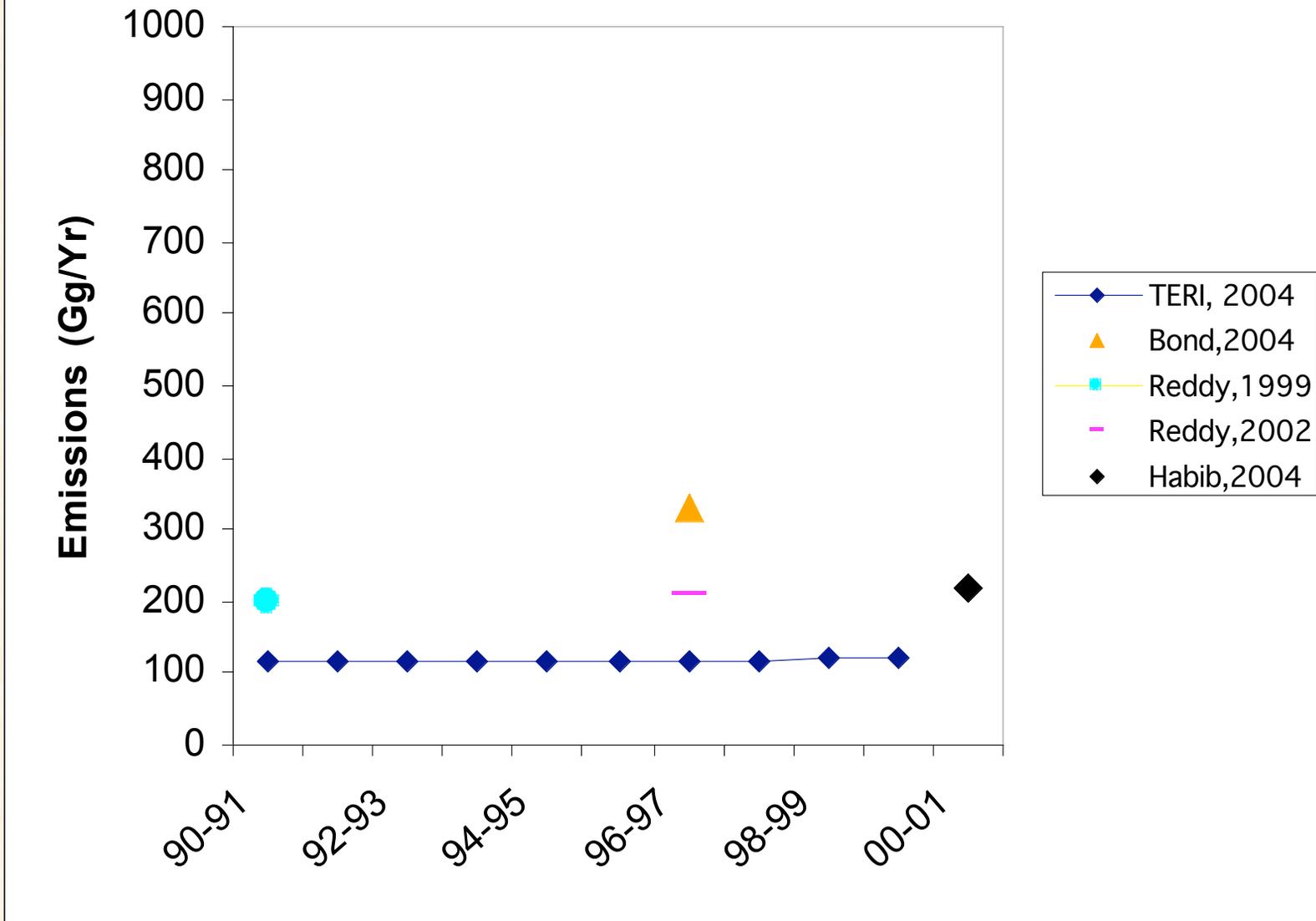
- Residential share less compared to total emissions, however, due to localised nature, has severe impact among poor households in terms of indoor air pollution
- Leads to significant health impacts especially among women and children

SO₂ emissions from biomass combustion



Source: TERI-UCSD project ongoing

BC emissions from biomass combustion



Source: TERI-UCSD project ongoing

Black carbon and SO₂ emissions –India

Large difference in estimates from various studies contributed both by differences in the fuel use estimates as well as emission factors.

In 1999-2000,

BC emissions from biofuels to total emissions= 23%

SO₂ emissions from biofuels to total emissions= 5%

Emissions from open burning of crop residue

- Production data related to 14 major crops
- Assumed 25% of available crop residue burnt in fields
- 1999-00 BC emissions
 - Open burning : 59 Gg (33%)
 - Biomass burning : 120 Gg (67%)
 - Total Biomass: 179 Gg
- Variations in emissions from crop burning follow the crop harvesting season , Two peaks: March-May and Oct-Dec

Source: TERI-UCSD project

Further issues

- Emphasis on development of local emission factors
- Updated energy consumption database
- Further work required to reconcile the source contribution based on results from emissions and measurement