Indo-German Symposium on Energy Efficiency

India's expansion plans for coal fired power generation including future technological requirements

15.05.2008

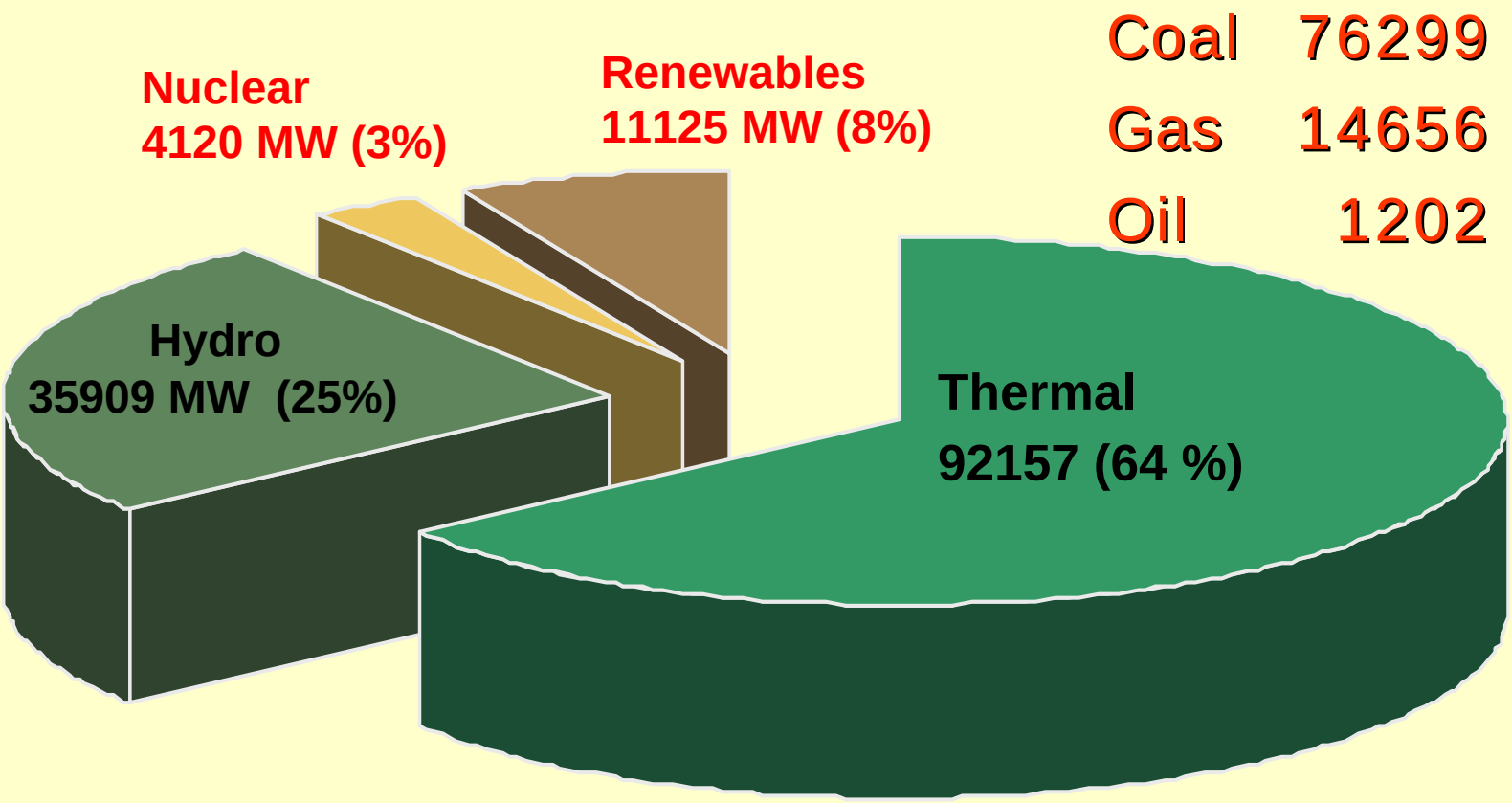
BY

Suresh Chander
Chief Engineer
Central ElectricityAuthority

OVERVIEW

- Present Power Supply Position and Expansion Plans
- Indian Coal
- Approach to Clean Development
- New Technology Options

Installed Capacity (As on 30th April 2008)



