

Clean Coal Technologies



PRESENTATION BY

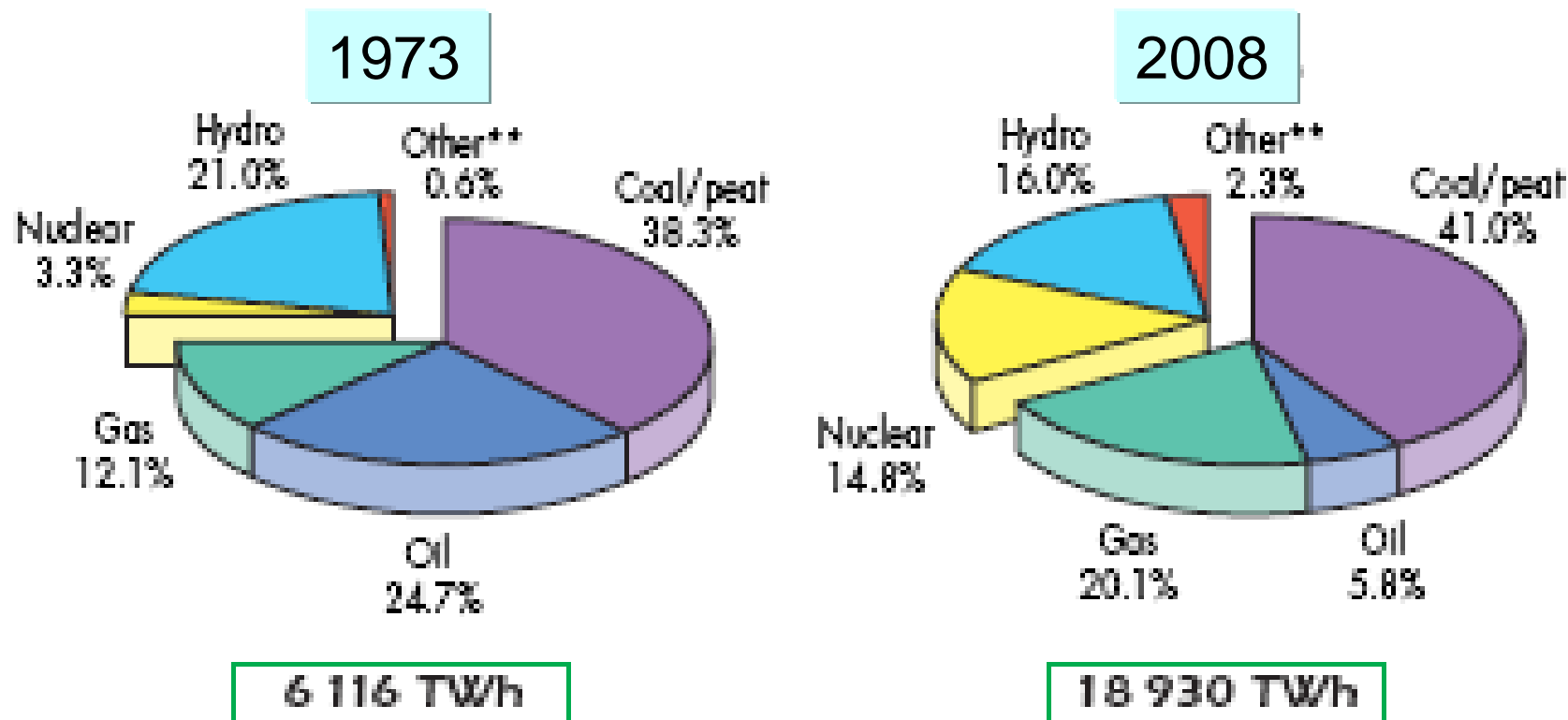
AJIT KUMAR

General Manager ,NTPC Ltd, India

Agenda

- Electricity Generation scenario
 - ❖ World
 - ❖ India
 - ❖ NTPC
- Drivers for Clean Coal Technology
- Clean Coal Technology-Options
- Clean Coal Technology- Initiatives
- Conclusions

