Need For Coal Beneficiation and Use of Washery Rejects

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Presentation Outline

- The Vision
- Indian Power Sector
- Electricity & Coal – The Projected Growth
- Quality of Coal – Power Sector Concerns
- Coal Beneficiation
- Coal Washery in India
  - Setting-up Coal Washeries - Challenges Ahead
  - Enablers for Setting-up Coal Washeries
- Power Generation from Washery Rejects – Technologies
- Suitability of using Washed Coal in Thermal Plants - Recommendations of Expert Committee
- To Sum-up

The Vision

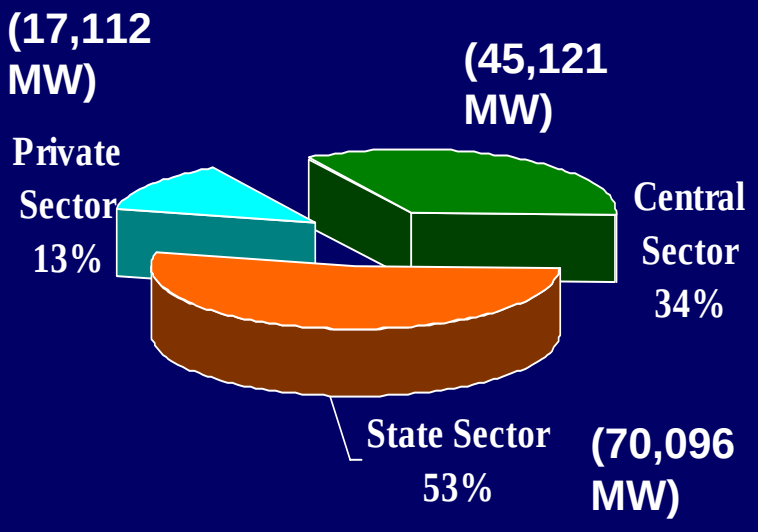
- “To reliably meet the demand for energy services of all sectors including the vulnerable households in all parts of the country with safe, clean and convenient energy at the least cost in technically efficient, economically viable and ecologically viable and sustainable ways considering different fuels and forms of energy, both conventional and non-conventional as well as new technologies and emerging energy sources.”

Source - Integrated Energy Policy

Indian Power Sector

Generating Capacity (MW)*		
Thermal	**86,015**	**65.0%**
Hydro	34,654	26.2%
Nuclear	3,900	2.9%
Renewable	7,760	5.9%
TOTAL	132,329*	100.0%