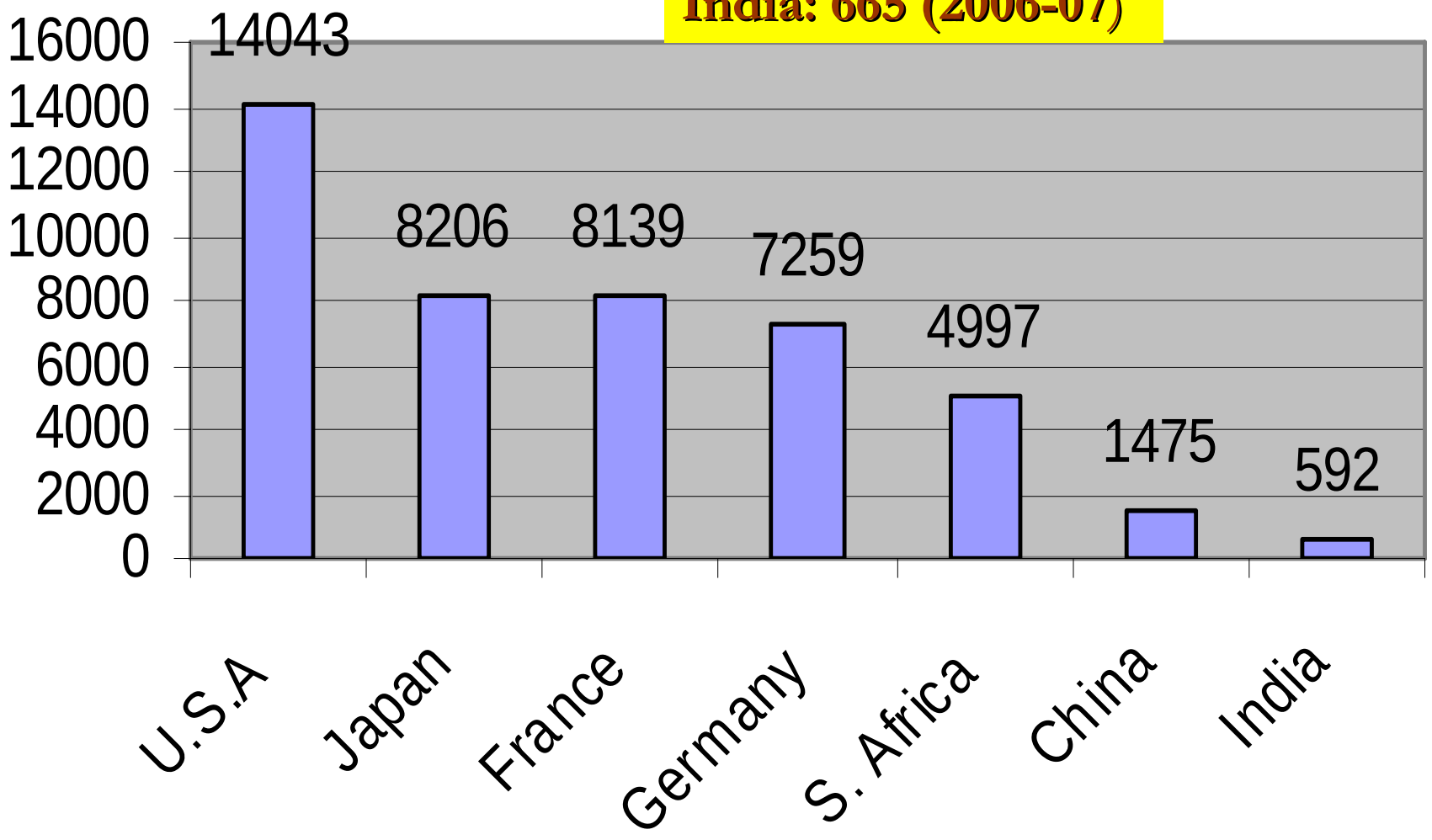
Total : 1,43,311MW

ACTUAL POWER SUPPLY POSITION (2007- 08)

	Peak (MW)	Energy (MU)
Requirement	1,08,866	7,39,345
Availability	90,793	6,66,007
(-)Shortage/ (+)Surplus	(-) 18,073	(-) 73,338
(%)	(-) 16.6	(-) 9.9

Per Capita Electricity Consumption (Yr 2003)

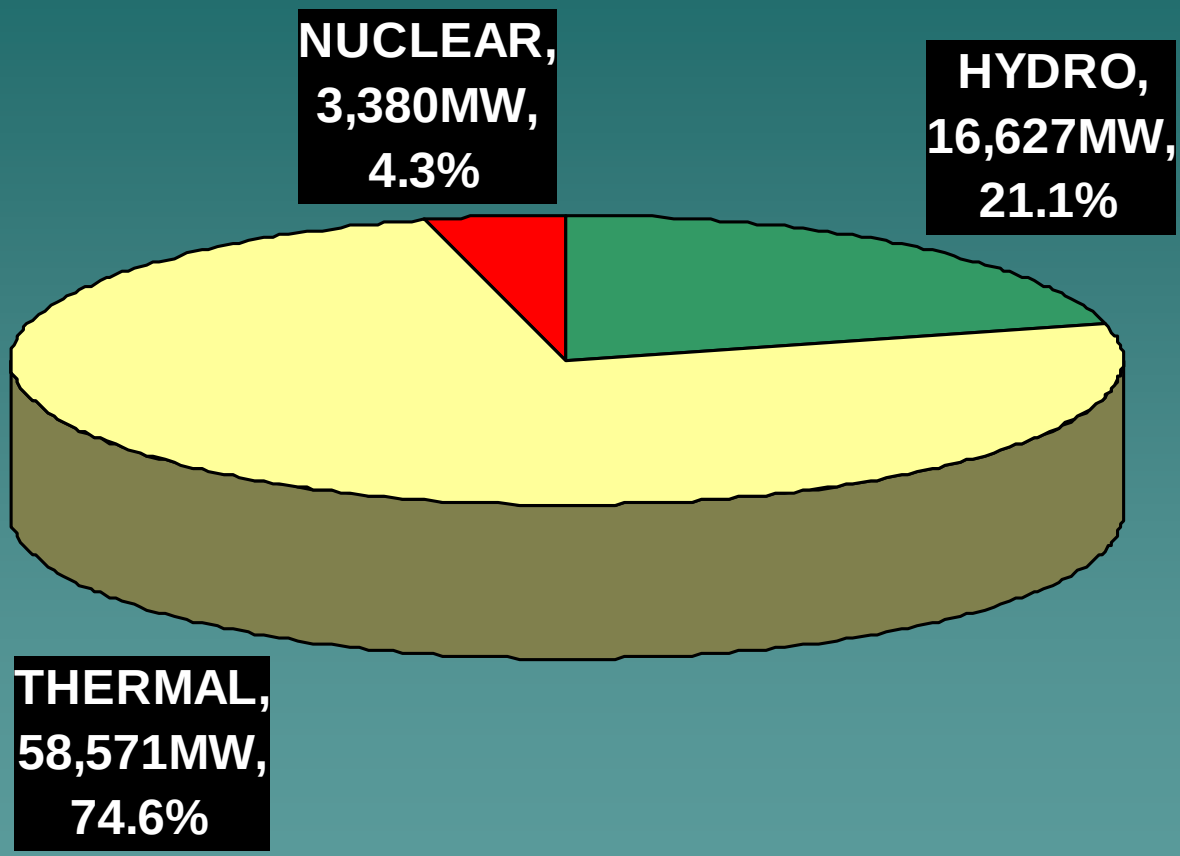
India: 665 (2006-07)