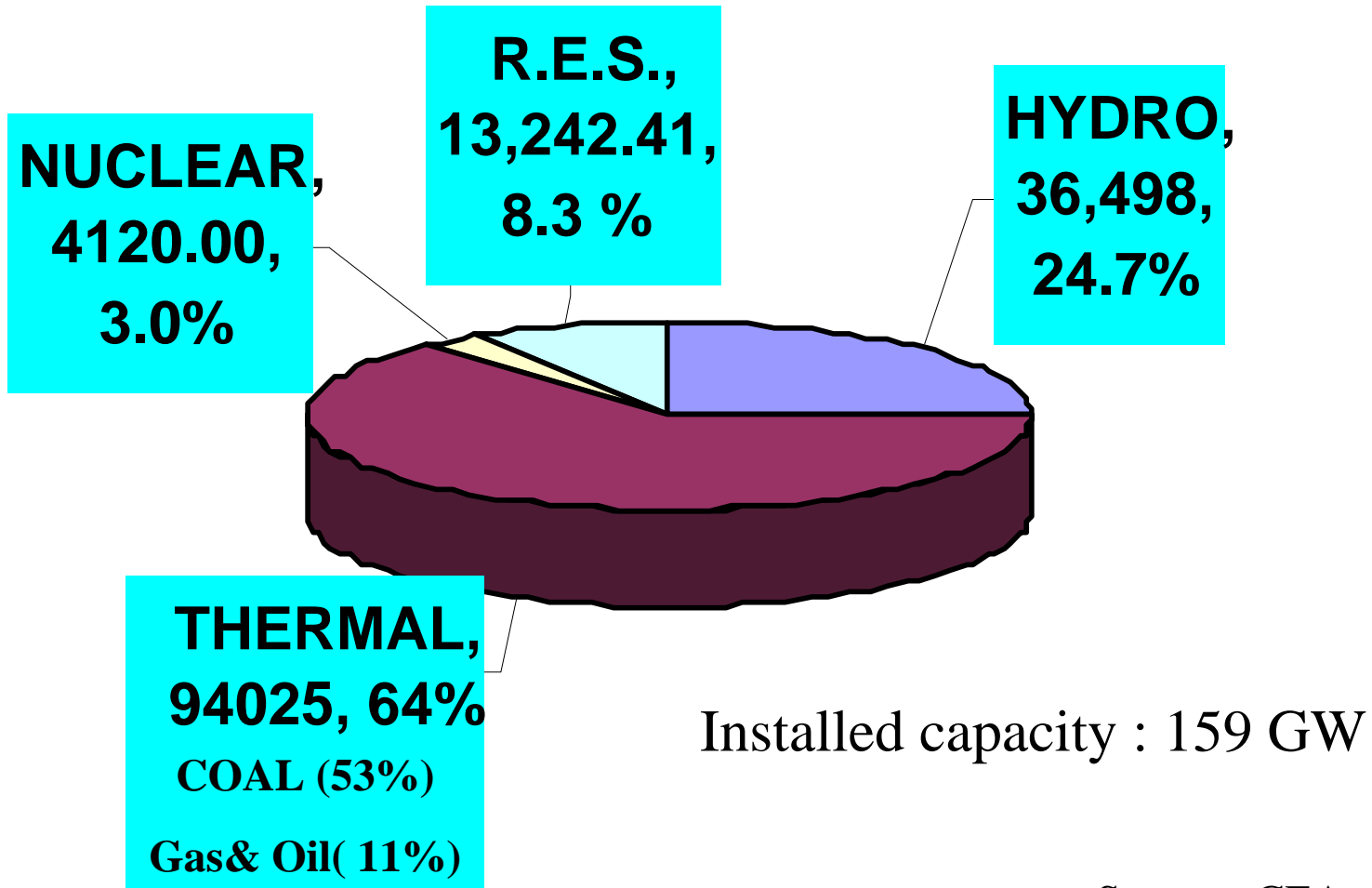
World -Electricity Generation



Source: IEA

World Electricity Generation – Dominated by Fossil Fuels

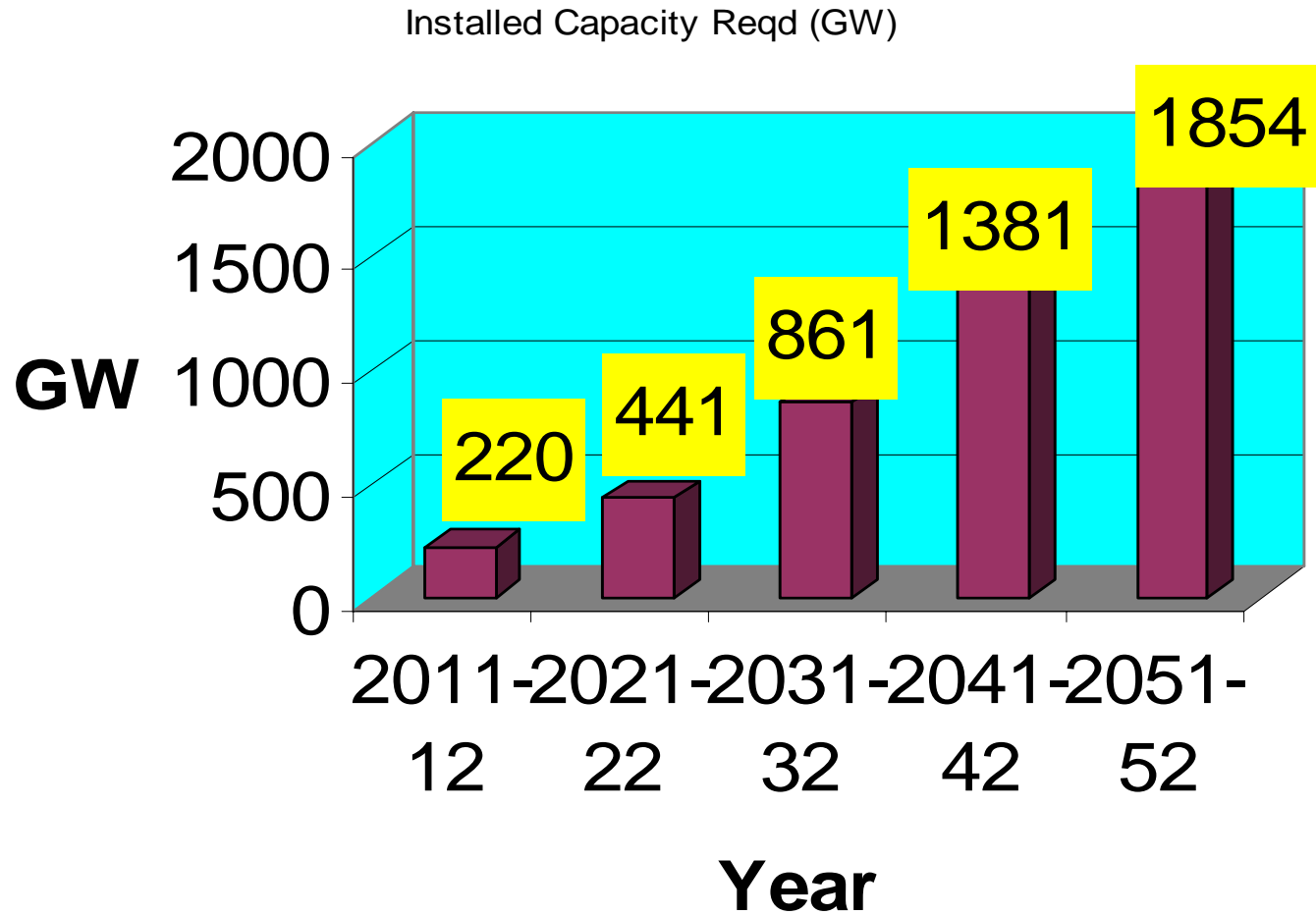
India - installed Power generation capacity



