CSLF Workshop on Capacity Building for CCS
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Theme-IV
Needs Of Emerging Economies- India

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Overview

- Indian Power Sector Profile
  - o Installed Capacity Mix
  - o Capacity Addition Plans
  - o Coal consumption
- Improving Efficiency
  - o Higher size units
  - o Supercritical technology
  - o Efficiency improvement in existing stations
- New Technology Options
- CCS Workshop- Observations
- Summary

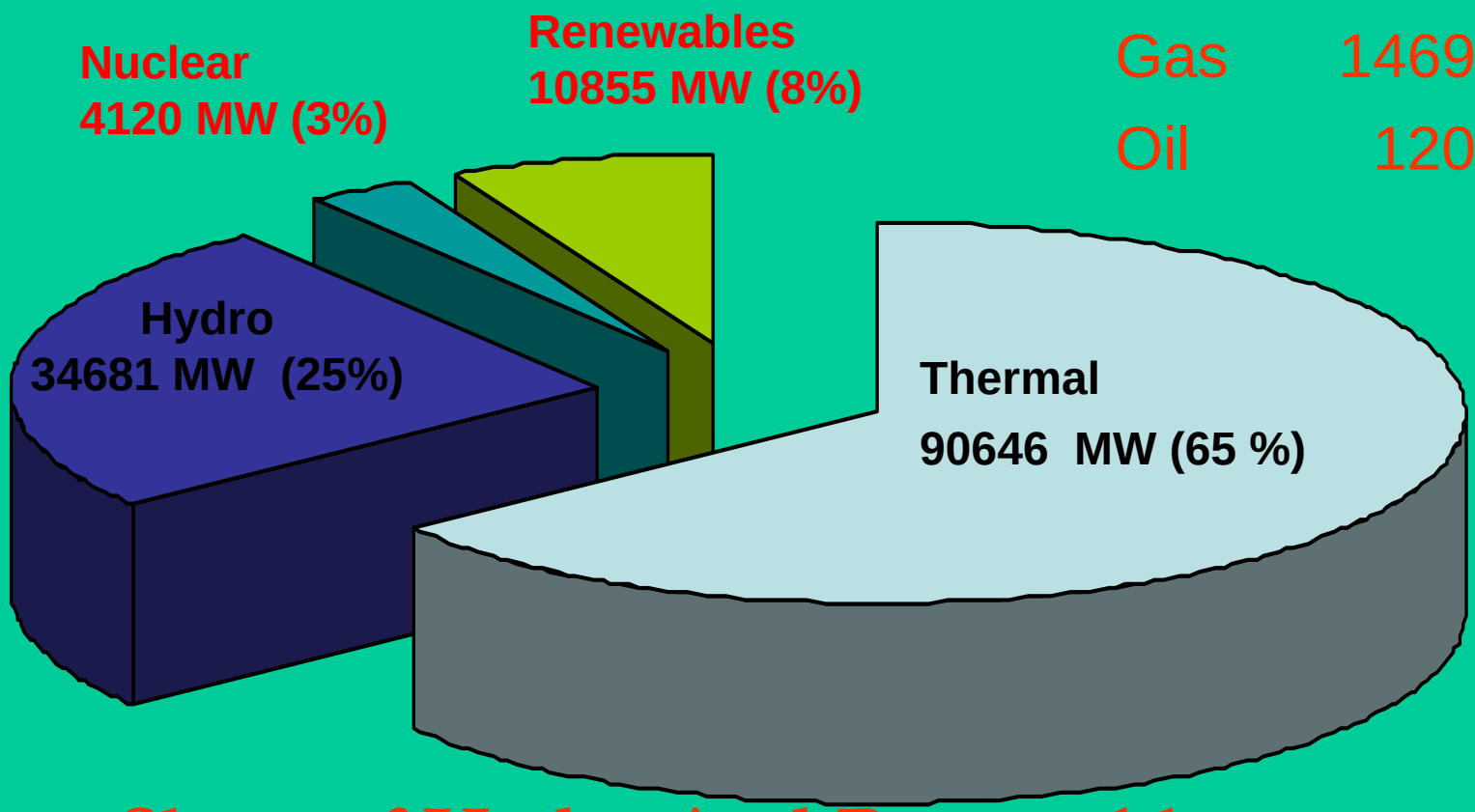
Indian Power Sector

- Installed Generation Capacity ~140 GW
- Electricity Generation- 660 Twh (2006-07)
- Per Capita Consumption-665 Kwh/Yr (2006-07)
- Shortages (Energy ~ 8.5%, Peak ~ 15%)
- Rapidly Expanding
- Emphasis on Efficiency
- Increasing private sector participation