DEMAND AND CAPACITY ADDITION REQUIREMENT DURING 11TH AND 12TH PLANS

Year	Energy Requirement (BU)	Peak Demand (MW)	Proposed Capacity Addition during 5 year plan (MW)	Generation growth rate required (CAGR)
2011-12	1038	1,52,000	78,577 (11th Plan)	9.5%
2016-17	1470	2,18,200	82,200 (12th Plan)	7.4%

CAPACITY ADDITION DURING 11th PLAN (2007-12)- 78,578 MW



(Coal – 51,650 MW
Lignite- 2,280 MW
Gas- 4,641 MW,)

11TH PLAN –CAPACITY ADDITION

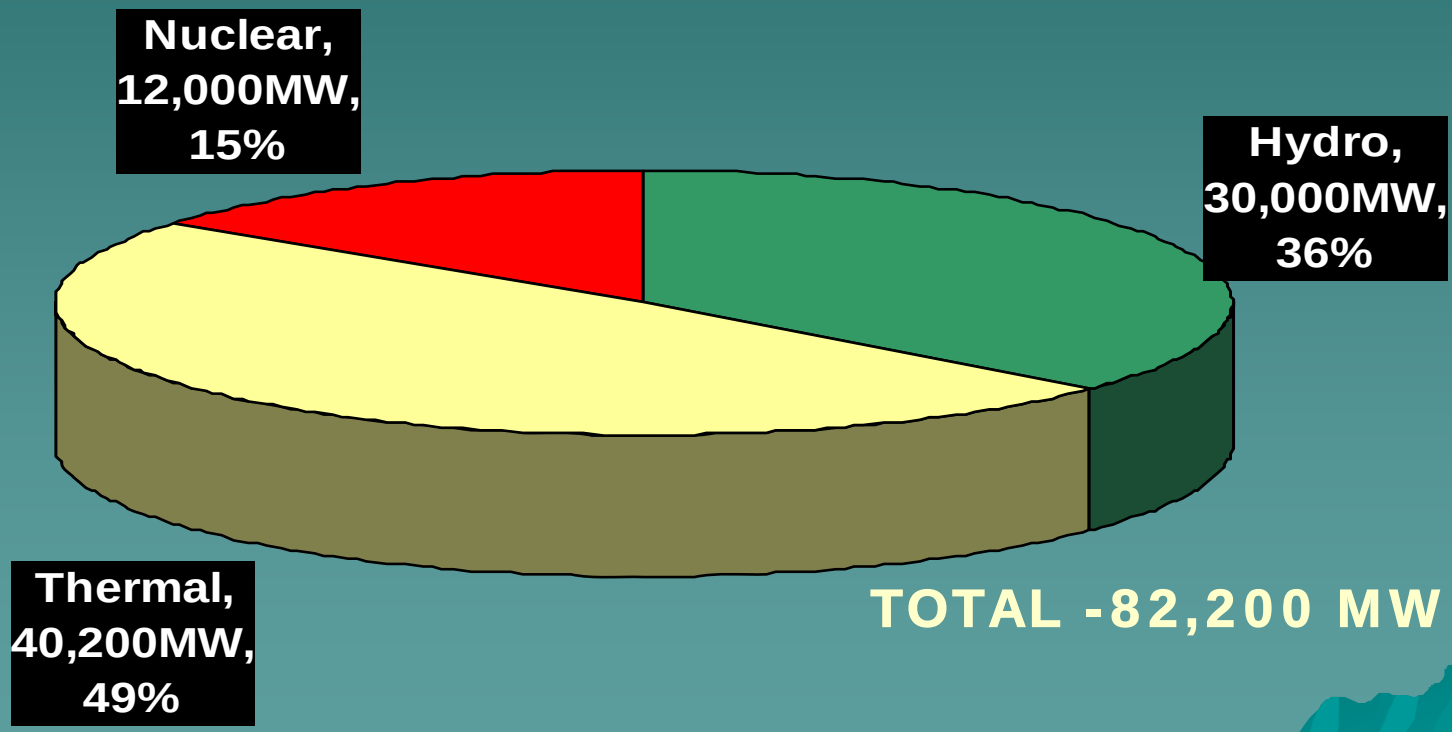
- 11th Plan target - 78,578 MW ⇒ 4 times 10th Plan achievement
  - 9,513 MW capacity - already commissioned
  - 64,097 MW - under construction
  - 9170 MW - to be awarded

  Total: 80,020 MW
- Additional 4,490 MW thermal projects under best effort category
- Above capacity excludes:

  Renewables -13,500 MW

  Captive Power Plants

TENTATIVE CAPACITY ADDITION DURING 12TH PLAN (2012-17) (9% GDP growth rate with 0.8 elasticity)



TOTAL -82,200 MW

FUEL REQUIREMENT DURING 2011-12

Fuel	Requirement (2011-12)
Domestic Coal	550 MT
Lignite	33 MT
Gas/LNG	89 MMSCMD

OVERVIEW

- Present Power Supply Position and Expansion Plans
- Indian Coal
- Approach to Clean Development
- New Technology Options

