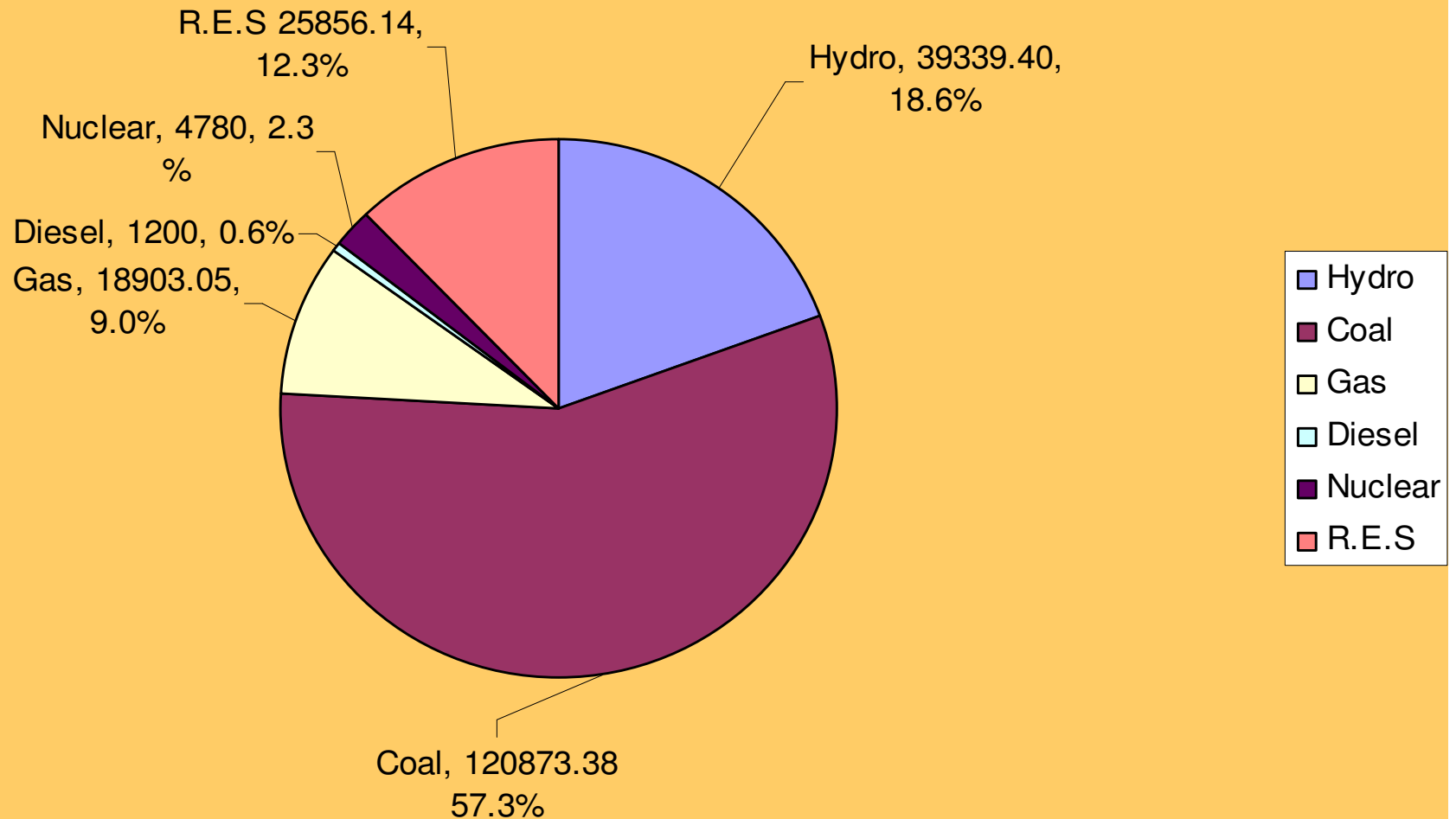


Efficiency Improvement and GHG reduction in Thermal Power Stations

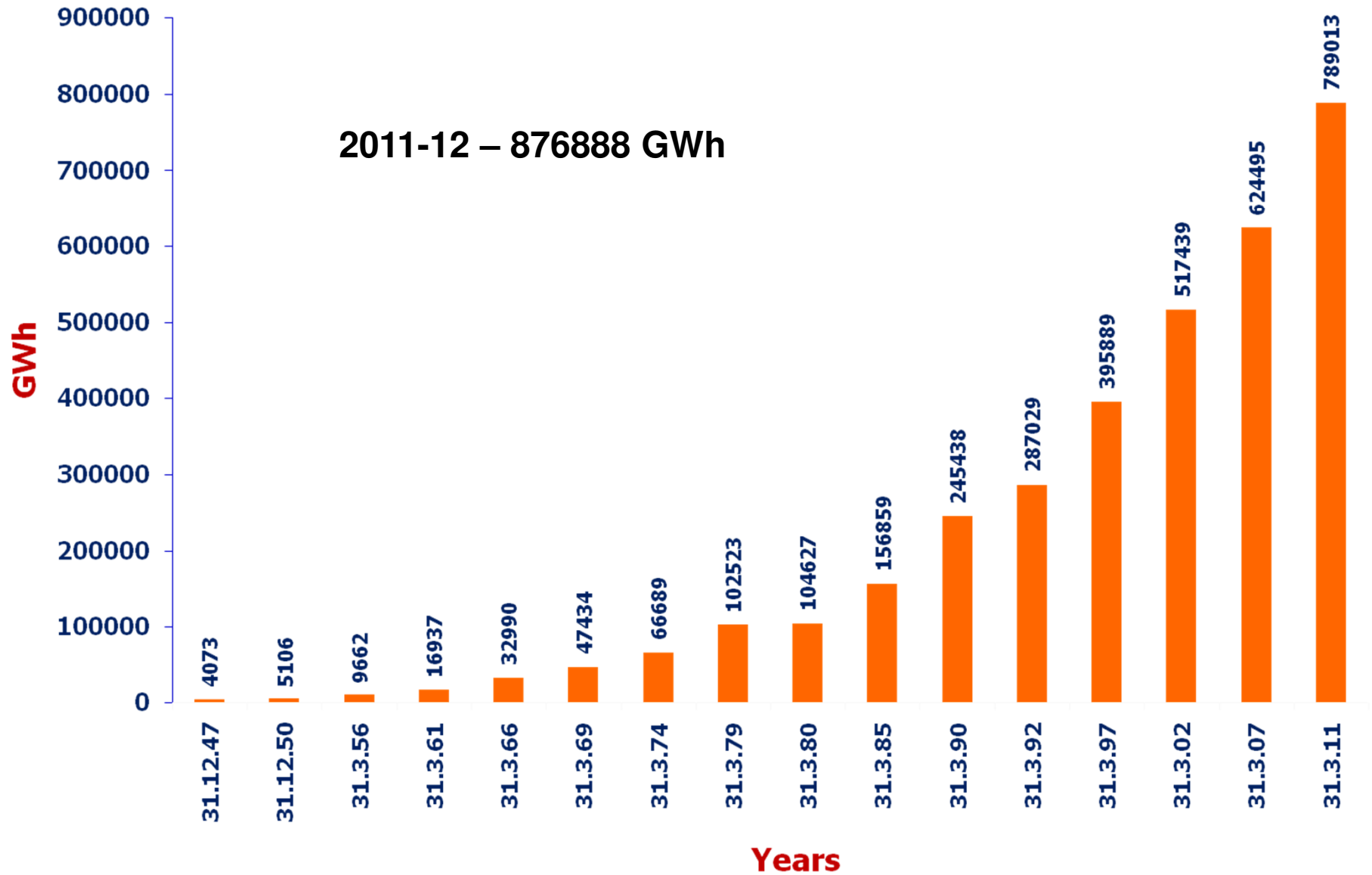
**Praveen Gupta
Central Electricity Authority
New Delhi
8th March, 2013**

Installed Capacity as on 31.12.2012 (Type Wise)



Installed Capacity = 2,10,951.72 MW

GROWTH OF ELECTRICITY GENERATION IN INDIA (Utility Only)