Source : CEA

Status as on 31.05.2010

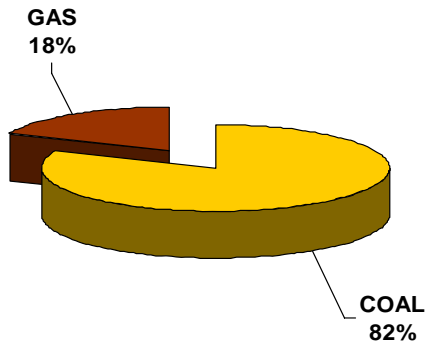
Electric Power- Demand projections



Source : Central Electricity Authority (CEA), India

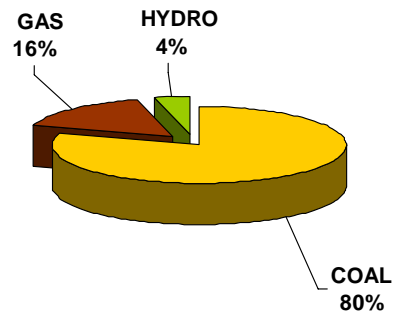
Electricity Generation-NTPC scenario

**CAPACITY MIX - TODAY
(31,704 MW)**



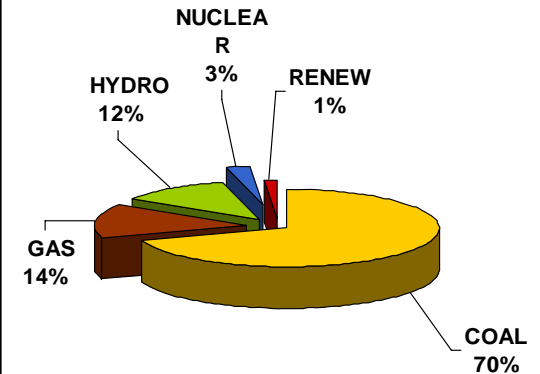
COAL	26269
GAS	5435

**CAPACITY MIX - 2012
(50,000 MW)**



COAL	40000
GAS	8000
HYDRO	2000

**CAPACITY MIX - 2017
(75,000 MW)**



COAL	53000
GAS	10000
HYDRO	9000
NUCLEAR	2000
RENEWABLE	1000

Drivers for Clean Coal Technologies

- Future energy Demand –Supply scenario is heavily COAL dependent.
- India is the third highest coal consumer in the world and it will remain so for next 40-50 years
- Compared to hydrocarbon resources, coal is more abundant, sustainable and cheapest domestic fuel for power
- Efficiency in utilization of coal is critical for conservation of resource, cost effectiveness and acceptability

Drivers for Clean Coal Technologies

- Conventional technologies have limitations
- Clean Coal Technologies are required for improving efficiency and performance in the Coal-Energy Chain.
- Global climate change concerns need to be addressed and steps initiated well before the problems become unmanageable.

Clean Coal Technologies--- Options

- Coal Beneficiation (Pre combustion)
- Efficiency Improvements (Post Combustion)
 - Plant upgrades
 - Supercritical/Ultra supercritical Technologies
- Advanced Technologies
 - Integrated Gasification Combined Cycle
 - Fluidised Bed Combustion

Coal Beneficiation

- Coal Extraction Stage
 - ✓Judicious mining – Removal of Dirt bands seperately
 - ✓In Situ Gasification – Still at Infancy stage
- Post Coal Extraction Stage
 - ✓Washing/ Processing the coal
 - ✓Blending high ash Indian coal with low ash imported coal

Currently India has:

20 coal washeries (32.37 MTPA) for Coking Coal

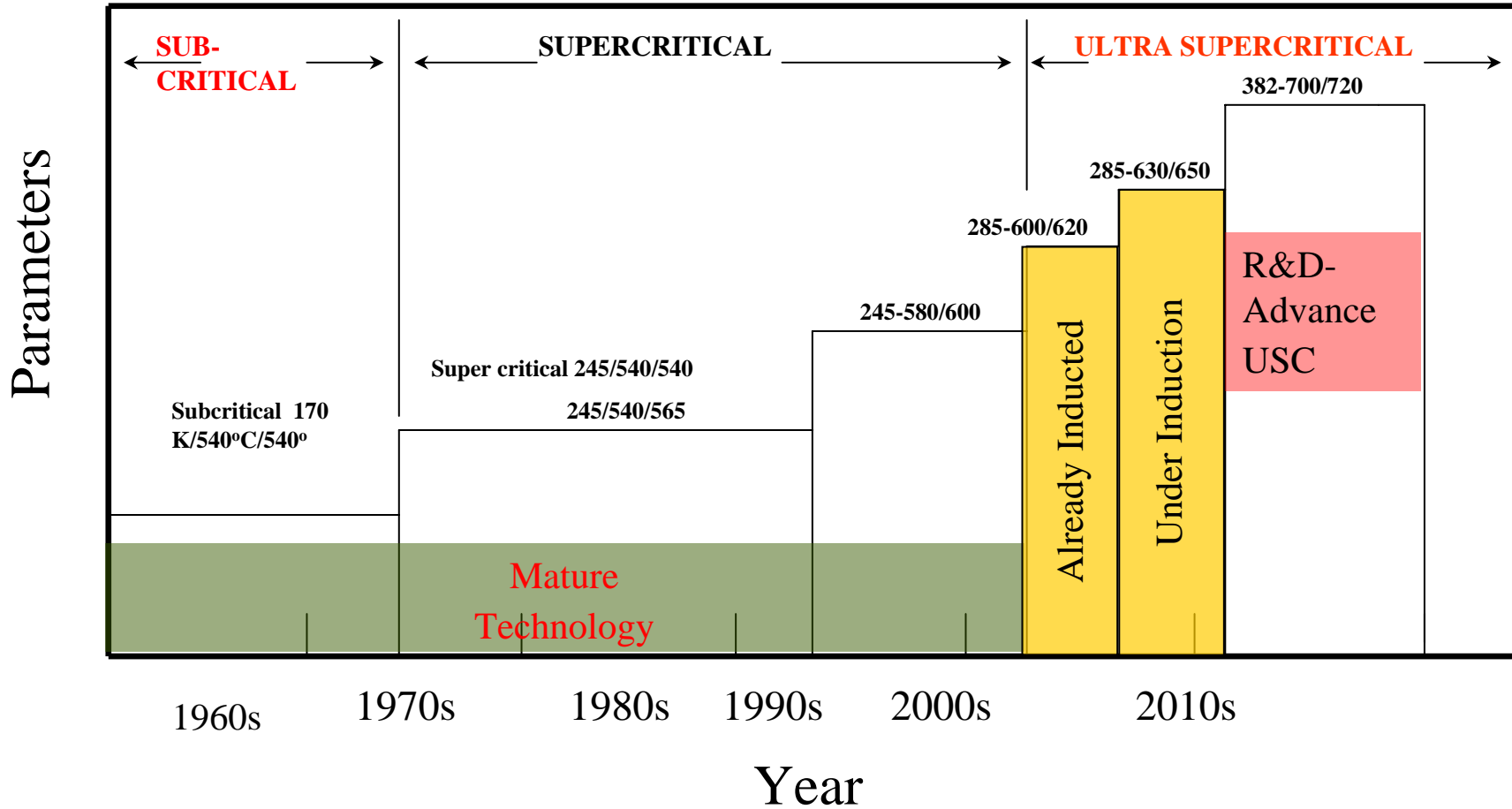
28 coal washeries (70.35 MTPA) for Thermal coal

