CFB – The Technology for India

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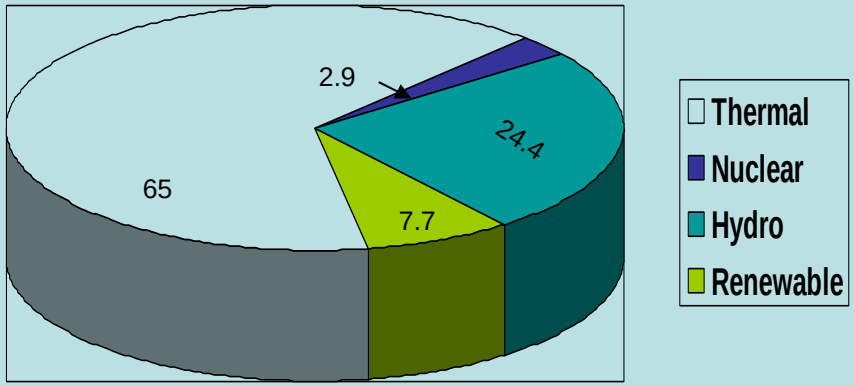
INDIAN POWER INDUSTRY

- **Most dynamic in the world today**
- **Result of Strong Economic Growth and rapid industrialization**
- **Demand for Power increases in a rapid pace**

  (1,00,000 MW would be required by the end of 2012 to achieve a target of over 1000 units of per capita electricity*)

* No.23/40/2004-R&R (Vol. III), National Electricity Policy, Ministry of Power

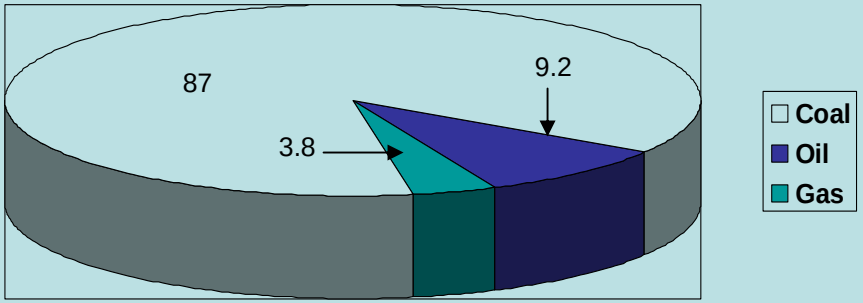
INDIAN ENERGY SCENARIO



SOURCES

* Numbers in Percentage (%)

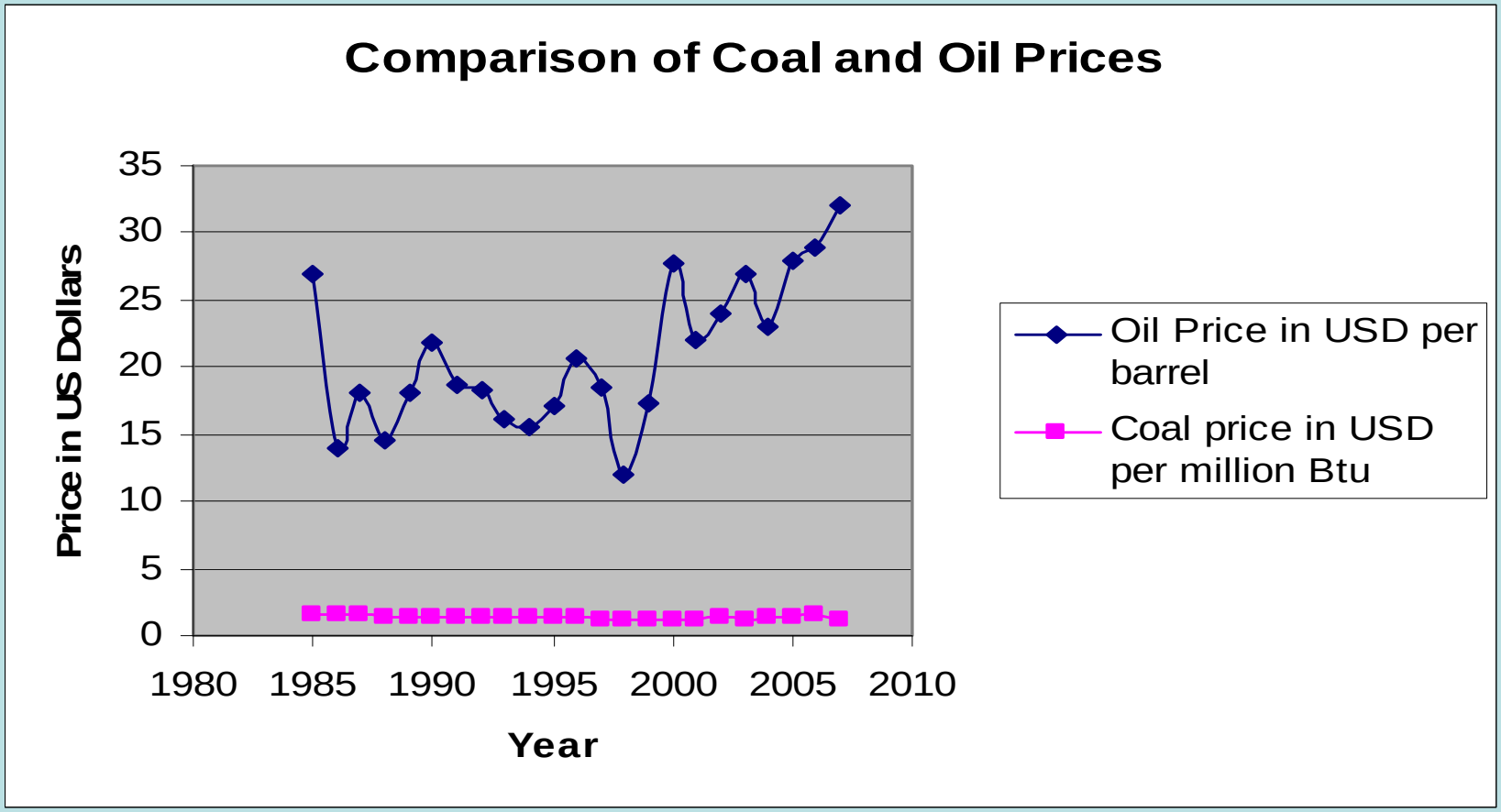
Heavily depending on Coal and Solid fuels !!!