Installed Capacity (As on 31st Dec. 2007)

Total : 140302 MW

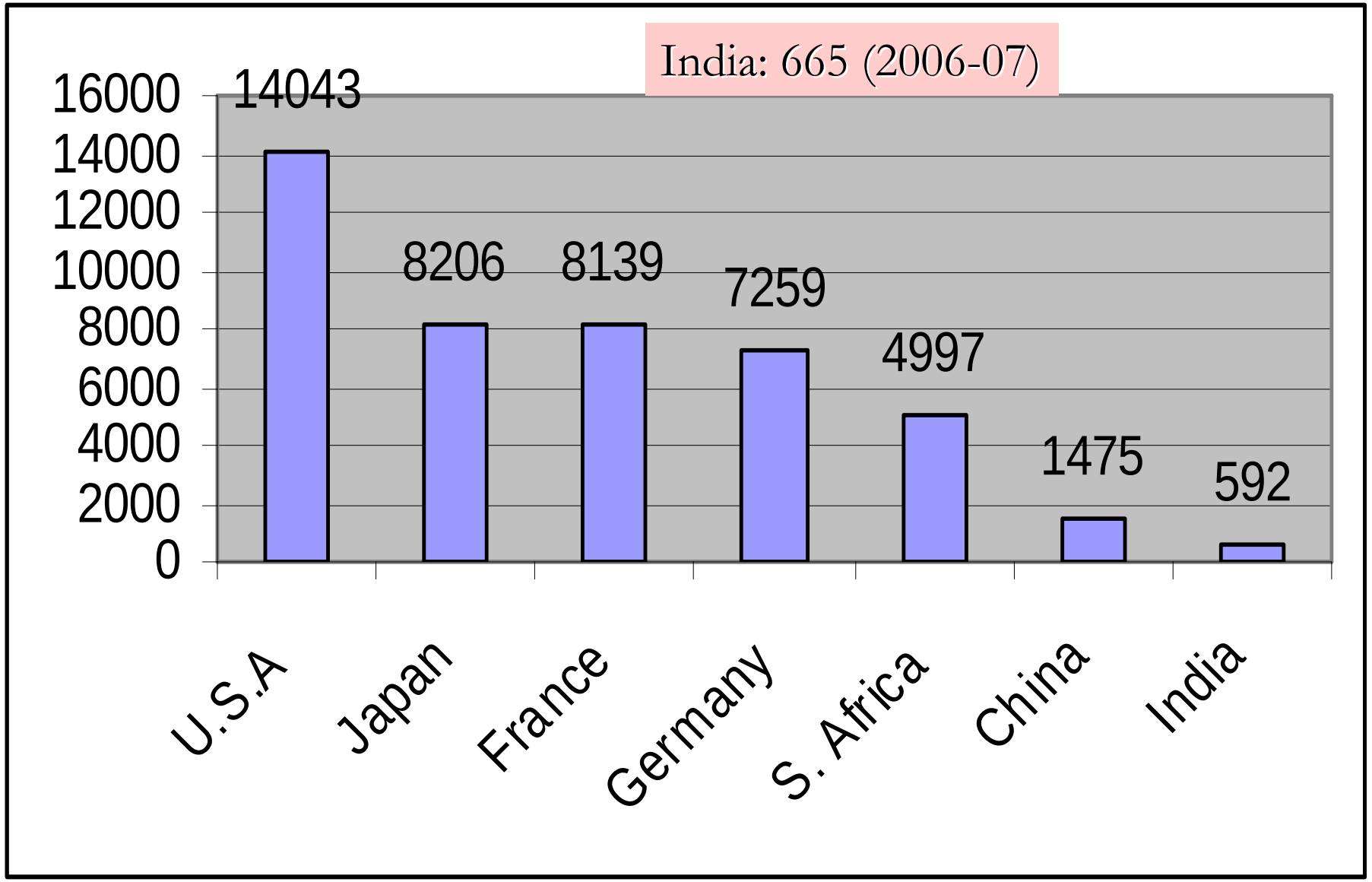
Coal	74752
Gas	14692
Oil	1202



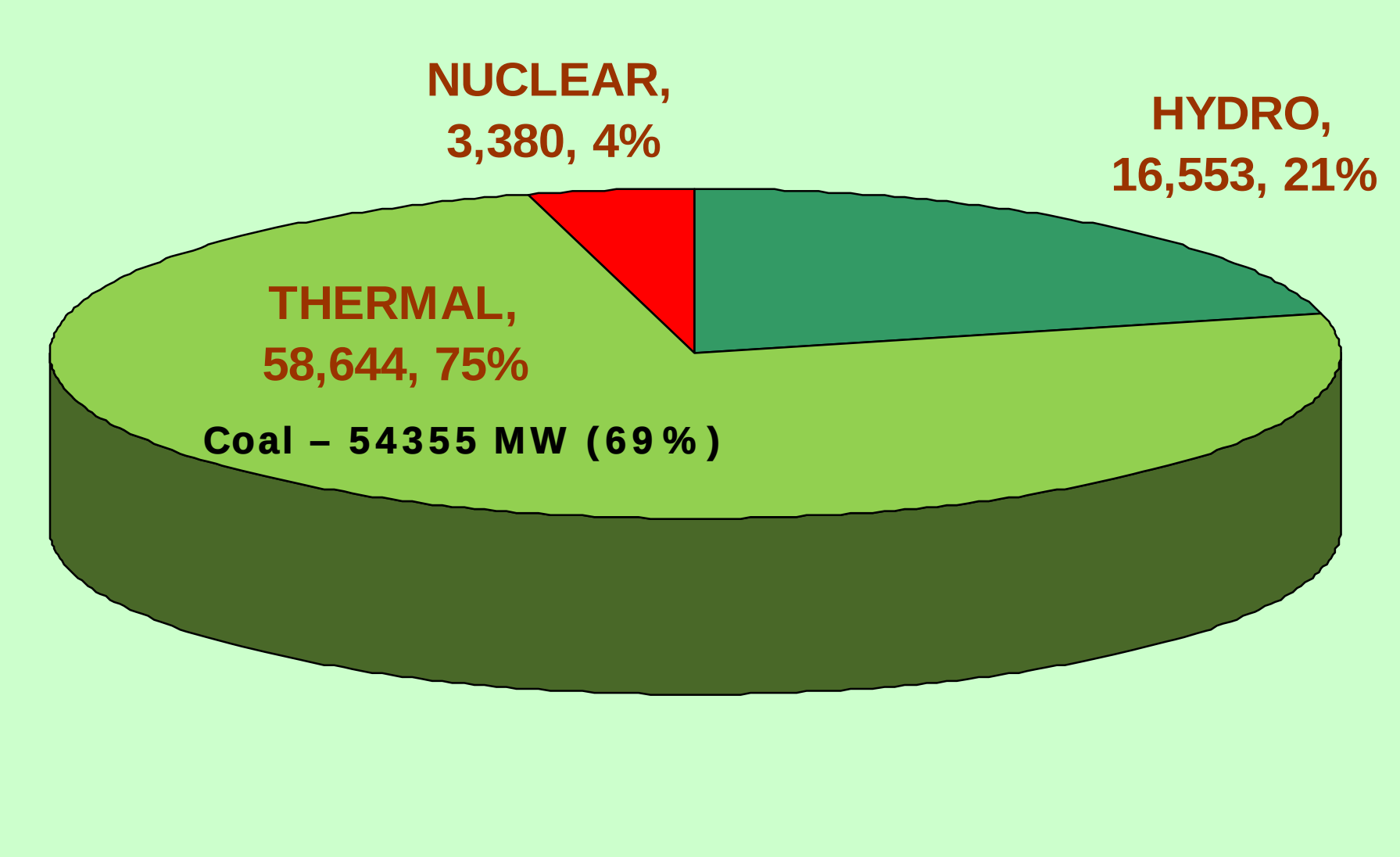
Large Share of Hydro And Renewable

Our Coal Based Capacity is ~ 5% of World Coal Based Capacity

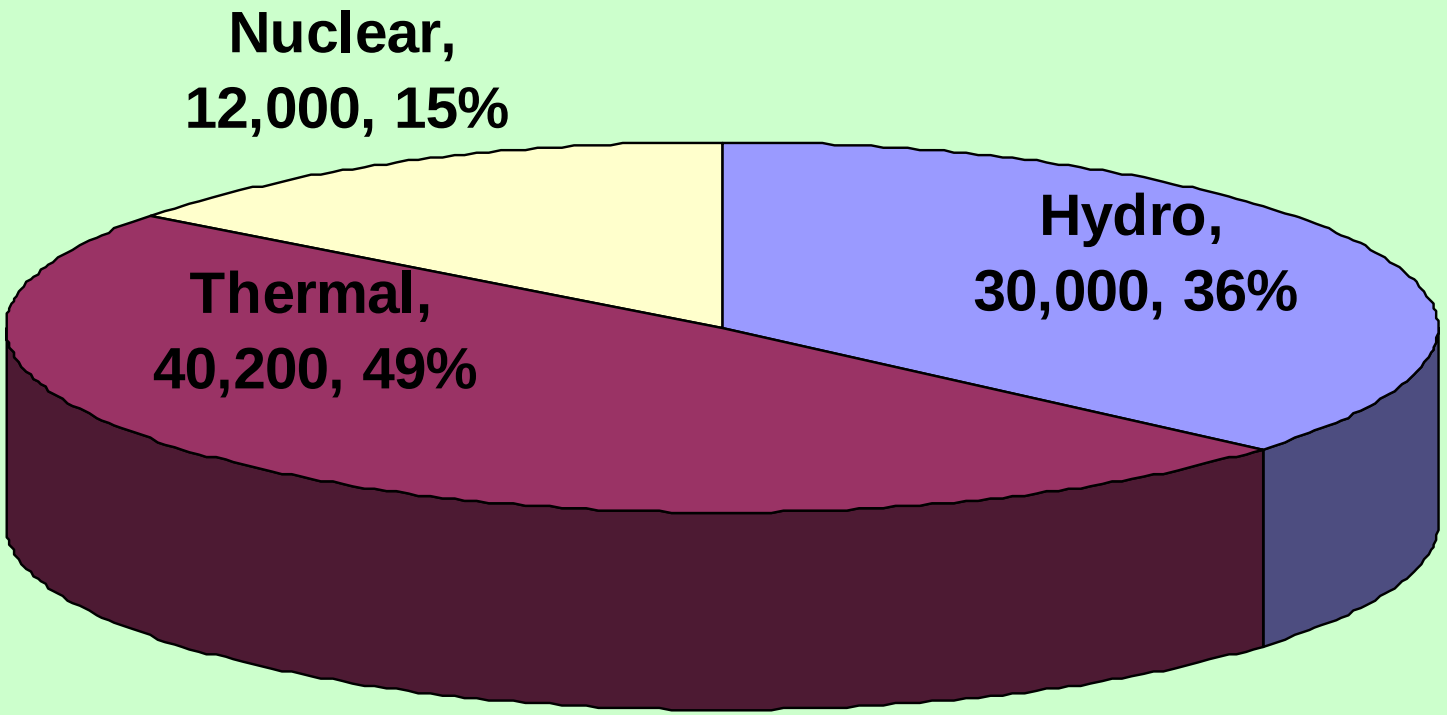
Per Capita Electricity Consumption (Yr 2003)



CAPACITY ADDITION PLAN (2007-12)
78,577 MW



CAPACITY ADDITION PLAN (2012-17)
Tentative – 82,200 MW



Efforts Towards Reduced Contribution from Coal

Coal consumption

- Proven coal reserve of about 96 billion tons
- Present coal consumption: 303 Mn Tons p.a.
  - Washed coal: 033 MT
  - Imported : 010 MT
- Projected coal consumption (2012) – 550 MT
- Coal mining capacity being augmented by allocation of captive coal blocks to private /public sector

Indian Coal Quality

- Indian coal - High ash content, Slow burning, & Highly abrasive ash.
- PC technology – the current workhorse perfected gradually through learning curve
- Any new technology must cope up with realities of Indian coal
- Being Abundantly available indigenously, it will remain the mainstay fuel for power generation.

Improving Efficiency

- **Supercritical Technology Higher size units**
  - o Higher efficiency
  - o Lower GHG emission
  - o Economy of scale
  - o Quicker capacity addition
  - o Reduced land/manpower requirement
- **Efficiency Improvement in existing stations**
  - o Upgrading old fleet
  - o Replacement in select cases

Drivers For Higher Plant Efficiency

- **Rapidly Growing Demand**
- **Open & Competitive Markets**
- **Increased Emphasis On Environmental Considerations**
- **Input Constraints- Fuel, Land & Water**
- **Incentives – CDM**