About 87% of Capacity is owned by Central/State Governments



*Excluding Captive generation capacity of appx. 15000 MW

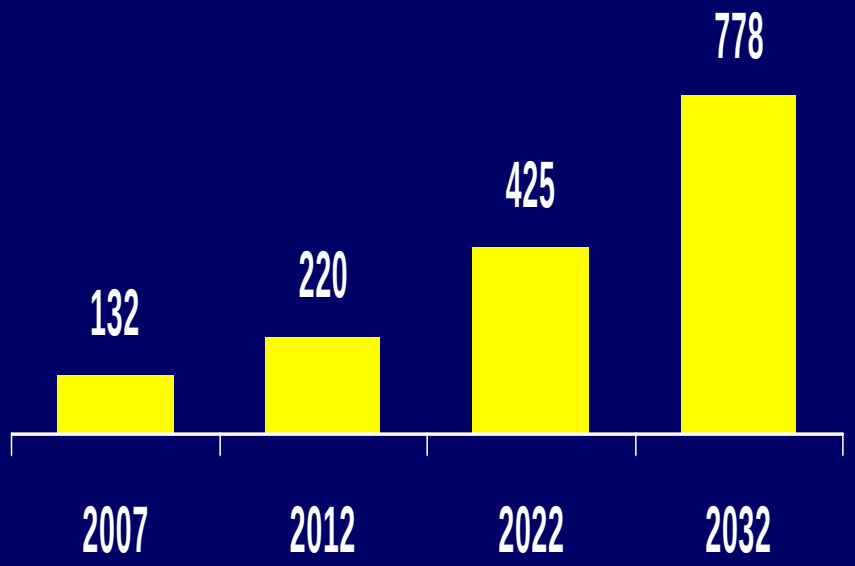
* As on March 31, 2007

Total Generation
2006-07: 662 TWh

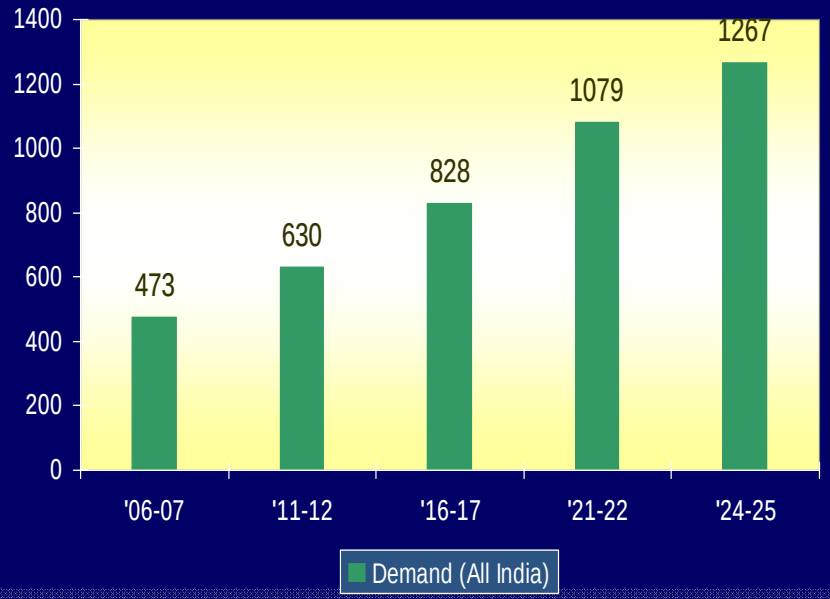
India currently faces Peak Power deficit of 13.5% and Supply deficit of 9.9%

Electricity & Coal – The Projected Growth

Generating Capacity (GW)



Coal Demand (Million Tes.)



- ✓ Generation capacity to grow at 10% PA - Major Capacity addition to be coal based.
- ✓ Coal Production capacity likely to grow at 6% PA.
- ✓ Top Priority - Ensuring matching Coal availability

There is an anticipated Demand supply Gap of about 95 MT by 2017

Steps Taken by GOI – Increased thrust on Captive mining.

Source: CEA, [Ministry of Power, and Ministry of Coal, GOI

Coal Quality - *Power Sector Concerns / Need for Beneficiation*

- Power Plants are designed for a particular Coal Quality range and deviation in quality adversely affects the performance and efficiency of the Plant.
- The key area of concern are:
  - Ash in coal - As high as 45%.
  - Inconsistency in Quality of Coal.
    - Chemical Quality
    - Physical Quality.
- These issues can by and large be addressed by resorting to Coal beneficiation.
- Need for using beneficiated coal further assumes importance for compliance to environmental requirement which stipulates that power houses situated beyond 1000 Kms from pithead coal mine must use coal having less than 34% ash.
- Besides the foregoing, improvement in plant availability / increased life and economy in long distance transportation also warrants coal beneficiation.

Coal Beneficiation

- Involves separation of Inert matter from coal.
- Efficiency of Beneficiation is dependant on Liberation of Inert matter, which varies at different size ranges.

Beneficiation can be done in various steps:

- At Mining Stage
  - Eliminating stone/shale bands / Selective Mining
- Post Mining Stage
  - Raw Coal Pre-Treatment
    - Stone Picking / Crushing / Screening / Dry Process
  - Coal Cleaning (Washing)
    - Wet Process

Coal Washeries in India

Existing Coking Coal Washeries		Number	Capacity (MTPA)
1	CIL	12	20.10
2	Others	8	12.27
3	Total	20	32.37
Existing Non Coking Coal Washeries			
1	CIL	7	20.20
2	Others	21	50.15
3	Total	28	70.35
Non Coking Coal Washeries under construction			
1	Others	3	21
GRAND TOTAL		51	123.72

Development of Coal Washeries in India is not keeping pace with the growing demand for washed coal.