FUEL RESERVES

Source: Power Ministry, India, A-2,3 Electric Power September 1994

Coal Vs Oil Prices



Source – World Coal and Oil Prices Statistics

CONCERN WITH COAL COMBUSTION TECHNOLOGIES

Environmentalism !!!

- Global environmental pressures could penalize the use of Coal
- World's Power Infra-structure today is the result of earlier environmental pressures:

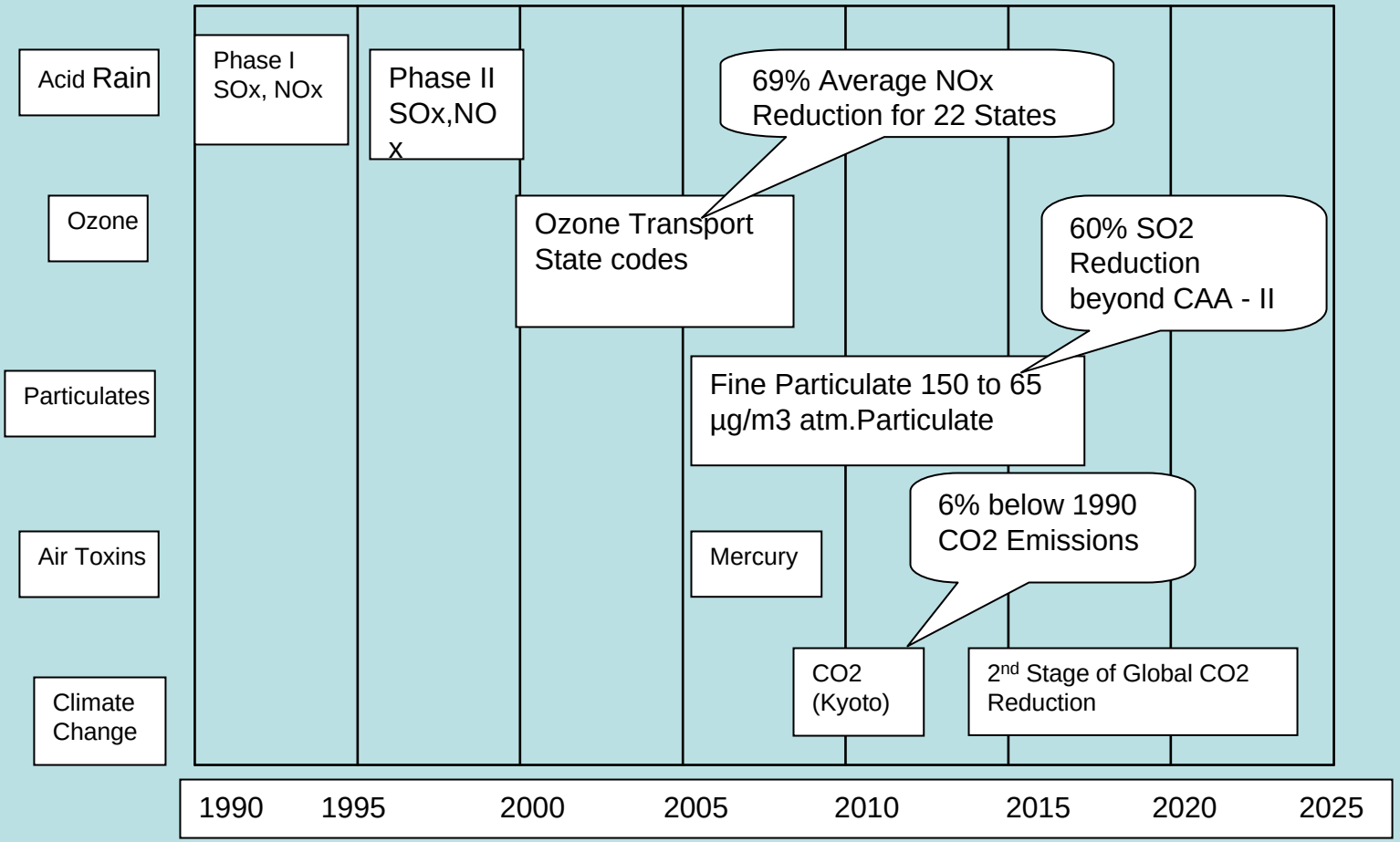
  - Emergence of FBC technology in the 1970s
  - Global decline in Nuclear technology in the 1980s
  - Dramatic Increase in Natural Gas technology in the 1990s
  - Re-emergence of Super-Critical technology in this decade