Prevailing Unit Sizes

Unit Size	MS. Pr	MS/ RH Temp	Design Efficiency * Gross on HHV
	kg/cm²	°C	(%)
30-50	60	482	~31
60-100	90	535	32-33
110/120/140/ 150	130	535/535	35-36
210/250 KWU	150	535/535	37.8
250 (New)	150	535/535	38.4
500	170	538/538	38.6

Proposed Unit Sizes

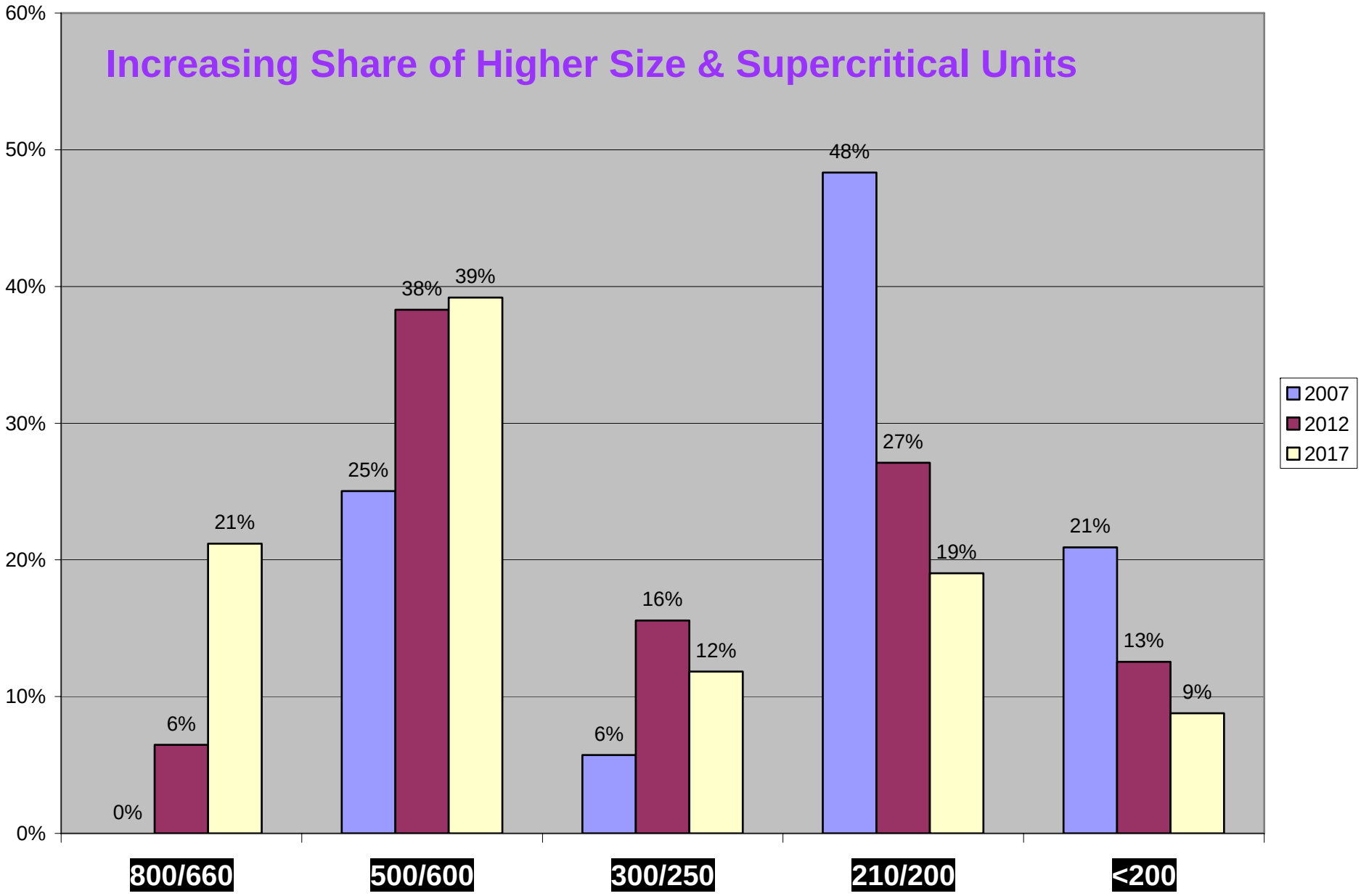
Unit Size (MW)	Parameters	Design Efficiency * Gross on HHV
660	247kg/cm^2 538/565 ^{O} C	39.56 %
	247kg/cm^2 565/593 ^{O} C	40.24 %
800	247kg/cm^2 565/593 ^{O} C	40.24 %