03 coal washeries (21.00 MTPA) Under Construction/Approvals

Efficiency Improvements Super Critical Technology

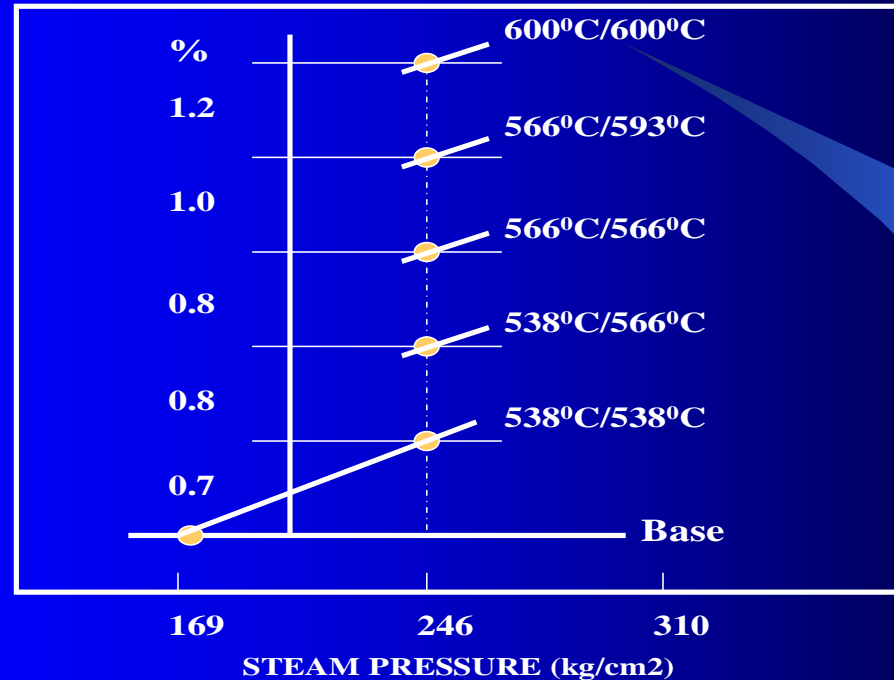
- Steam Power plant efficiency increases with increase in steam pressure and temperature
- Power plant Cycle operating above Critical pressure(221.2 bar) are classified as Supercritical cycles
- With higher cycle efficiency the supercritical cycle offers the advantage of ' burn less fuel for the same output' and lower emission.