CLEAN COAL MIND-SET

- Now emerging in India and in other developing countries
- Regulating Policies - already in place in Developed countries (North America, Europe and Japan).

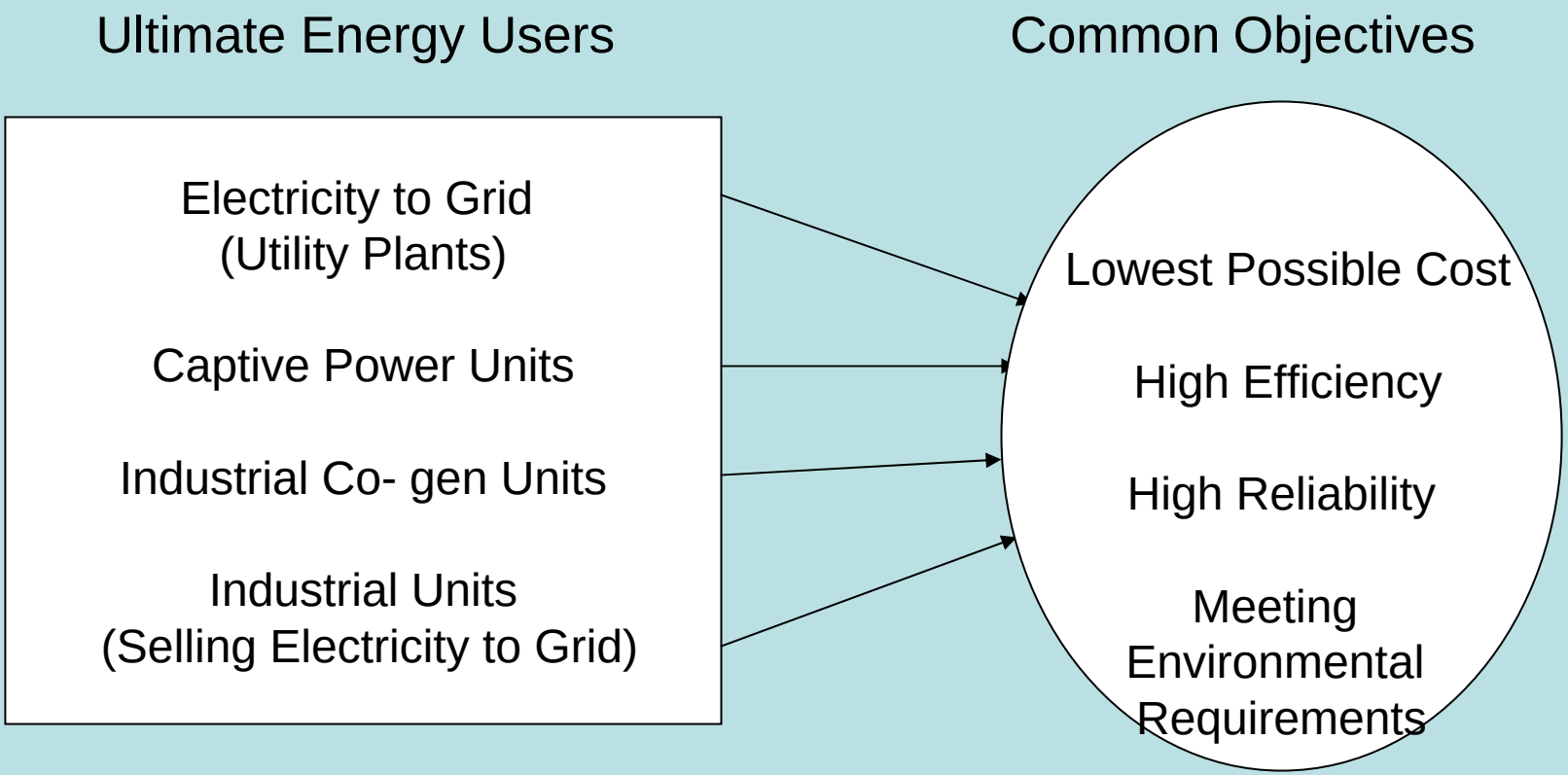
Developing Countries eventually would adopt the environmental standards of the developed countries .