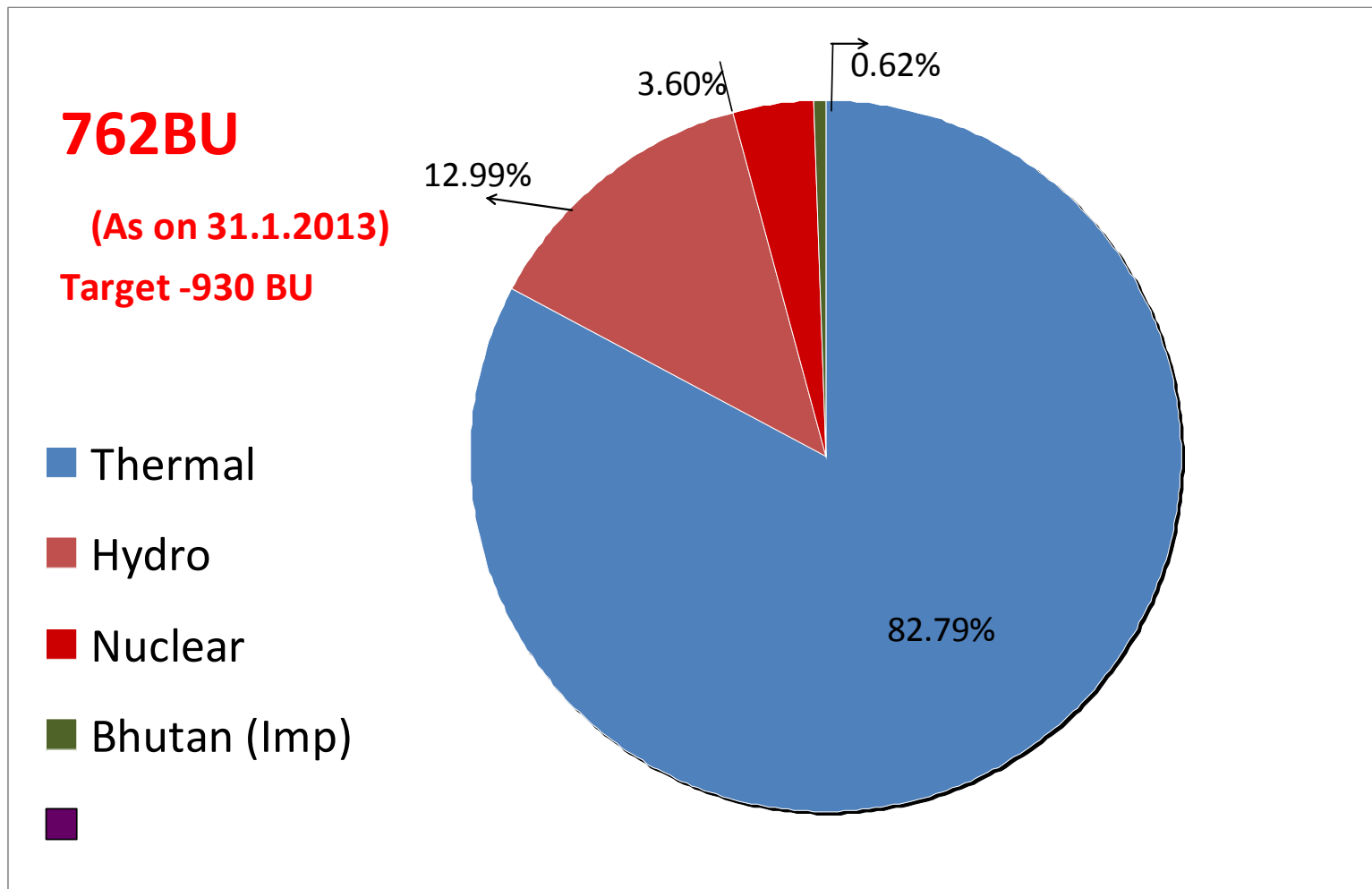


COAL BASED GENERATION AND PLF OF PLANTS

- Generation 2011-12 -876 BU (102.5% of the target)
- Comprises Coal/lignite based 612.7BU (69.9%), Gas = 93.4BU(10.6%)