Super critical Technology- International Scenario



Supercritical technology

THERMAL EFFICIENCY IMPROVEMENT

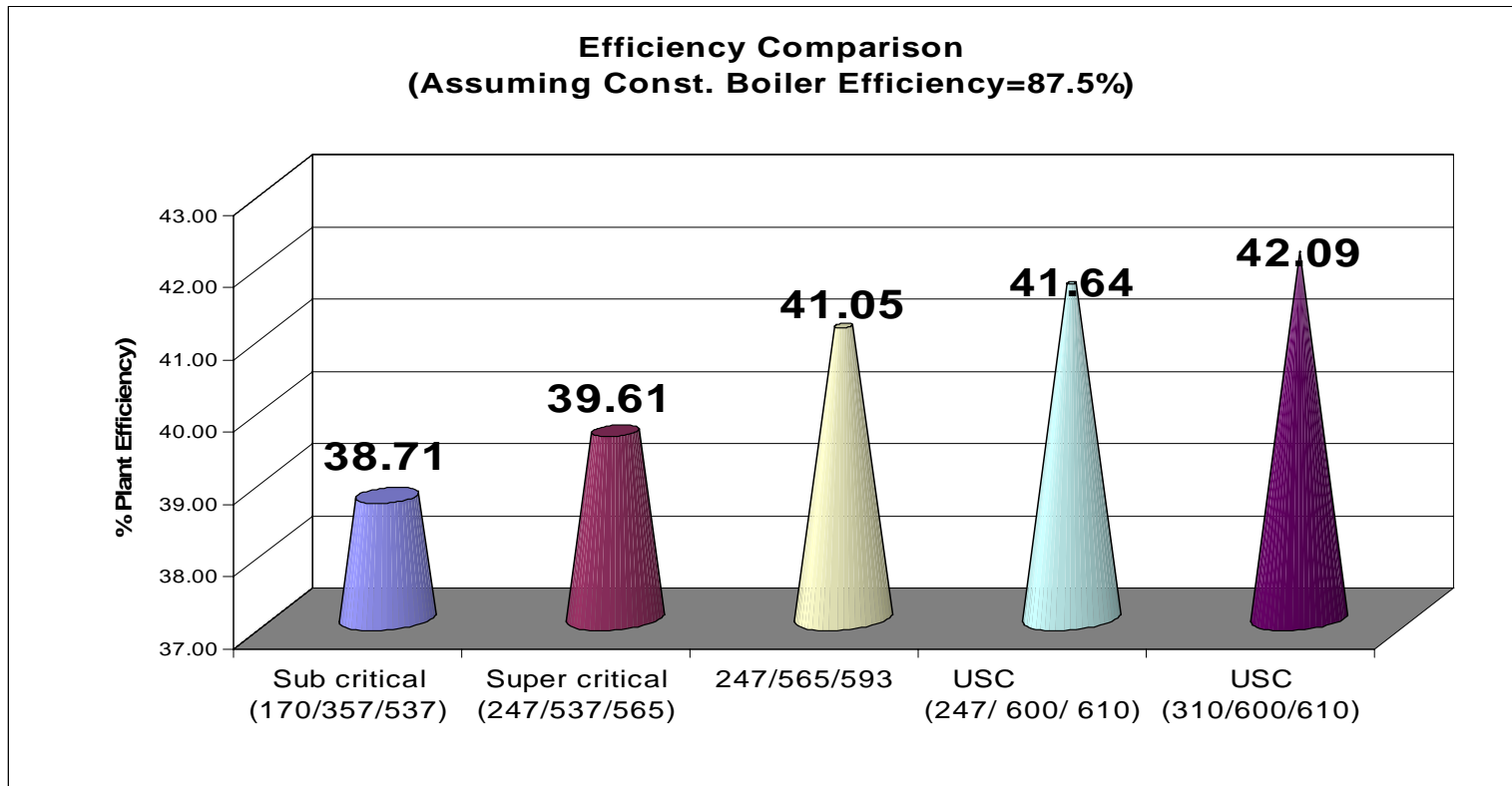


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MS Pressure Kg/cm²

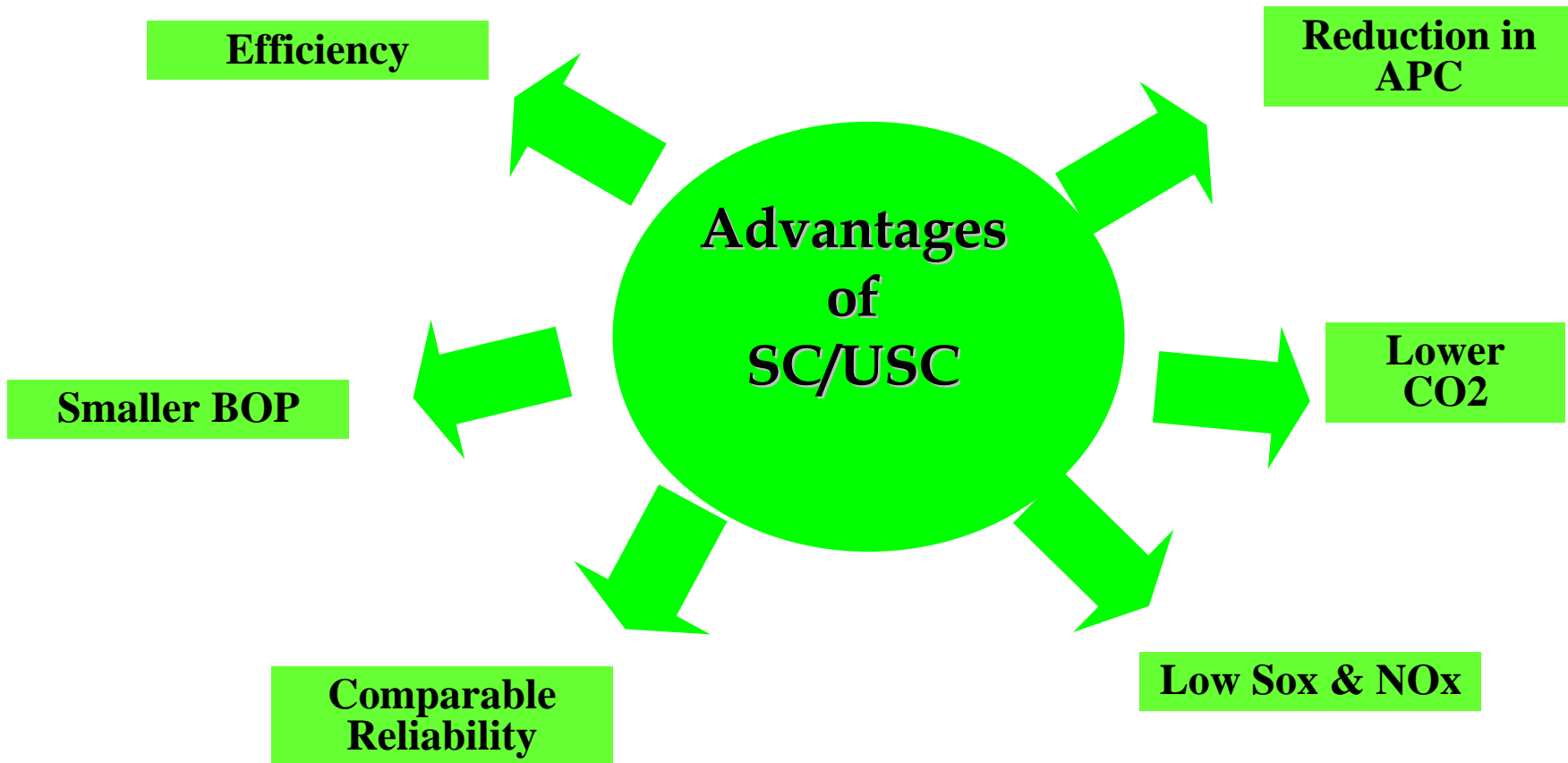
In fossils fuel dominated energy sector, Supercritical/Ultra Supercritical power plants with higher cycle efficiency offer the best opportunity for CO₂ mitigation.