Broad Issues of Concern are:

i. Assurance on supply of requisite quantity & desired quality of raw coal (both physical & Chemical from the linked source(s);
ii. Availability of land for setting-up washery
iii. Availability of land for disposal of washery waste i.e., rejects;
iii. Access to associated infrastructure such as Power, Water, Railway Siding etc.

Sourcing of coal from one company and getting it washed through another agency has series of inherent risks, which may add to the cost of washing

Source: MOC Website

Setting up Coal Washeries - *Challenges Ahead*

- Washed coal is not yet a commercially favoured commodity by the consumers
  - Gains in heat value due to reduction in ash are lost due to increase in moisture.
  - Cost of rejects is charged to washed coal price, whereby increase in cost of washed coal does not get compensated through economic gains a/c transportation.
  - Amount of rejects far too exceed the reduction in ash content in coal. As a rule of thumb, for every 1% reduction in ash the yield drops by 3.5 to 4.5%. Typically for reduction of ash from 40%-34%, yield may range anywhere between 70- 80%.
- Need of the hour is to upgrade coal washing technology to have better recovery.
- Make best use of the available residual heat energy in the rejects using the desired type of combustion system

Enablers for Setting-up of Coal Washery in India

Parameters that need to be ensured for washery project to become viable are:

- Firm source of coal supply.
- Commitment on supply of evenly spread and defined quantity of coal over a reasonably long period say 15 to 20 years.
- Commitment on quality of raw coal feed (Size, Ash, Moisture etc).
- Providing Land for setting-up of washery
- Allowing backfilling of rejects into the mine.
- Sharing of infrastructural facilities such as Power, Water, siding etc.

- ✓ Developing coal washery in a cost effective manner, is possible, only if the coal washery is set-up by the coal Producer itself, wherein, he can make best usage of sharing of the common facilities.
- ✓ This will also eliminate risks associated with achieving above stated parameters through contractual arrangement with washery developer

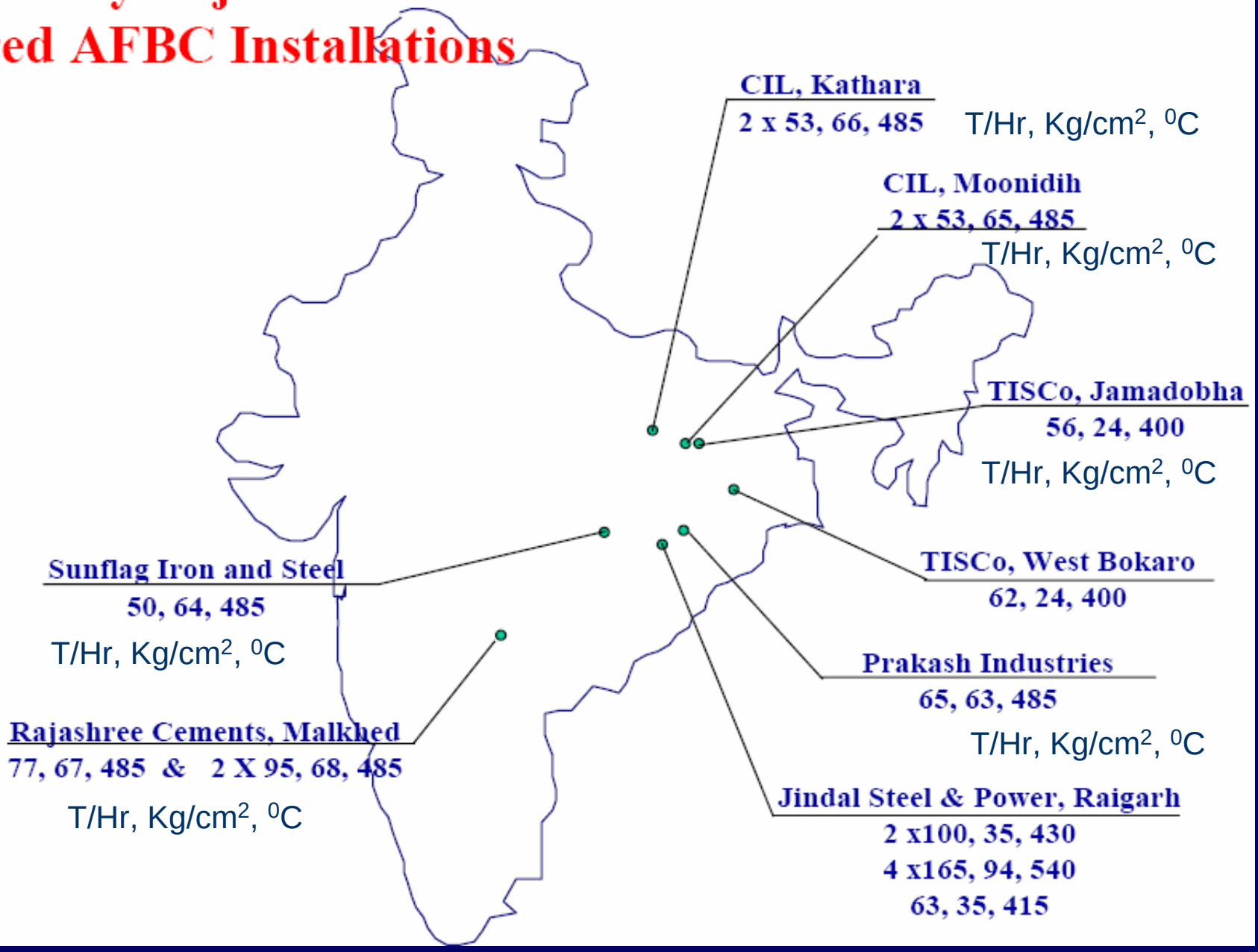
Using Washery Rejects for Power Generation