Status of power generation in the country

Generation Achievement (2012-13) (MUs)



CAPACITY ADDITION DURING 11TH PLAN (2007-2012)

(in MW)

Capacity addition target during 11th Plan	78,700
Capacity addition likely as per Mid Term Assessment	62,374
Capacity Commissioned during 11th Plan	54,964 MW 43384 MW coal 5156MW gas 5544MW hydro

CAPACITY ADDITION DURING 12TH PLAN (2012-2017)

(in MW)

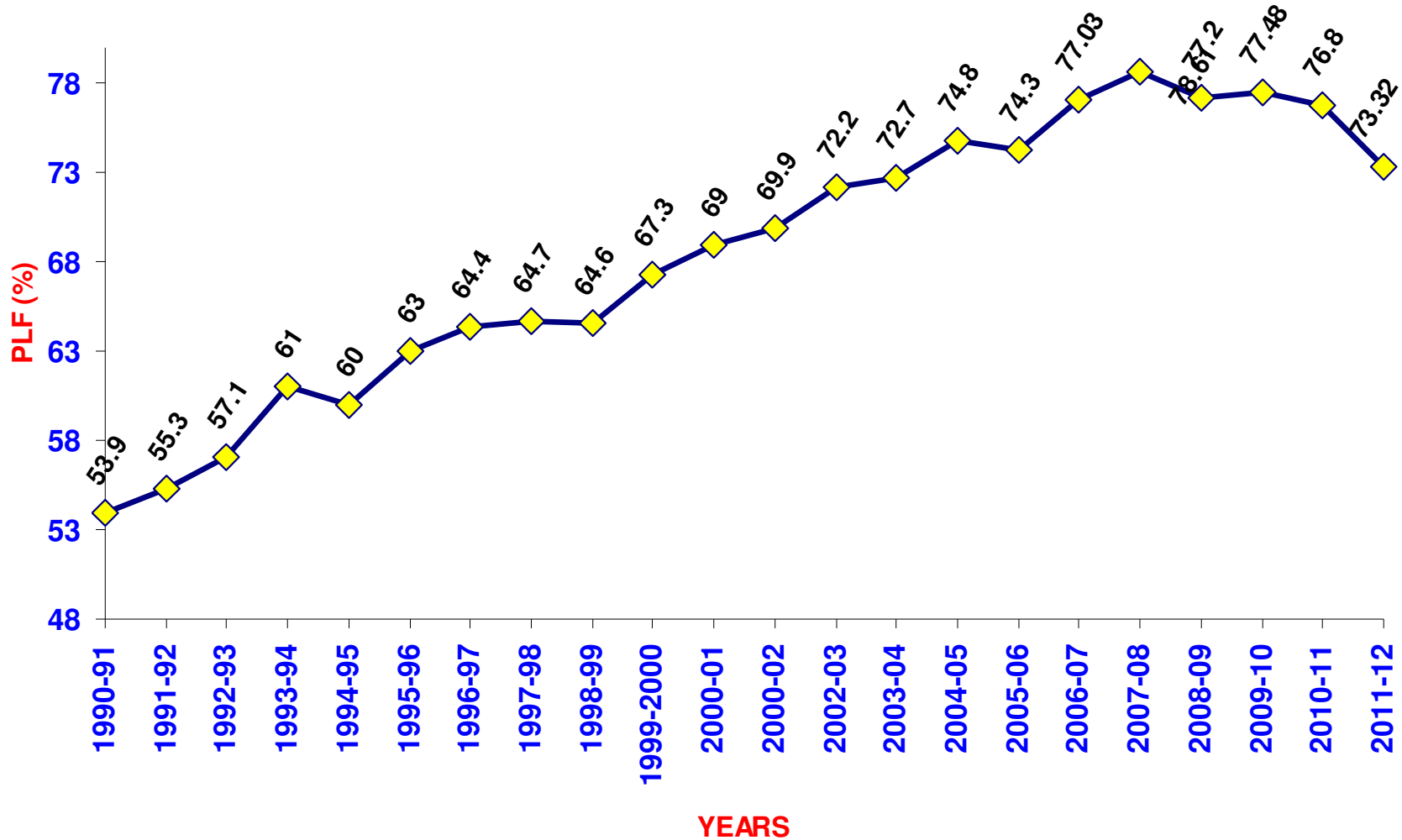
Capacity addition target during 12th Plan	88,537
Capacity already Commissioned during 12th Plan (as on 31 Jan 2013)	Total- 10731 10,055 coal 250 gas 426 hydro