Ultra Super Critical Plants- Efficiency Gains

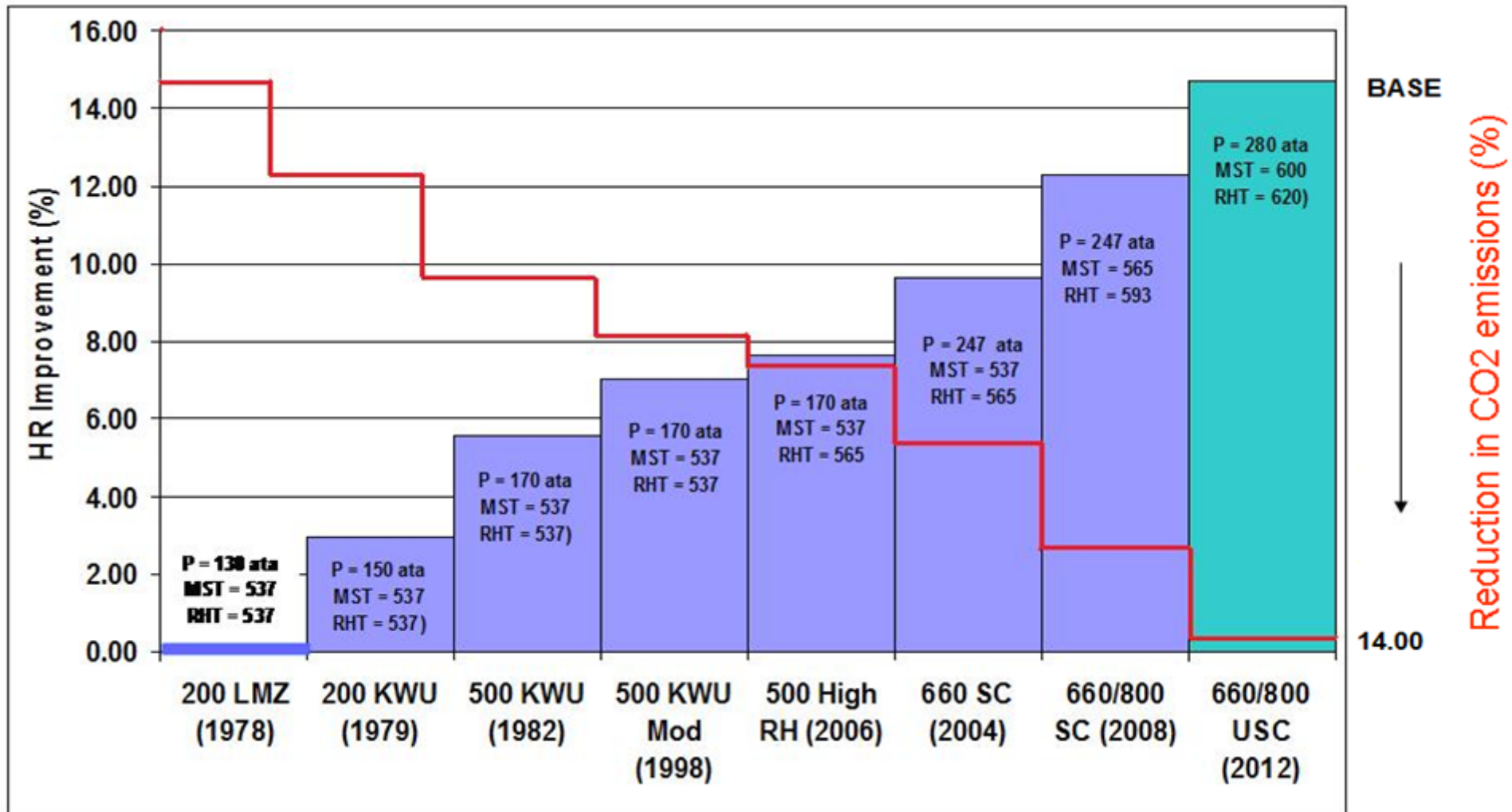


Major advantage of using USC is improved efficiency

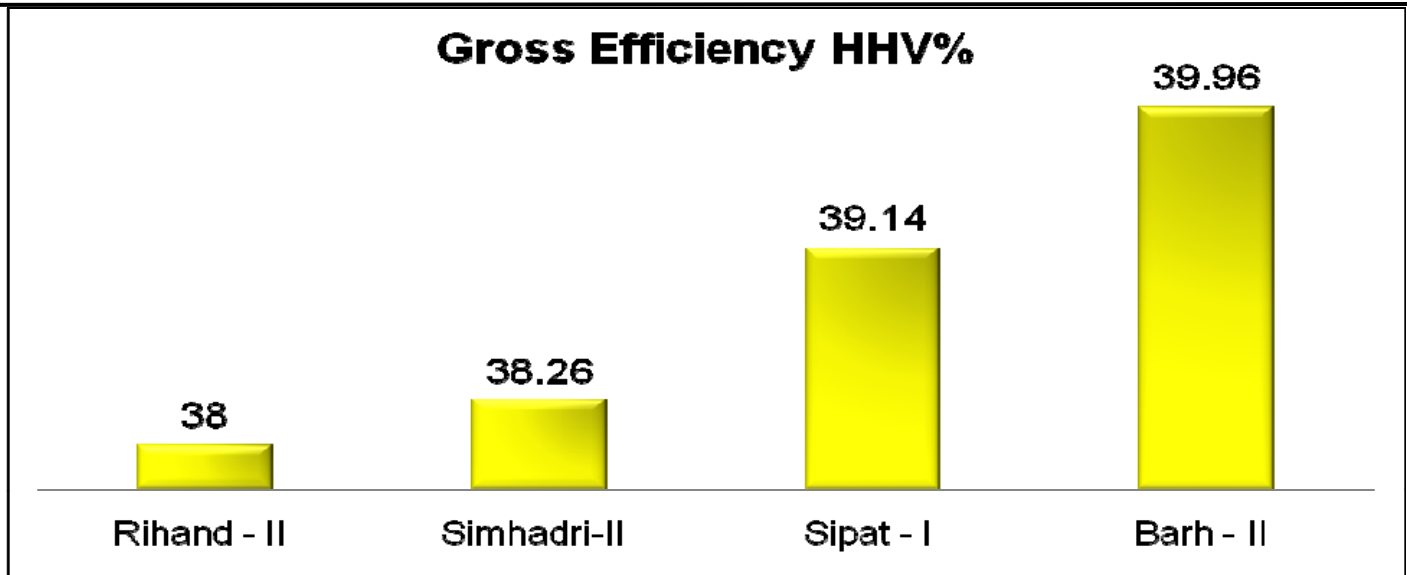
Supercritical/Ultrasupercritical technology