US Emission Regulation Outlook

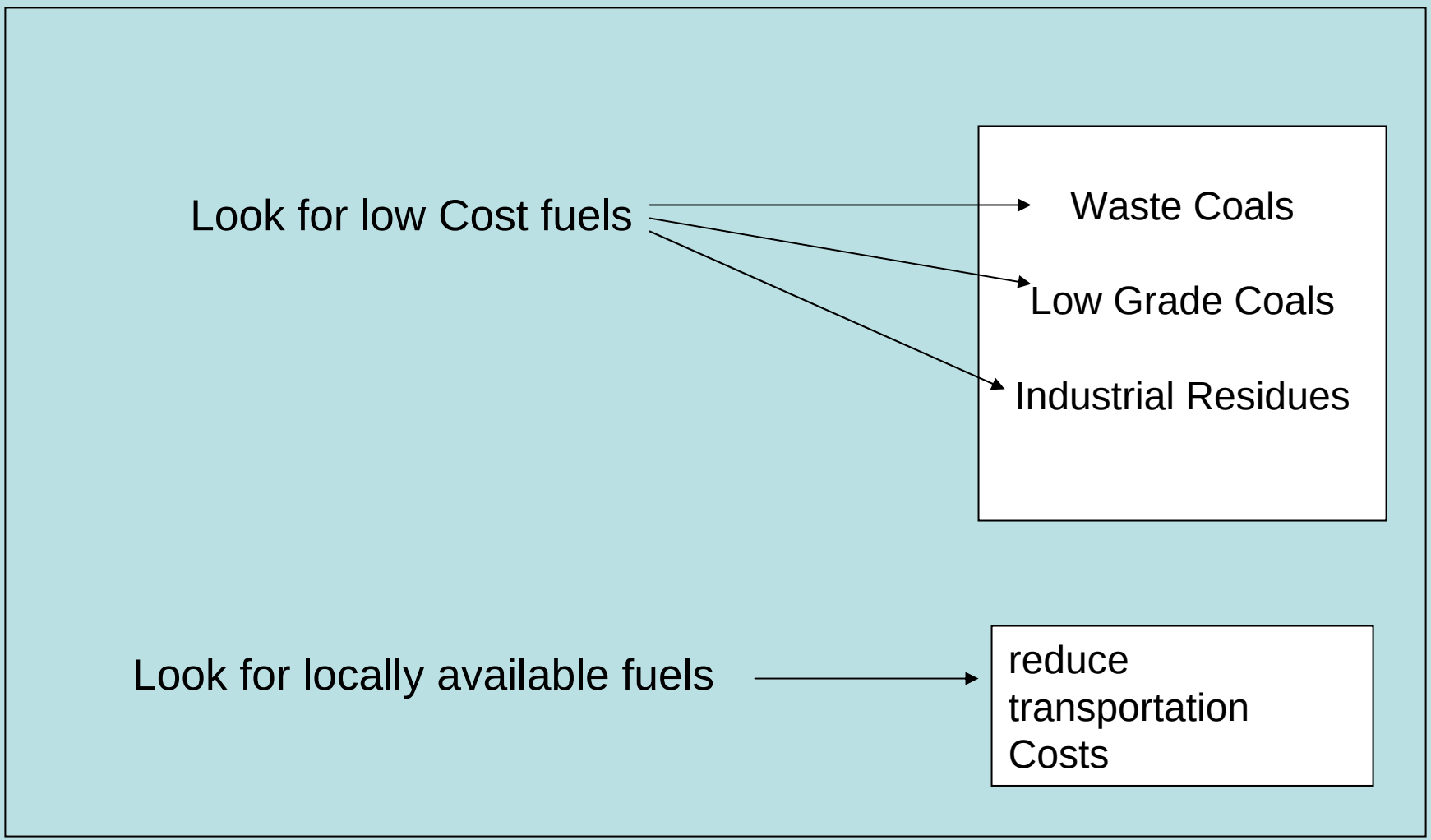


Source: EPA Office of Air and Radiation, 1997 & Coal Utilization Research Council, 1998