Major Unit Sizes and Steam parameters

Size	Steam Parameter	Design Efficiency	Year
MW	ata/C/C	(%)	
30-50	60/ 482	~31	1950
60-100	90/ 535	32-33	1960
110 to150	130/ 535/535	35-36	1970
200/210	130,150/535/535	36.3,37.8	1977
250	150/535/535	38.3	1995
500	170/ 538/538	38.5	1984
500	170/535/565	38.7	2010
660	247/535/565	~39.5	2010
660/800	247/565/593	40.5	2012

Efficiency on HHV basis

ALL INDIA PLANT LOAD FACTOR OF COAL BASED POWER PLANTS (%)



PLF of Power Plants

- PLF (2011-12) of
 - State sector – 68.43%
 - Central Sector – 82.12%
 - Pvt – 76.19%
 - IPPS – 67.27%
- Reduction in PLF of coal based plants due to
 - Coal shortage
 - Receipt of poor coal quality
 - Low schedules from beneficiaries
 - Increased Hydro generation

PLF% Groupwise

Sno	Capacity Group(MW)	No. of Units	Capacity in MW	PLF% in 2011-12
1	660-800	4	2640	44.31
1	450-600	57	29105	78.38
2	300-330	20	6120	72.26
3	250	40	10000	81.75
4	210	143	30030	78.67
5	195-200	25	4990	74.98
6	100-150	90	10550	49.11
7	25-99	75	4333	55.46
8	Total	454*	97768	73.32

* No of units reviewed (Total commissioned – 490 units)

All India Station Heat Rate Deviations

S.No	Particulars	2011-12
1.	Total Stations analyzed	74
2.	Capacity (MW)	74234
3.	Weighted Average Design SHR (kcal/kWh)	2335
4.	Weighted Average Operating SHR (kcal/kWh)	2603.2
5.	% Operating SHR Deviation with respect to Design SHR	11.49

Actual Heat Rate Deviations

S.No	Particulars	2011-12
1.	Total Stations analyzed	74
2.	No. of Stations in the range of SHR deviation(0-5%)	20
3.	No. of Stations in the range of SHR deviation(5-10%)	17
4.	No. of Stations in the range of SHR deviation(10-20%)	21
5.	No. of Stations with SHR deviation of more than 20%	16

NTPC Station Heat Rate Deviations

S.No	Particulars	2011-12
1.	Total Stations analyzed	15
2.	Capacity (MW)	27035
3.	Weighted Average Design SHR (kcal/kWh)	2287.8
4.	Weighted Average Operating SHR (kcal/kWh)	2414.7
5.	% Operating SHR Deviation with respect to Design SHR	5.55

Efforts towards
improvement in
Efficiency of Thermal
Power Generation

Adoption of Supercritical Technology

- Efficiency gain of about 2 % is possible over sub critical units
- First Supercritical unit of 660 MW Commissioned in Dec-2010, 800 MW in July, 12
- 15 Units with total capacity 10,460 MW operating
- Supercritical to constitute ~40% (~25000MW) coal fired capacity addition in 12th Plan (2012-17)
- 100% coal fired capacity addition in 13th Plan and beyond to be supercritical

Advance Ultra Supercritical Technology

- Efforts underway for indigenous development of 700 deg C technology
- MoU between IGCAR, NTPC & BHEL
- Indigenous design and manufacturing of materials proposed