Indian Coal

- Indian coal
  - high ash
  - slow burning
  - highly abrasive
  - high ash fusion temperature

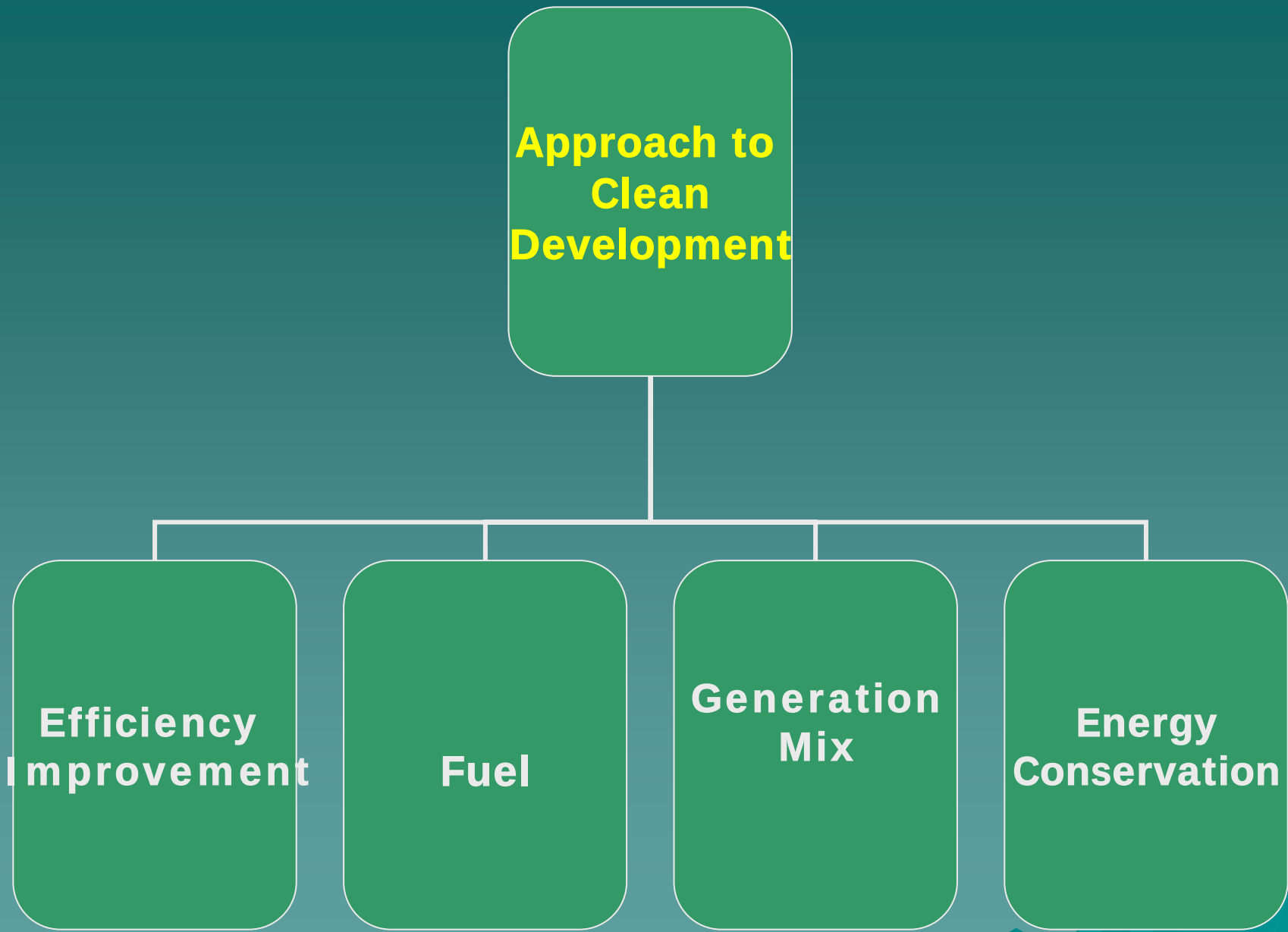
  All these factors affect the design of boiler
- PC technology – the current workhorse perfected gradually through learning curve
- Any new technology must cope up with realities of Indian coal
- Being the cheapest and indigenously available fuel, it will remain the mainstay fuel for power generation for many more years