Indian Scenario



Indian Scenario – Common Objectives



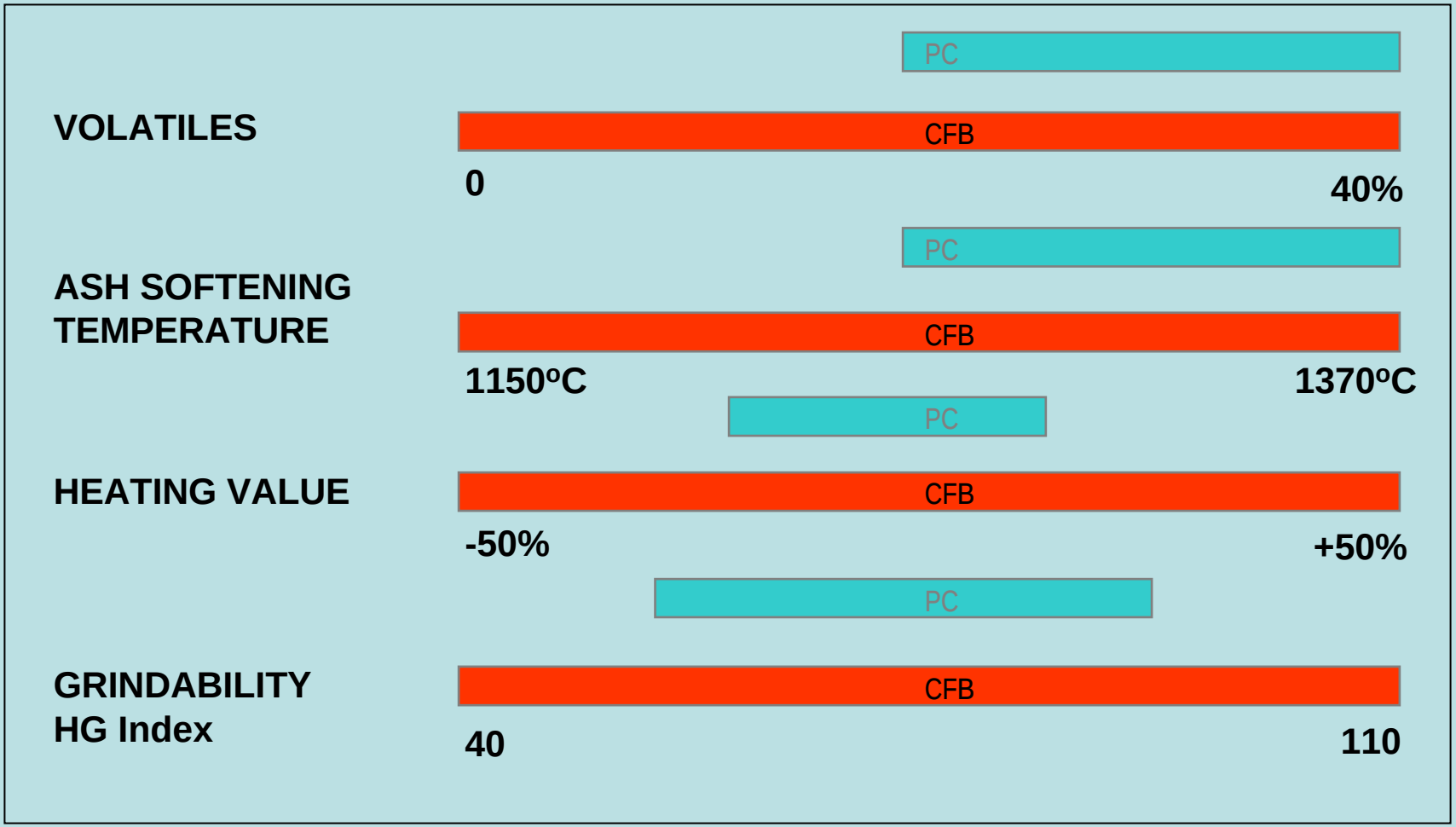
Indian Scenario – Need of the Hour

- Utilization of Low Grade Coals/Wastes
- Meeting Environmental Requirements

Indian Scenario - Technologies available

- Pulverized Coal (PC) Firing
- Circulating Fluidized Bed Combustion (CFBC)
- PC with De- SOx and De-NOx