PAT Scheme

- Perform, Achieve and Trade scheme- aim is to improve Efficiency of the thermal plants both coal & gas based.
- Total Target Set for thermal power stations= 3.2 MTOE out of total 6.686 MTOE
- Threshold limit to be DC = 30,000 tons of oil equivalent (TOE) per annum (all power plants above 11-12 MW will be covered in PAT scheme)
- MOP notified net heat rate reduction targets to 144 Thermal power Stations.
- Stations to achieve the targets within 3 years from date of notification i.e by 31.3.2015
- Penalty for non achievement

Thermal Power Plant Groups under PAT Scheme

Coal/Lignite [97]

Thermal Power Plants
[DC :144 Nos]

Diesel [7]

Gas [40]

Target Setting for Reduction of NHR

Deviation in Net Station Heat Rate from Design Net Heat Rate	Reduction Target for Deviation in Net Station Heat Rate (%)
Up to 5 %	10 %
More than 5% and Up to 10 %	17 %
More than 10% and Up to 20%	21 %

Renovation & Modernization of old thermal power stations

- CEA has prepared a National Enhanced Efficiency Renovation and Modernization Program for implementation during 11th and 12th Plans. This covers R&M of 4971 MW and LE of 16532 MW during 12th Plan

RENOVATION AND MODERNISATION/LE PROGRAMME

- 200 MW and above size units, barring few, performing at national average PLF
- Some 200 MW units crossed economic life of 25 years and have high specific fuel consumption.
- Such units suitable for capacity uprating and extended period of operation – R&M an economical option to supplement capacity addition programme for increased power availability.
- R&M programme primarily aimed at generation sustenance and overcoming problems due to generic defects, design deficiencies/ modifications, obsolescence of equipments / systems, inadequacies due to poor quality of coal, change in terminal parameters w.r.t. design, stringent environmental conditions and safety requirements.
- LE programme focuses on plant operation beyond original design life after carrying out specific life assessment studies of critical components.

RETIREMENT OF POWER PLANTS

- **Retirement in a systematic manner an ongoing activity with focus on closing down**

- **Small and Old units**

- **Units of non-reheat type**

- **Units having very low design efficiencies**

- **Units having very low actual efficiency**

Present Methodology for Retirement of units

- Units deviating more from design to retire first
- Retirement is linked to commissioning of new units
- In case of Gas based , Technology changing rapidly. Faster retirement could be considered to keep abreast with technology development

RETIREMENTS OF OLD UNITS

- Details of Retirements :
 - 11th Plan - 2398 MW has already been retired comprising mainly of small size (<100 MW) ,old and non reheat units
 - 12th Plan(Planned)- 4075 MW (< 100 MW coal units, > 35 years old Gas stations)
 - 13th Plan (Planned) – about 4000MW

Establishment of Excellence Enhancement Centre for Indian Power sector

- Established under Indo German Energy Forum
- Member driven society
- Objective to provide a common platform for sharing best practices in power sector
- Governing body chaired by Chairperson, CEA with members from NTPC, BEE, CBIP etc
- Projects presently under finalization:
 1. Compendium of best practices in coal based thermal power stations.
 2. Combustion optimization for coal based plants.
 3. Condenser optimization
 4. Efficient use of Water in thermal power stations

GHG REDUCTION IN POWER SECTOR

Per Capita CO2 Emissions

(t CO2/capita)

- World – 4.29
- India - 1.37
- China – 5.13
- Germany – 9.16
- France – 5.49
- USA - 16.90

(Source: IEA key world Energy Statistics 2011)