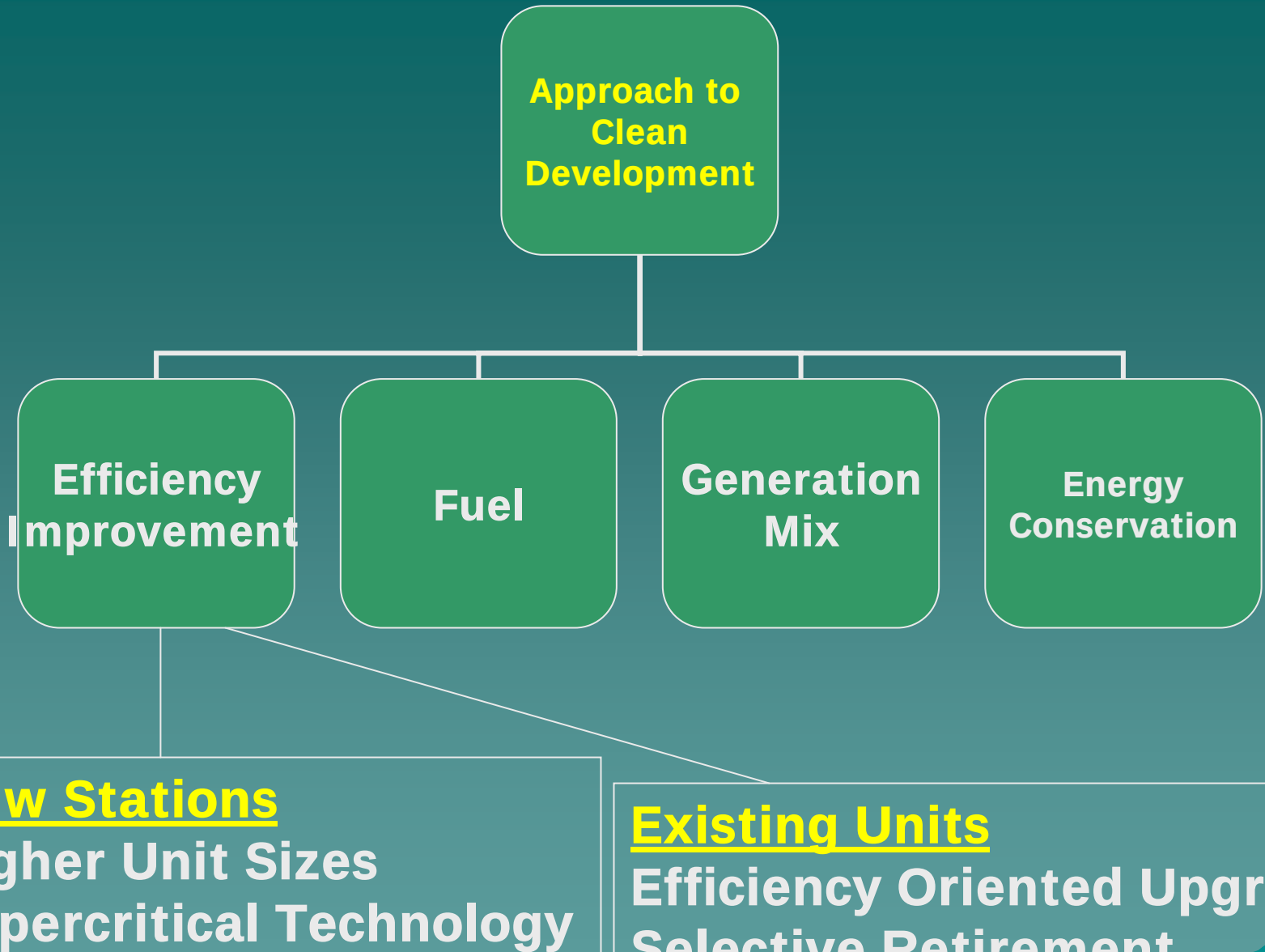
Coal Beneficiation

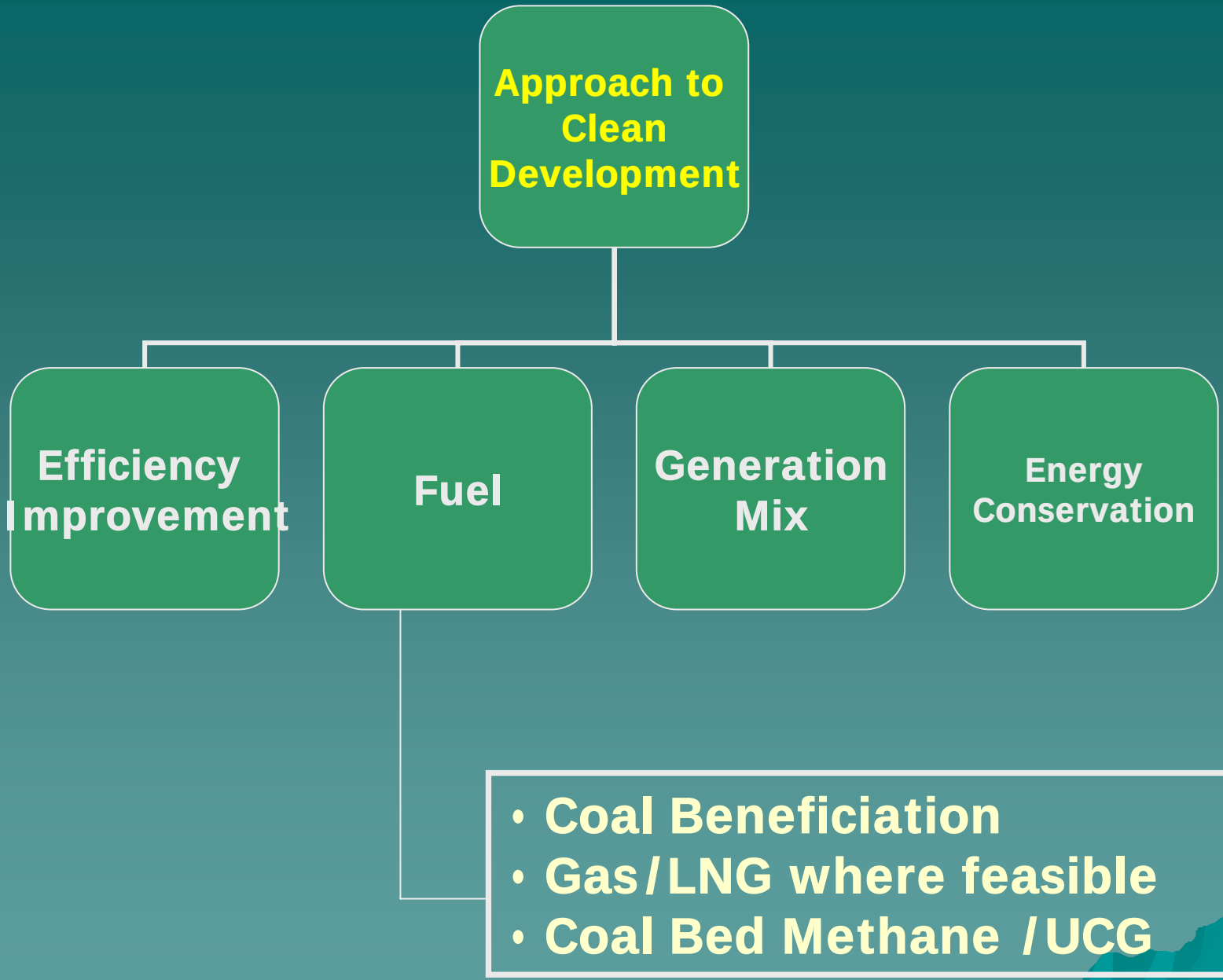
- Indian coal – high ash 40-45%
- Open cast mining Impurities
- Coal Beneficiation
  - –Savings in Transport cost & Energy
  - –Better use of Transport infrastructure
  - –Advantages in O&M
  - –33 Mn T washed coal used out of 303 Mn T last yr
- Concerns
  - –Low Washing Yields
  - –Problem of Rejects Disposal/use
  - (FBC plants planned)
- Presently Washing Has Been Found Economical For Load Centre Stations