Supercritical- Efforts in NTPC



Supercritical- Efforts in NTPC



	Sub - critical units		Super - critical units	
Unit Size	500 MW	500 MW	660 MW	660 MW
MS Pressure kg/cm ²	170	170	247	247
MS Steam Temp(° C)	537	537	537	565
RH Steam Temp (° C)	537	565	565	593

Super Critical Technology in NTPC

□ PLANTS IN ADVANCE STAGE OF CONSTRUCTION

- 3 x 660 MW Sipat STPP Stage-I
- 3 x 660 MW Barh STPP Stage-I
- 2 x 660 MW Barh STPP Stage-II

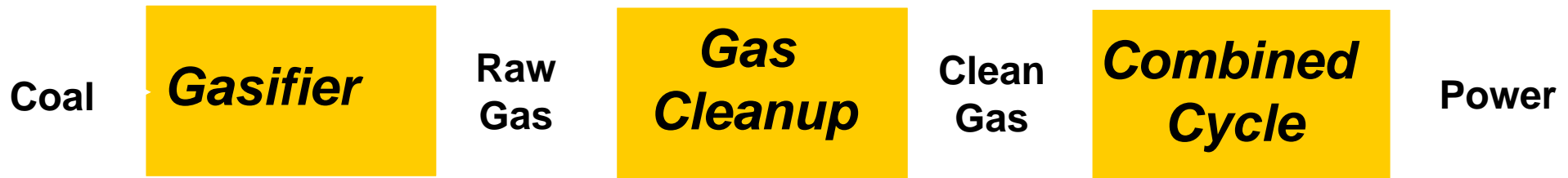
□ UPCOMING PLANTS

- Meja - 2x660 MW
- Sholapur – 2x660 MW
- New Nabinagar-3x660 MW
- Mauda-II – 2 x 660 MW
- Darlipali – 4x800 MW
- Lara – 5x800 MW
- Kudgi – 5x800 MW

and many more in advanced stage of planning and development

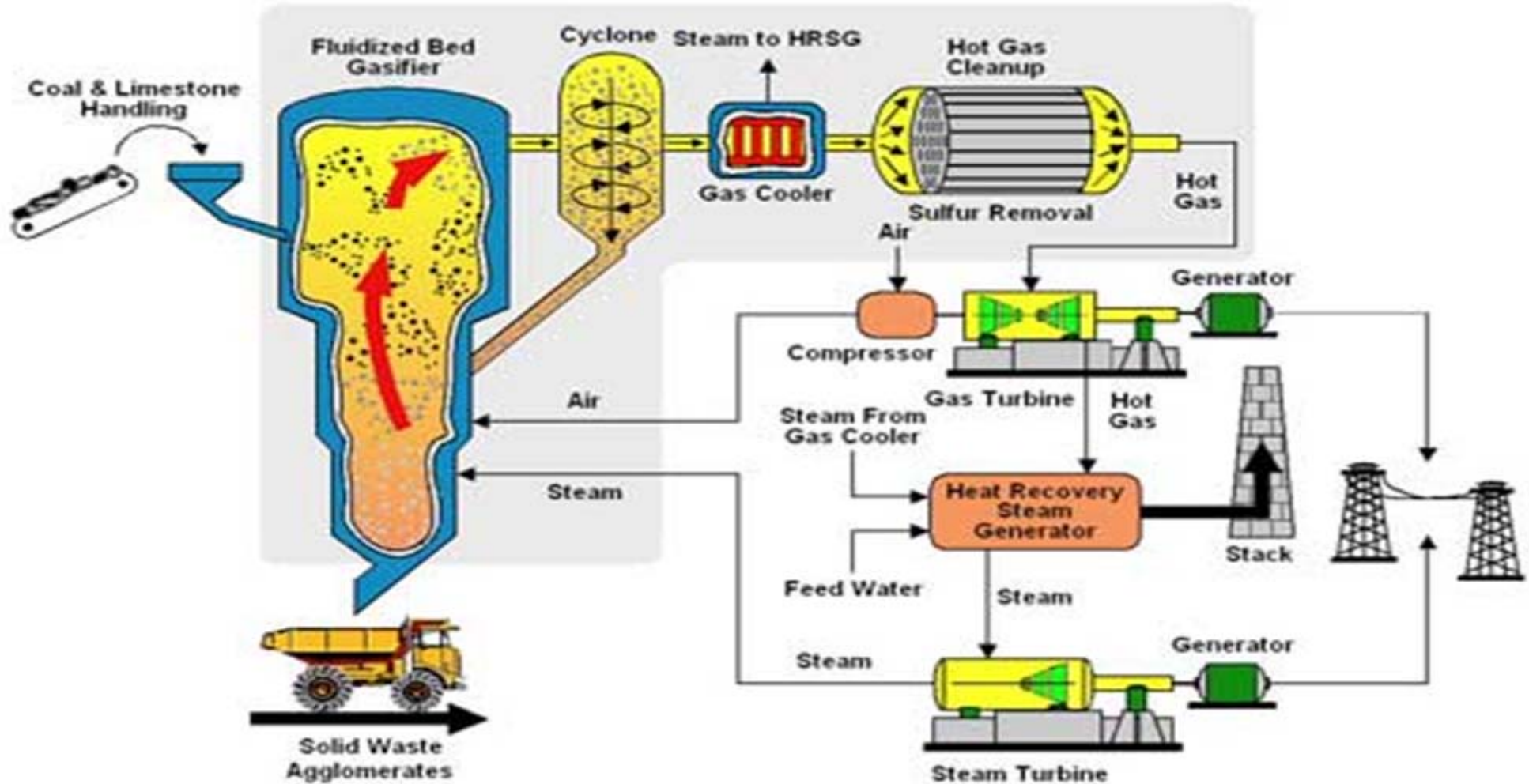


IGCC-The Process



- Conversion of coal into fuel gas by reacting with steam and oxidant (either air or oxygen) in the gasifier under high pressure
- Clean up of raw gas produced to remove sulfur and particulate contained.
- Feeding the high pressure clean fuel gas to a gas turbine based combined cycle unit to generate power

Integrated Gasification Combined Cycle (Schematic..)