Available Technologies – Fuel Sensitivity



Characteristics of Typical Indian Coal

% by Wt. on as received basis

	Talcher coal	Talcher Coal	Simhadri Coal	Kutch Lignite (Panandharo)	Surat Lignite	Neyveli Lignite
VM	21%	16.5%	19%	20 - 30%	25 - 30%	23.5
Ash	42%	49.5%	46%	18 - 35%	10 - 15%	3.6%
Moisture	15%	18%	15%	30 - 35%	40 - 44%	52%
Sulphur	0.5-0.7%	0.5-0.7%	0.38%	2 – 4.5%	0.9 – 1.0%	0.7%
GCV (Kcal/kg)	3300	2350	2800	2200 - 3200	2800 - 3500	2890
Ash Analysis Na_2O	0.1	0.1	0.1	0.6 – 8.5	2.0 – 2.7	1.2
K_2O	0.8-1.4	0.8-1.4	0.8-1.4	0.3 – 0.4	0.1 – 012	0.3

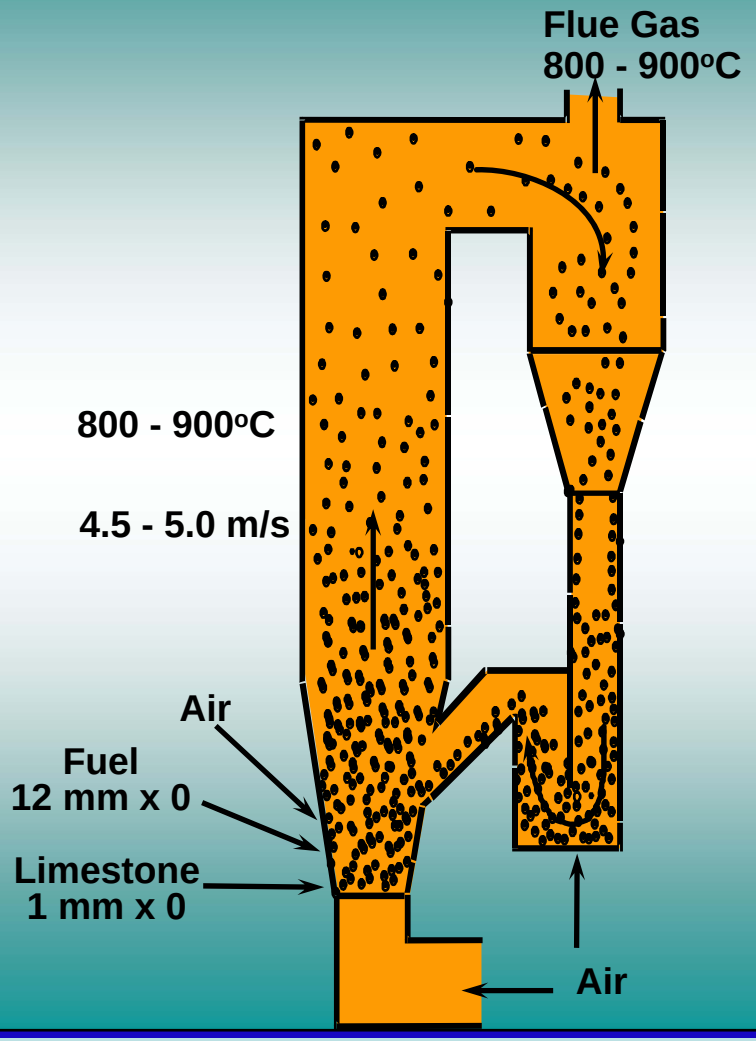
Availability of Waste and Alternate fuels