- Ash content in Washery Rejects is generally > 50%.
- Pulverized coal combustors have limitations in using coal with Ash > 50%.
- Technological developments have facilitated using coal with ash > 50% in fluidized bed combustors
- Principle: The fuel is burnt in a fluid bed maintained by blowing air through an inert bed into which the coal is introduced.
- Types of Fluidized Bed Combustion Boilers:
  - Atmospheric Fluidized Bed Combustor (AFBC).
  - Bubbling Fluidized Bed Combustor (BFBC).
  - Circulating Fluidized Bed Combustor (CFBC).
  - Pressurized Fluidized Bed Combustor (PFBC).

Atmospheric Fluidized Bed Combustor (AFBC)

- AFBC is the conventional FBC Boiler
- The fluidized bed is maintained at atmospheric pressure.
- Low efficiency
- Improper combustion
- Flexibility of fuel choice (Washery rejects with a wide range of ash % can be used)

Washery Reject and Waste fuel Fired AFBC Installations



Bubbling Fluidized Bed Combustor (BFBC)

- In a Bubbling Bed Fluidized Bed Combustor (FBC), the air velocity is just sufficient to maintain the particles in suspension. This arrangement is suitable for small machines up to about 50MWe in size, but in larger units the flow of air becomes unstable and it is difficult to maintain efficient combustion

Circulating Fluidized Bed Combustor (CFBC)

- In a Circulating Fluidized Bed Combustor (CFBC) the air velocity is much higher, causing the inert particles and ash to be blown out of the top of the boiler. They are then captured by a cyclone and returned to the bed. The high air velocity enables the CFBC to cope with larger capacity and boilers of this type are commonly in use up to 200MWe. In addition, higher ash coal can be more easily burnt and the boiler is less sensitive to variations in feed quality

Pressurized Fluidized Bed Combustor (PFBC)

- The Pressurized Fluidized Bed Combustor (PFBC) operates at several times atmospheric pressure, whereas both the FBC and CFBC operate at atmospheric pressure. The result is that the hot combustion gases can be used to directly run a gas turbine and raise steam to operate a steam turbine as well, giving higher efficiency. PFBC is, however, still the subject of development and there are very few units in operation.

Suitability of using Washed Coal in Thermal Plants - Recommendations of Expert Committee

- Techno-economically, pithead power plants with ROM coal has least Cost of Energy (COE).
- ROM coal with 44% ash levels, if it becomes the bulk supply to the power plants, should only be used at pithead without washing.
- The washing of coal with AFBC/CFBC plant for utilization of washery rejects at pithead is a techno-economically viable for load centre power plants beyond a "certain distance" from the pithead. Use of 34% ash level in coal produced using ROM coal with 40% ash, gives the most appropriate solution.
- For the low performing power plants (where the poor quality of coal has been identified as the reason for low performance), any increase in the PLF with the use of washed coal will result in higher breakeven cost of washed coal. For such cases, use of washed coal up to calculated break-even costs may be a viable option for consideration.