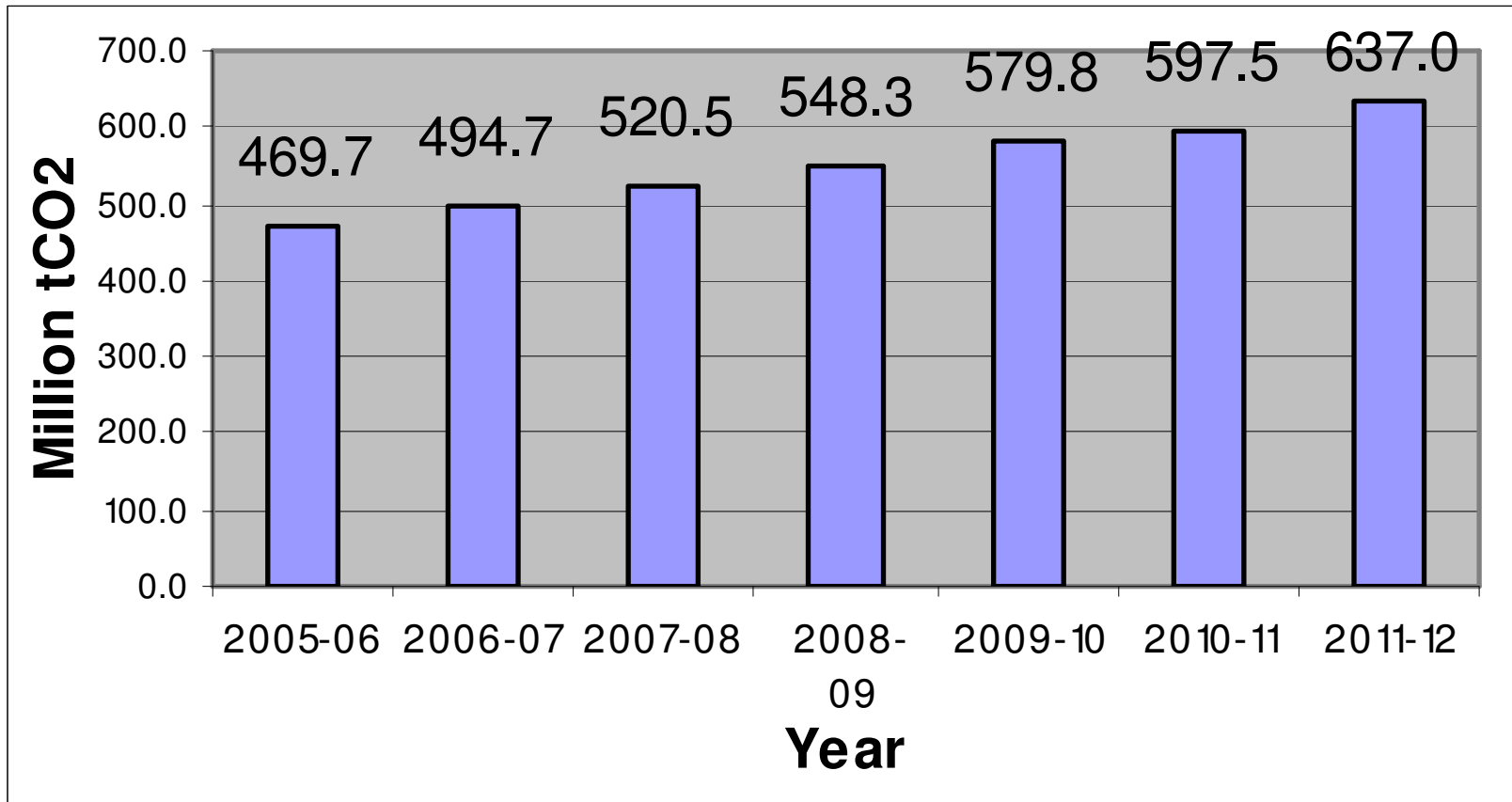
Main Sources of GHG Emissions

- **Energy Sector - Power**
- **Transport Sector**
- **Agriculture Sector**
- **Industrial Sector**
- **Power sector is estimated to contribute around 50% of total CO2 Emissions**

CO2 Emissions from Power Sector

- **CEA is carrying out studies to calculate total CO2 emission from all grid connected power stations since the year 2000-01**
- **The database along with the user guide is available on CEA website**
- **www.cea.nic.in**