Rapid Industrialization results in more burnable wastes

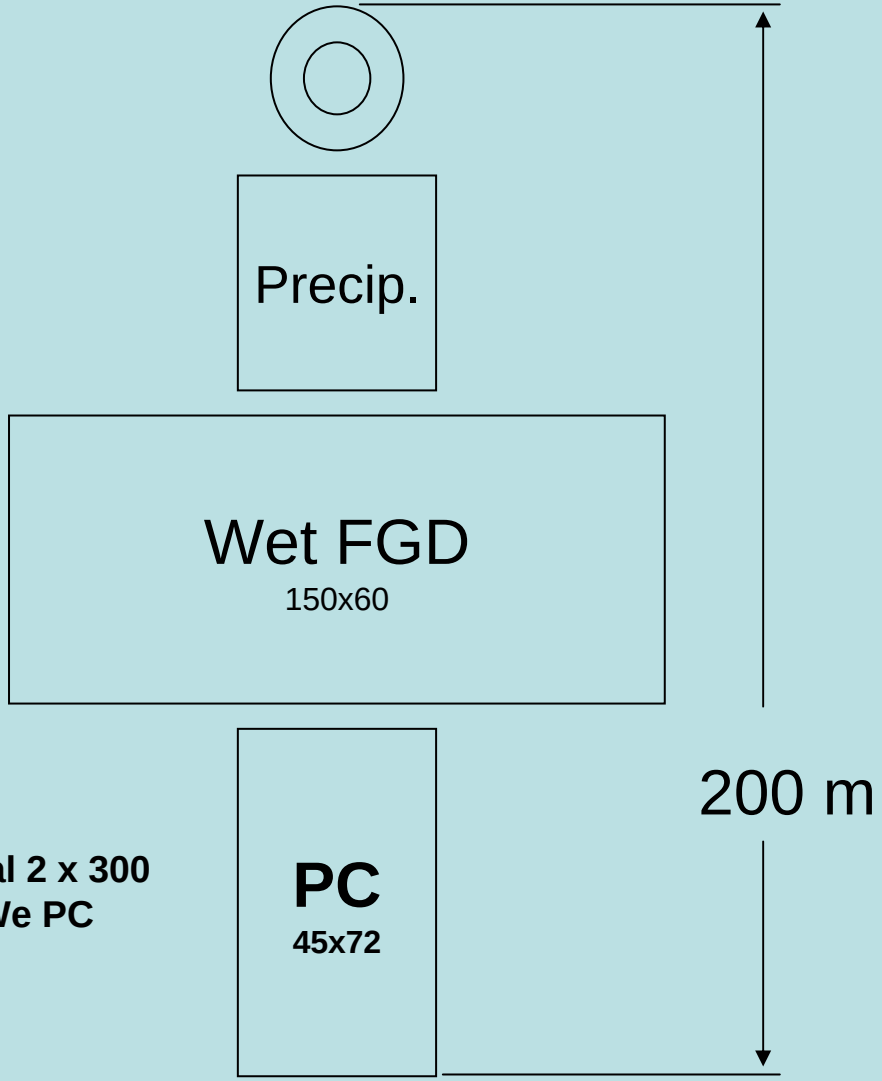
Type	Source	Description
Washery Rejects	Sub-Bituminous Coal washeries in Eastern India	40 - 50% ash, 1-2% sulfur, 6-10% moisture, more fines, GCV 2200-3200Kcal/kg,
Dolo Char	Sponge Iron Plants	More ash, containing high levels of iron particles, low moisture and volatile matter, more fines, low heating value(1800-2300Kcal/kg)
Petroleum Coke	By-products of Petroleum refinery Industries	High Heating value, low volatile, high sulfur content, difficult to use in conventional boilers.
Bagasse	By-product of Sugar plants	50% Moisture, Low ash , burn in combination with coal
Pulp and Paper sludge	Pulp & Paper mill waste	70 – 75 % Moisture, low Volatile & GCV, burn in combination with coal .

CFB Process Design – Features and Benefits

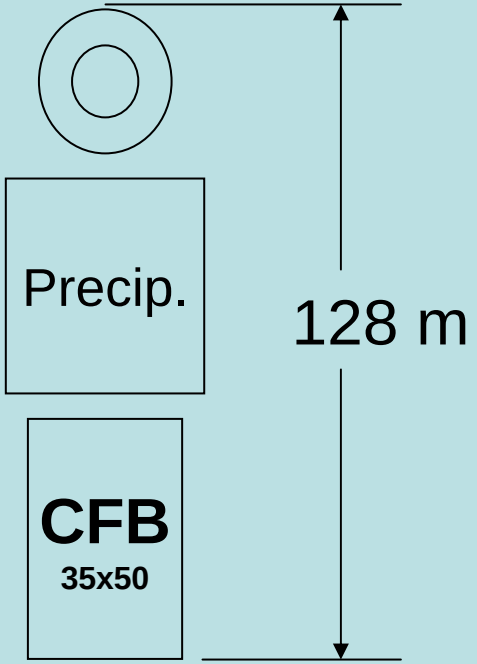
Feature	Benefit
Low Furnace Temps.	Low NO_x Low SO_2 Fuel Flexibility
Hot Circulating Solids	Handles Poor Fuels Simple Feed Systems
Long Solid Residence Time	Good Fuel Burnout Good Sorbent Utilization



CFB Requires Smaller Plan Area



Typical 2 x 300 MWe PC



Typical 2 x 300 MWe CFB

Emission Performance of Commercial CFB Units

	SOx		NOx		CO		DUST	
	Guaranteed	Measured	Guaranteed	Measured	Guaranteed	Measured	Guaranteed	Measured
100MW	775	150	200	59	200	40	50	30
300MW	270	74	150	45	200	40	20	20
460MW	200	-	200	-	200	-	30	-