IGCC-The Benefits

- High efficiency ~ 43-45 %
- Potential for achieving even higher efficiency ~ Using advanced class Gas Turbines(Up to 50 %)
- Potential for Green House Gas(GHG) Reduction
- Low Emissions
- Low water consumption: Since 2/3 of power is generated from Gas Turbine

IGCC power plants - Issues

- ❑ IGCC technology although available worldwide, yet to be commercialized for high ash coals .
- ❑ Technology specifically for high ash Indian coal gasification requires new developments in Gasifiers to address issues of scale up and higher carbon conversion and improved Syngas calorific value.
- ❑ NTPC is making concerted efforts for induction of IGCC technology for Indian coals.

IGCC power plants in India

The emerging technology to utilise coal with the maximum efficiency

6.2 MWe capacity coal based combined cycle demonstration facility at BHEL, Trichy



IGCC-Efforts in NTPC

International Cooperation

100 MW IGCC Demo Plant at NTPC-DADRI

Feasibility study sponsored by USAID- Conducted by Nexant(USA).

Indigenous Efforts

100 MW IGCC Demo Plant at NTPC-AURAIYA

NTPC-BHEL Collaborative effort.- Draft DPR Under preparation

Recent Development

NTPC will soon appoint an experienced consultant who will assist in set up of IGCC plants

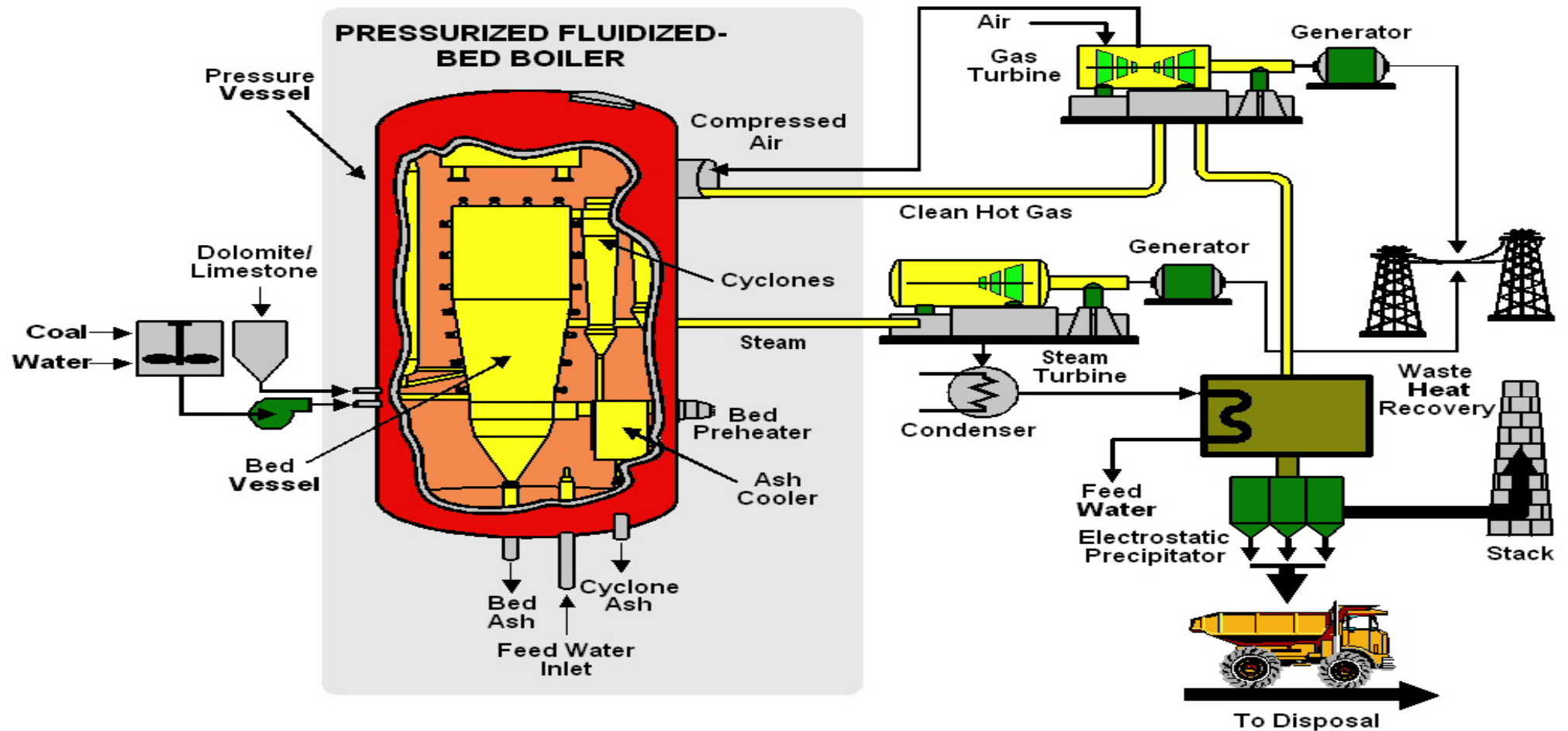
Fluidised Bed Combustion

Technologies in vogue:

- **Bubbling Fluidised Bed Combustion (BFBC)**
- **Circulating Fluidised Bed Combustion (CFBC)**

- ✓ **Ideally suited for Low Grade fuels, Lignite, Pet coke ...**
- ✓ **Does not need coal pulverisation system**
- ✓ **Keeps SO_x & NO_x emissions low**

Fluidised Bed Combustion



Conclusion

- **Ultra Super Critical Technology:** India is contemplating an extensive program for development and deployment of materials for high temperature applications for advanced Ultra-super critical power plants as a low carbon strategy. Any co-operation for development of high temperature materials for such plants could be useful.
- **IGCC:** Efforts are on full swing to set up demo plants of 100-125 MW for high ash Indian Coal.



Thank you

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