Absolute CO₂ Emissions from Indian Power Sector



Emissions are from Grid Connected power stations

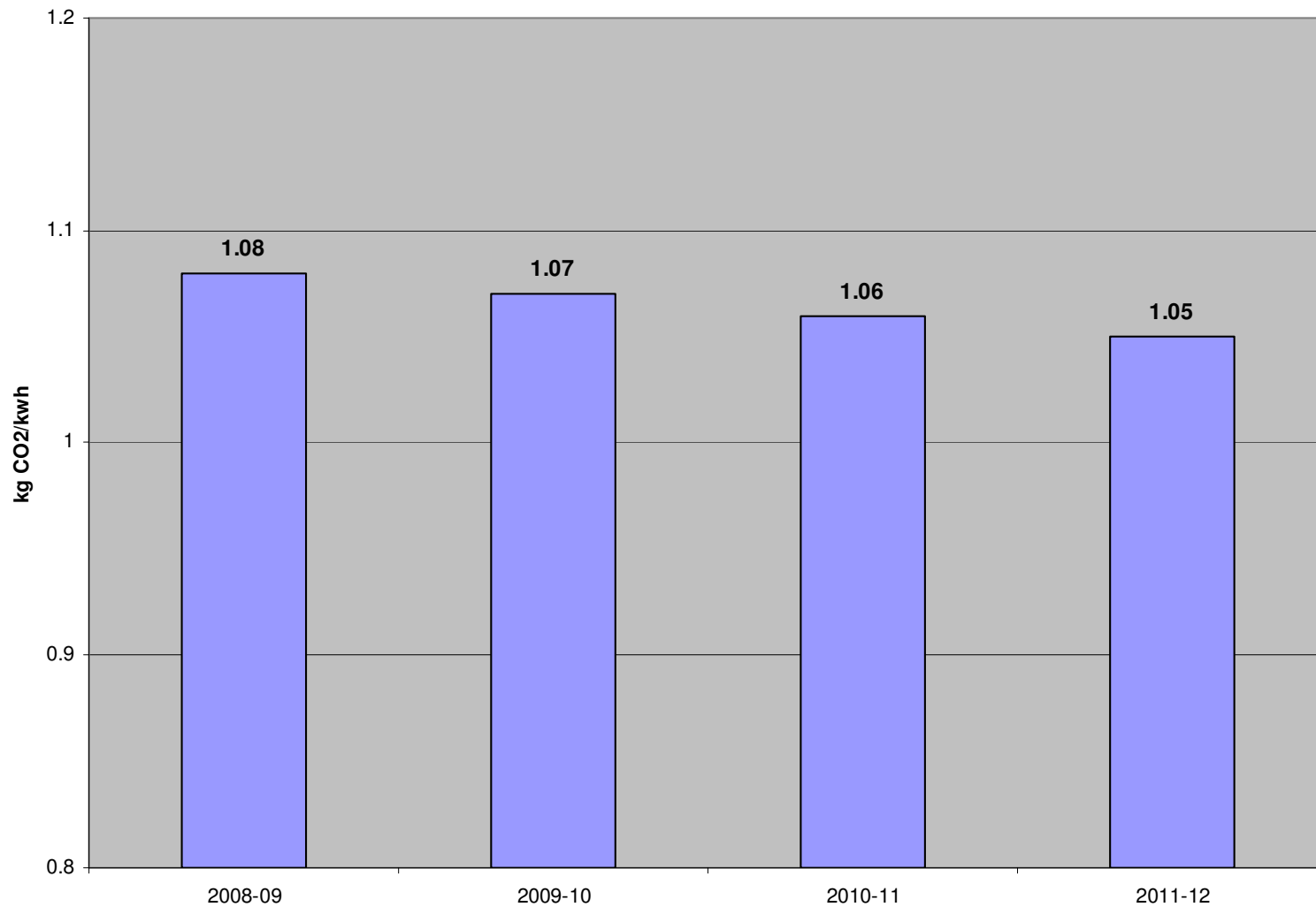
Average CO₂ Emissions per unit

(Based on Net Generation)

Grid	Average kg CO ₂ /kWh	
	2010-11	2011-12
NEWNE	0.80	0.78
Southern	0.75	0.76
India	0.79	0.78

NEWNE – Northern, Eastern, Western and North Eastern Grid

Average Emissions in Kg CO₂/kwh(net) from coal based power plants



NTPC Stations – 0.97 kg CO₂/Kwh (from coal plants) in 2011-12

THANKS