Expected Efficiency Gain of ~ 4% over Present 500 MW Units (170 kg/cm^2 535/535 ^{o}C)

Efficiency
Impact of Tropical Climate & Coal

Parameter	**Impact on Gross Efficiency (%)**	**Impact on Aux. Cons (%)**
CW Temperature (33 Vs 15) ^{o}C	2-3%	1.5%
Indian Coal		

Share of Different Unit Sizes- Yrs 2007-17



Supercritical Technology

- Supercritical technology being adopted to enhance efficiency, reduce coal consumption and GHG emission
- 660/800 MW units planned in big way
- Parameters adopted 247 kg/cm^2 535/565 deg C and 247 kg/cm^2 565/593 deg C
- Six units under execution
- Ultra Mega Projects, 4000 MW each, envisaged with supercritical units.
  - **3 projects already awarded**
- Many more supercritical units in pipeline.

Efficiency improvement in existing stations

- Upgrading old fleet of power stations through Renovation & Modernisation
- Improving efficiency / availability through improvement in Operating &Maintainance practices
- Replacement of very old poor performing units

Future Approach Towards R&M

- Shift in focus from ‘Generation Maximization’ to ‘Overall Plant Optimization’
- Replacement of very old small size low efficiency units
- High end technology solutions for efficiency enhancement
  - Steam turbine and boiler upgrades
  - Steam flow path modification
  - Improved plant control
  - Higher steam parameters
- Additionality in efficiency (Beyond Original Design efficiency)

New Technology options

- Ultra supercritical (USC) and advanced USC technology
- Circulating Fluidised Bed Combustion (CFBC)
- Integrated Gasification Combined Cycle (IGCC)

Ultra supercritical technology

- Parameters of about 280 bars and 600 deg C – more efficient but higher capital cost
- Experience limited mainly in Japan, Germany and Denmark
- Techno-economics, suitability with Indian coal, institutional capacity building to be guiding factors for adoption

Circulating Fluidized Bed Combustion

- CFBC being used for high Sulphur lignite

- 125 MW CFBC units
  - 4 units operational at Surat lignite and Akrimota
  - 6 units under implementation at Surat lignite, Barsingsar and Giral TPS

- 250 MW CFBC units
  - Under installation at Neyveli Lignite

IGCC

- Limited International experience available with low ash coals
- No large IGCC units in operation with fluidised bed gasifier considered suitable for Indian coals
- High Cost
- India pursuing a demo project of about 100 MW by NTPC
  - Through international co-operation (Feasibility study done by Nexant, USA)
  - Through indigenous R&D – NTPC & BHEL

International Participation

- Close watch on International developments
- Participation in International forum
  - FutureGen
  - Carbon Sequestration Leadership Forum
  - Asia Pacific Partnership on Clean Development and Climate
- Kyoto Protocol
  - Large Nos. of CDM Projects
  - Official CO_2 Emission Baseline Notified

CCS Some Observations..1

- Present Sequestration efforts have mainly been pursued in areas of EOR and EGR
- Possible economic benefits appear to be the driver in these areas.
- Developments and Wide applications in these areas could reduce costs
- Site Specific studies/methodologies required.

CCS Some Observations..2

- CCS technologies would be specific to the input conditions
- Techno economics varies widely with fuel quality (Sulphur, Ash, GCV.) & local conditions.
- Concerns of Safety and Reliability of long term storage need to be addressed
- Indian coal is a challenge.
- No proven gasification technology for Indian Coal

CCS Some Observations..3

- Presently CCS Technologies are Expensive and involve large energy penalty.
- No Credible Cost Estimates available.
- Wide variations in costs estimates by Various Studies done. All studies project very high costs.

CCS Some Observations..4

- CSLF charter provides for making CCS **“Commercially Competitive”.** Efforts needed to Pursue this objective to reduce costs significantly.
- Collaborations, Sharing of Knowledge & Open IPR regime are Possible Solutions.
- India’s vast pool of Scientific and Technical manpower could be utilized by International community.

Summary

Indian Power Sector

- **Efficiency Increase**
  - Supercritical Technology
  - Efficiency Oriented Renovation / Up gradations
- **Improving Generation Mix**
  - Hydro & Renewables
  - Nuclear
- **Active participation in International Forum**
  - Development of Reliable, Safe and Economically Viable Technologies for Efficiency Improvement & CO2 Mitigation

THANKS