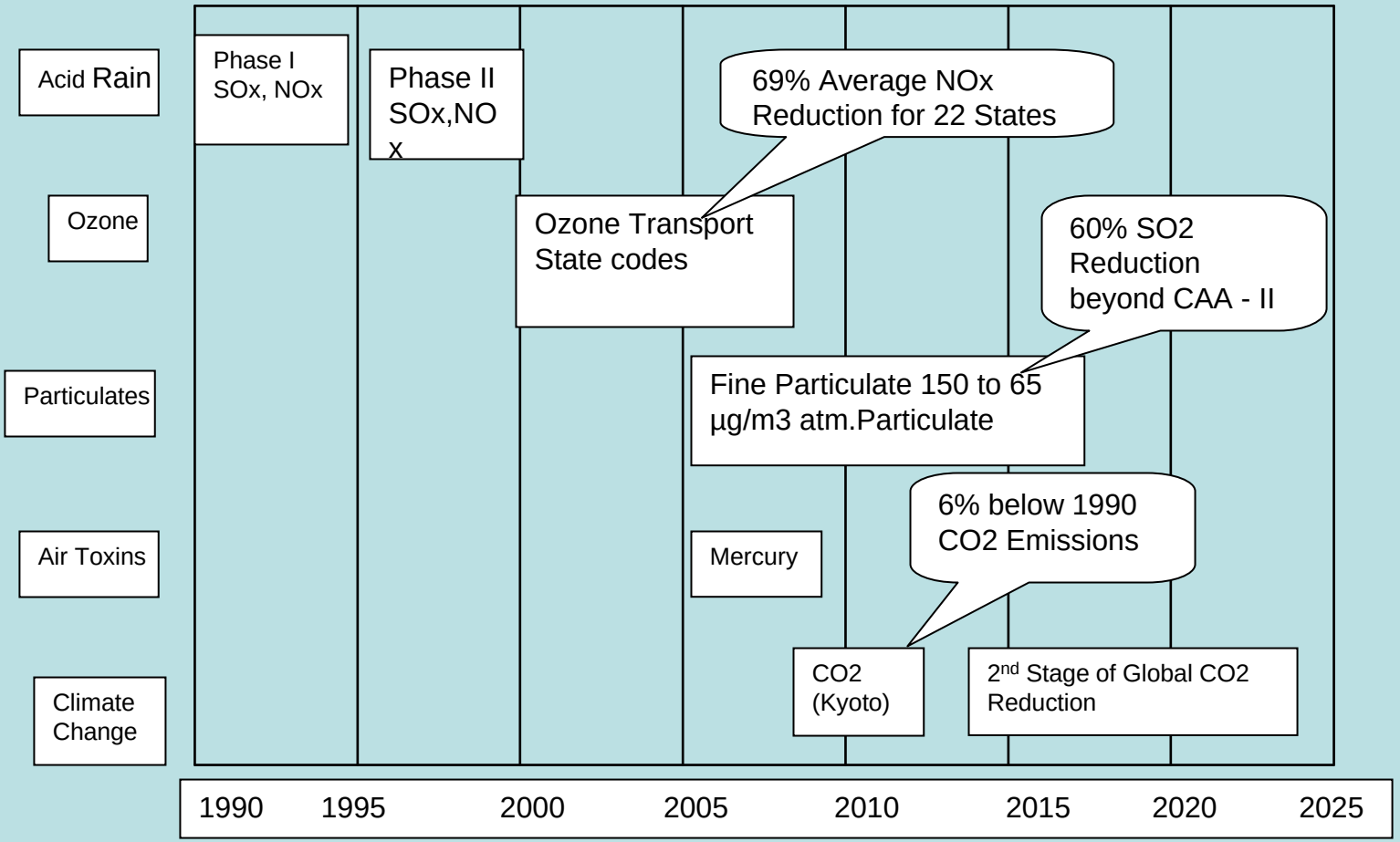
* mg/Nm3 @ 6% O2 dry volume basis

Comparison of Emission Levels

Emission Levels for Typical Indian Coals*				Emission Level in Developed Countries*	
S% in Fuel	GCV (Kcal/kg)	SOx Level in PPM	NOx Level in PPM	SOx Level in PPM	NOx Level in PPM
0.7	3000	1115	600	200	200
0.5	3300	715	600	200	200
0.38	2300	495	600	200	200

* @ 6% O2 dry volume basis

US Emission Regulation Outlook



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Conclusion

- **Indian Need is**

  - Utilization of Low Grade coals / wastes
  - Meeting Environmental Requirements

- **CFB is the right Technology**

  - for efficient combustion of low grade fuels
  - for better SOx and NOx Control

CFB is the Right Technology for India