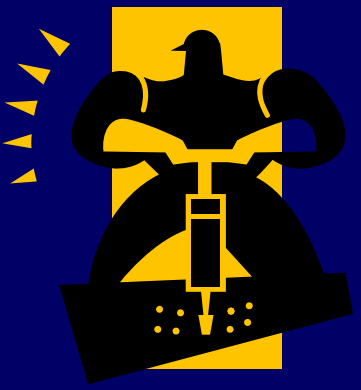
To sum-up

Coal Washery

ROM

Washed Coal

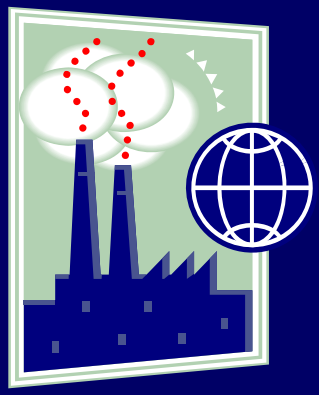
Washery Rejects



Coal Mine

Ash – Back Filling

FBC Power Plant

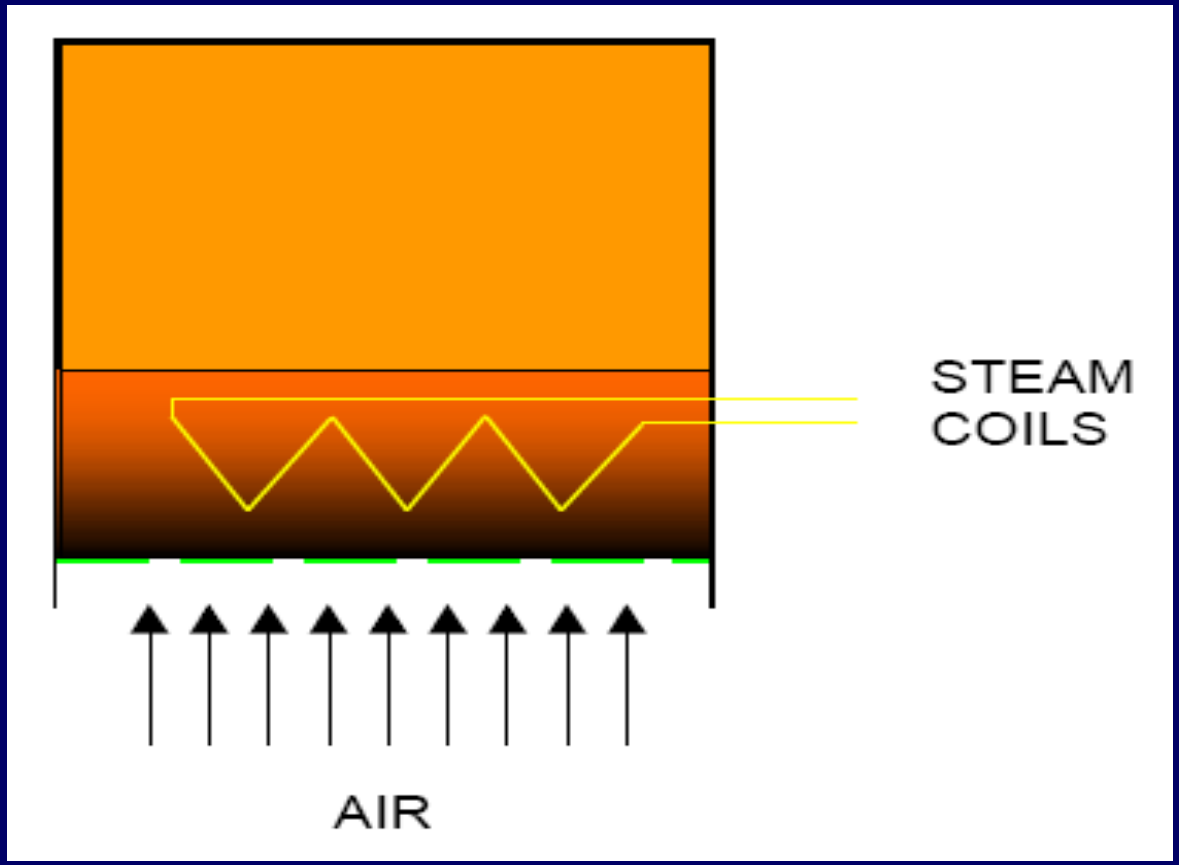


Power Plant

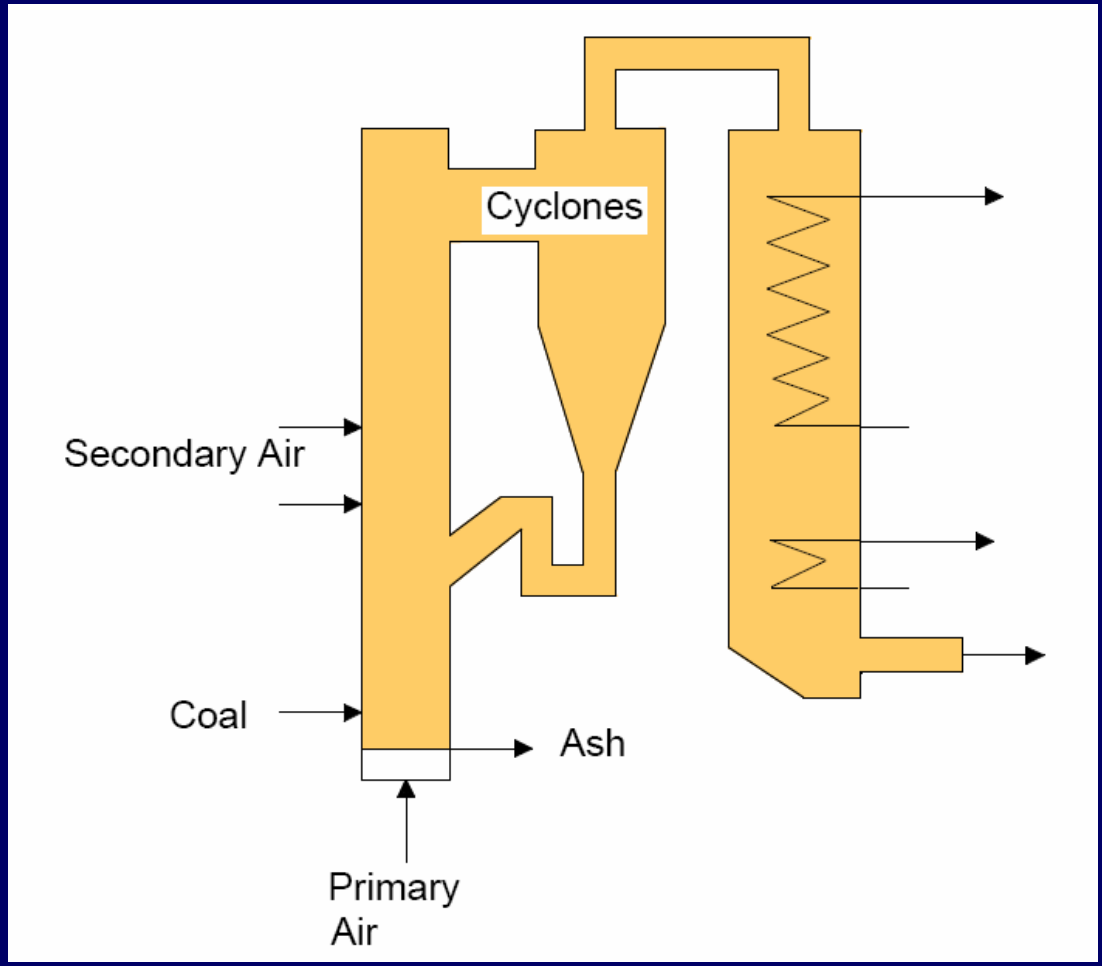
Ash

- **Fly Ash Bricks**
- **Cement**
- **Embankment etc**

Thank You

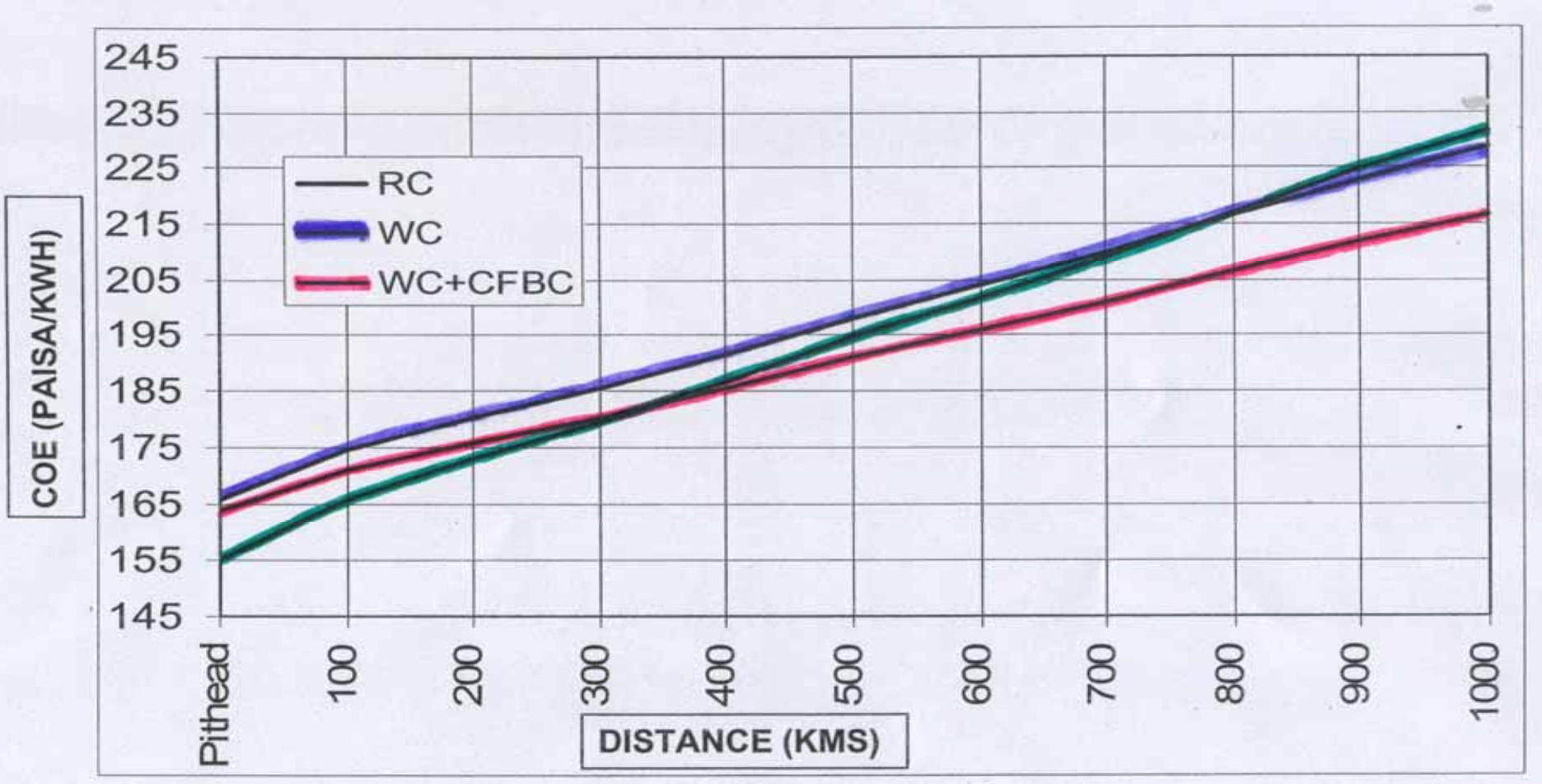


Bubbling Bed boiler arrangement



Circulating Fluidised Bed Boiler

Techno-Economic viability of using Washed Coal Vs Distance of Power Plant from Pit Head.



ROM Coal with 40 % ash level washed to 30 % ash level