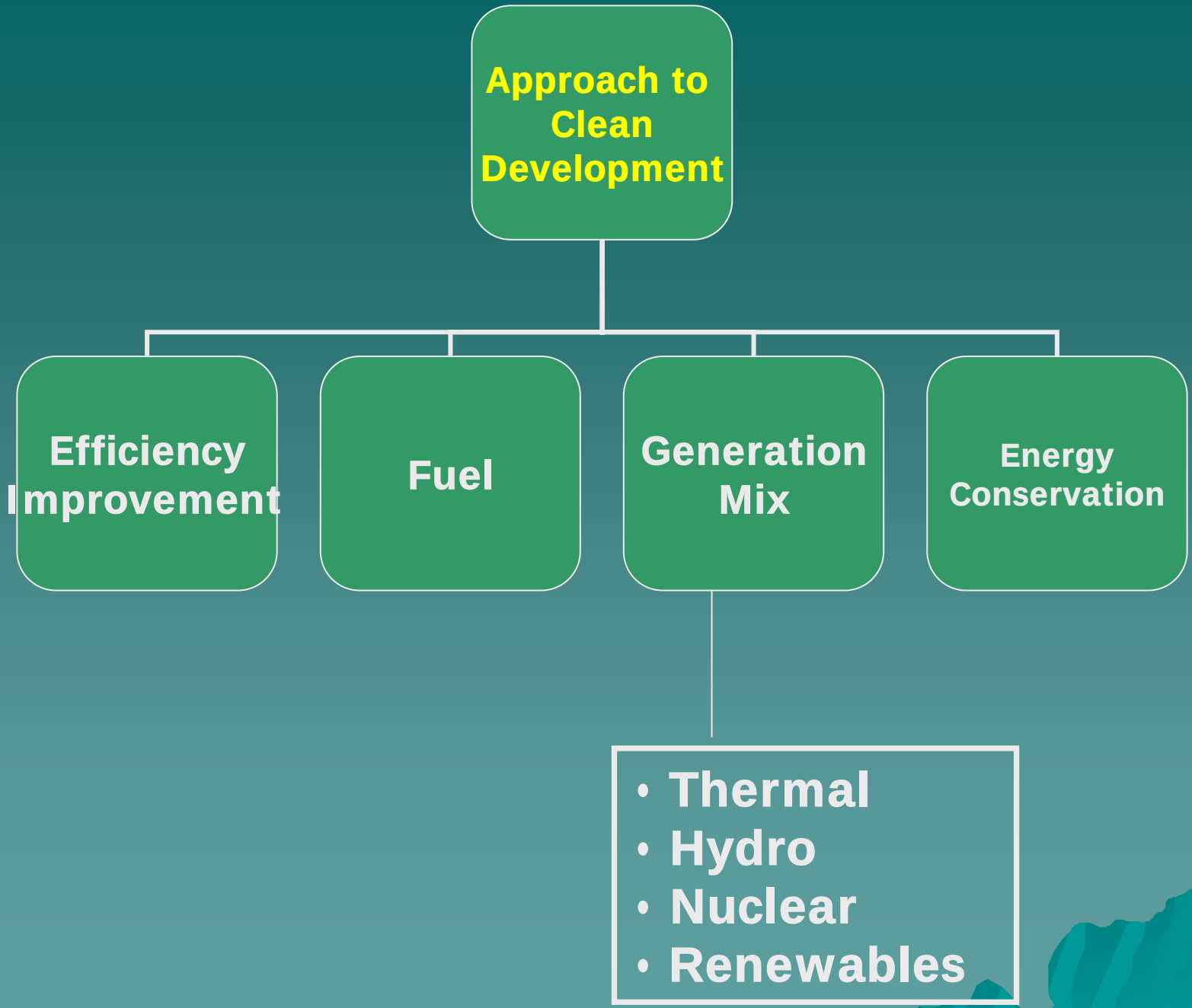
OVERVIEW

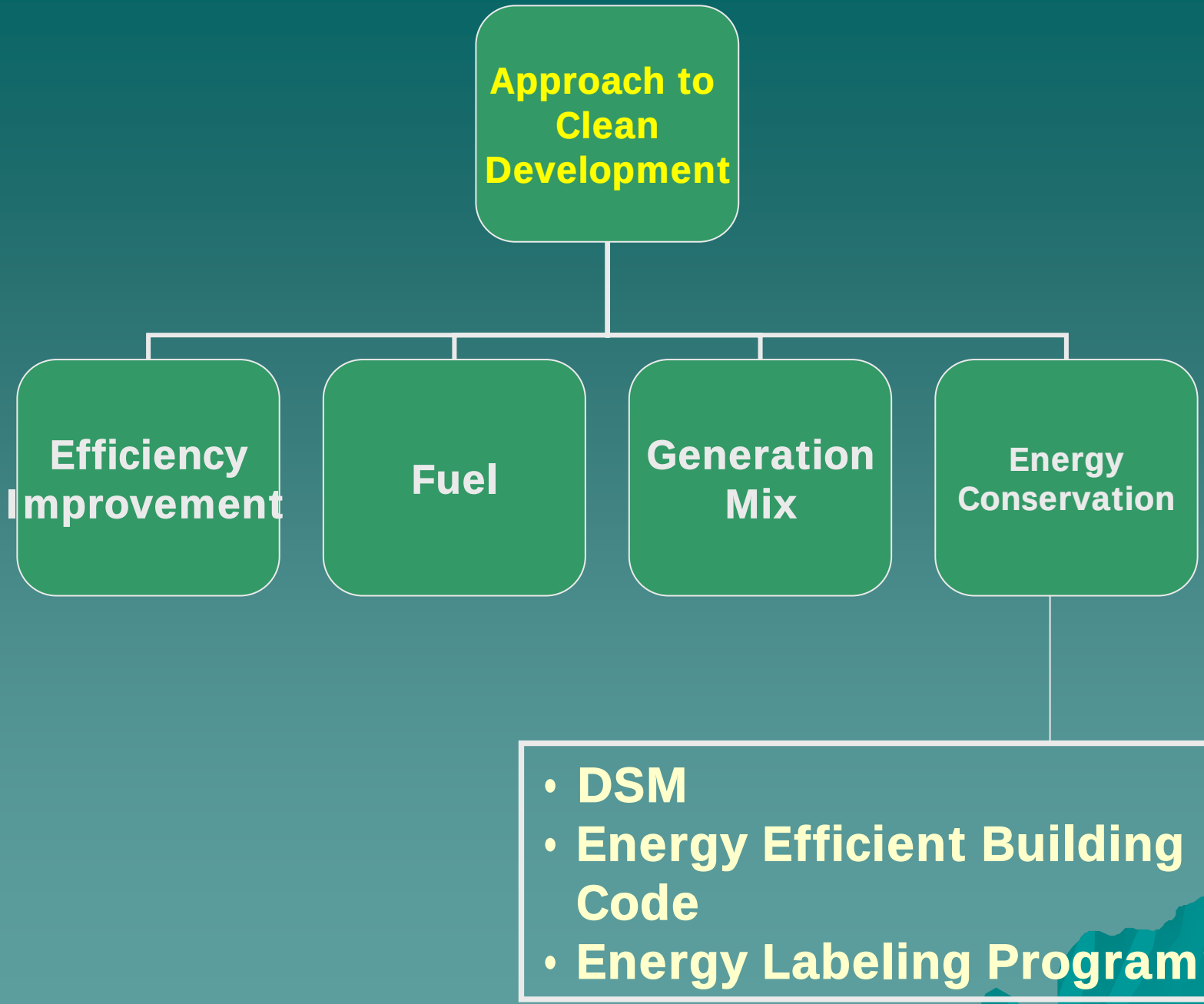
- Present Power Supply Position and Expansion Plans
- Indian Coal
- Approach to Clean Development
- New Technology Options


Approach to Clean Development
Efficiency Improvement
Fuel
Generation Mix
Energy Conservation


Approach to Clean Development
Efficiency Improvement
Fuel
Generation Mix
Energy Conservation
New Stations
Higher Unit Sizes
Supercritical Technology
Existing Units
Efficiency Oriented Upgrades
Selective Retirement


Approach to Clean Development
Efficiency Improvement
Fuel
Generation Mix
Energy Conservation
• Coal Beneficiation
• Gas/LNG where feasible
• Coal Bed Methane /UCG


Approach to Clean Development
Efficiency Improvement
Fuel
Generation Mix
Energy Conservation
• Thermal
• Hydro
• Nuclear
• Renewables


Approach to Clean Development
Efficiency Improvement
Fuel
Generation Mix
Energy Conservation
• DSM
• Energy Efficient Building Code
• Energy Labeling Programme

Drivers For Higher Plant Efficiency

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

Improving Efficiency

- Higher size units
  - More efficient, economy of scale
  - Quicker capacity addition
  - Reduced land/manpower requirement
  - Transport/logistics to be kept in view
- Supercritical Technology
  - Higher efficiency
  - Lower GHG emission
- Efficiency Improvement in existing stations
  - Upgrading old fleet
  - Replacement

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 and 565/593 deg C
- Six units under execution by NTPC
- Supercritical technology mandatory for Ultra Mega Projects (4000 MW each) - 3 projects awarded
- Many more supercritical units in pipeline.
- Introduction of supercritical units would improve the efficiency in power generation

Prevailing Unit Sizes

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

210/250 & 500 MW Units Constitute Over 80% of the Total Capacity

New Unit Sizes

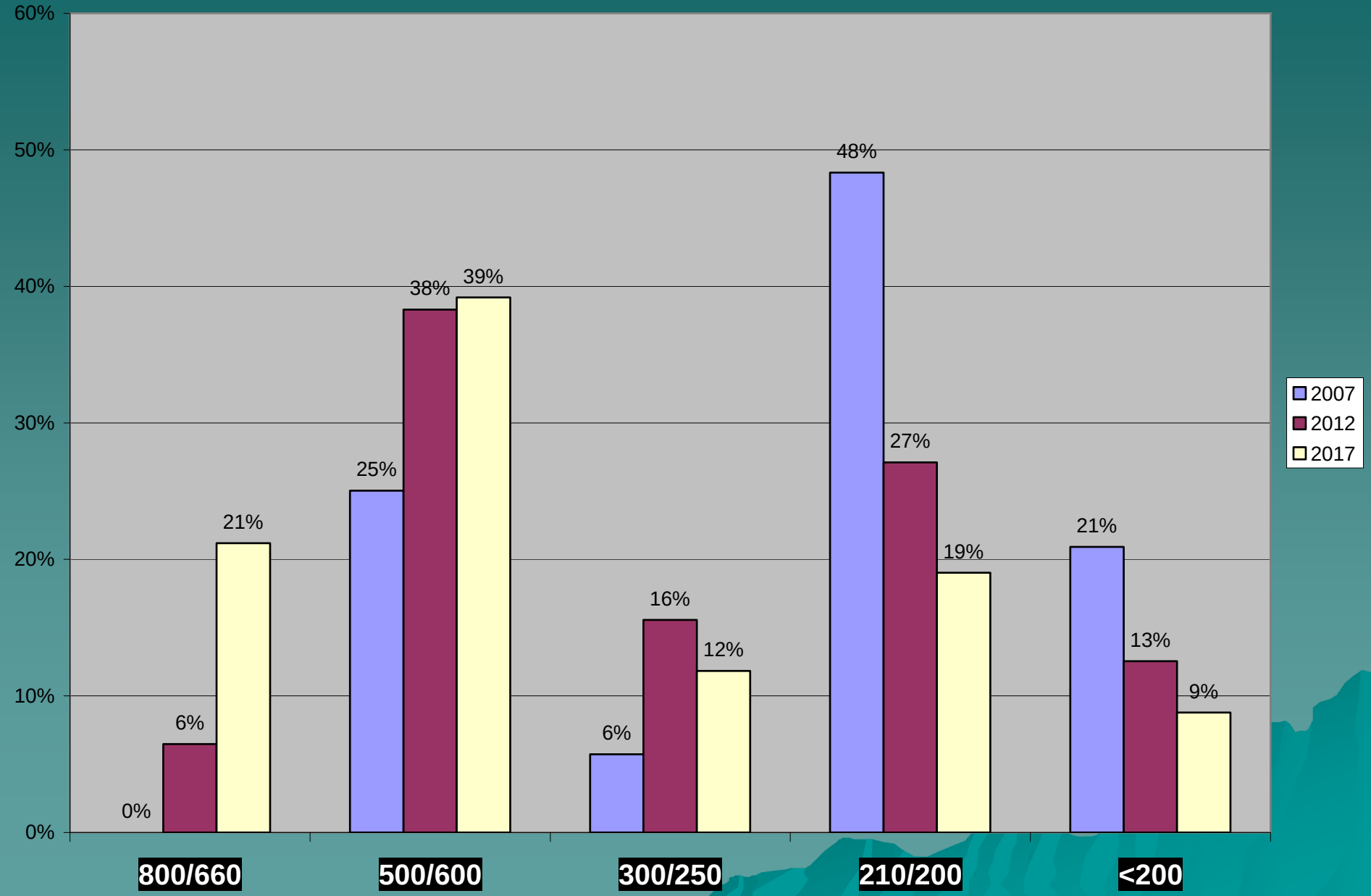
Unit Sizes (MW)	Parameters	Gross Efficiency (HHV)
660/800 MW	247 kg/cm^2 537/565 ^{O}C	39.6 %
	247 kg/cm^2 565/593 ^{O}C	40.25 %

Efficiency
Impact of Indian Climate & Coal

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

Efficiencies in India are calculated based on HHV

Share of Different Unit Sizes- 2007-17



OVERVIEW

- Present Power Supply Position and Expansion Plans
- Indian Coal
- Approach to Clean Development
- New Technology Options

New Technology options

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

Ultra supercritical technology

- **Parameters of about 280 bars and 600 deg C**
  - **More efficient but higher capital cost**
  - **Perceived risks with regard to Indian coal, lack of O&M expertise, lack of service support**
  - **Limited suppliers**
  - **Experience limited mainly in Japan, Germany and Denmark**
  - **Uncertainty about CDM benefits post 2012**
  - **Some gestation period required to assimilate supercritical technology under implementation**

Circulating Fluidized Bed Combustion

- CFBC being used for high Sulphur lignite
- 125 MW CFBC units
  - 4 units operational in Surat lignite and Akrimota
  - 6 units under implementation at Surat Lignite, Barsingsar and Giral TPS
- 250 MW CFBC units
  - Under installation at Neyvelli Lignite

IGCC

- Experience worldwide with high ash coal in few units
- No large IGCC units in operation with fluidised bed gasifier considered suitable for Indian coals
- Cost not competitive with PC technology
- India pursuing a demo project of about 100 MW
  - Through international co-operation (Feasibility by Nexant USA theough USAID)
  - Through indigenous R&D (NTPC & BHEL)

Oxy-Fuel Combustion

- Oxy- fuel combustion involves combustion of coal with oxygen
- Flue gas is recycled to keep the furnace temperature within limits
- Flue gas is almost pure CO2 and hence easy for carbon capture
- High energy penalty due to oxygen separation from air
- Some demo plants being put up in developed countries
  - Vattenfall, Schwarze Pumpe/D 30 MWth
  - Saskpower, B&W, 300 MW

Summary

- India needs accelerated capacity addition
- Coal will remain the mainstay in near future
- Efficient use of coal a must for sustainable development
- Efficiency improvement strategy includes introduction of higher size units, supercritical technology and efficiency based R&M of existing units
- New technology options under close watch for adoption in future based on techno-economics and concerns related to coal etc.

THANKS