Coal Beneficiation Technology - 2007

Initiatives, Policies and Practices

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Coal Beneficiation

Coal beneficiation is a process by which the quality of raw coal is improved by either reducing the extraneous matter that gets extracted along with the mined coal or reducing the associated ash or both.

Two basic processes of beneficiation:

- Dry-deshaling: Non-coal or shaly-coal is removed without using any liquid media.
- Wet process: Coal is crushed to smaller size and put in a liquid media of adjustable specific gravity to separate the lighter coal (low ash) from heavier coal (high ash). The rejects from wet process also contain carbonaceous matter

Unlike India, major coal producing countries in the world sell prepared or beneficiated coal to their consumers.

Demand for appropriate quality of coking coal in steel making compelled coking coal producers in India to wash and sell.

Till recently all non-coking coal produced in the country was consumed as mined.

One policy initiative by the Government changed scenario. Today, more than 100 million tonne non-coking coal washing capacity exists.

Thermal coal washing

The Ministry of Environment & Forests, Govt. of India promulgated Gazette Notification (GSR 560(E) & 378(E), dated September 19, 1997 and June 30, 1998 respectively) on use of beneficiated/blended coal containing ash not more than 34 percent w.e.f. June 2001 (extended to June 2002) in the following power plants :

- Power plants located beyond 1000 km from pit head;
- Power plants located in critically polluted areas, urban areas and in ecologically sensitive areas.
- Power plants using Fluidized Bed Combustion (CFBC, PFBC & AFBC) and IGCC combustion technologies are exempted to use beneficiated coal irrespective of their locations.

Whose Gain?

- Coal producers continued to sell RoM obviously no gains.
- Washery operators gained and return on investment was quite encouraging .
- Power sector got the taste of consistency in quality and reported improvement in plant availability.
- Consumers' gain in cost of transportation almost offset the washing charges and cost of coal lost as rejects.

Measure taken by coal producers and consumers for compliance of the stipulation

Short Term Measure: Blending of low ash with high ash coal at the plant site on annual average basis.

Long Term Measure: Setting up of coal washeries to meet the requirement.

EITHER the Coal producer sells beneficiated coal OR Consumers set up coal beneficiation units at the mine site Or a third party undertakes coal washing on Build Own Operate basis or on contract at the initiative by the producer or the consumer.

Beneficiated/blended coal is being supplied to 17 thermal power plants such as Dadri (U.P.), Badarpur, Rajghat & Indraprastha (Delhi), Dahanu (Maharashtra), Kota (Rajsthan), Sikka (Gujurat) etc.

Independent Power Producer, BSES built washery near the mine for their plant in Maharashtra.

State Electricity Boards of Punjab, Karnataka, Gujrat, Tamil Nadu, Andhra Pradesh took initiative in involving private entrepreneurs to invest in putting up a washery at the pit head and deliver washed coal to them. Washery operators charge cost of washing and own the rejects (15-20%) generated during washing.

Benefits of Thermal Coal Beneficiation

- Saving in transportation cost by not transporting the dirt material over long distances

- Saving in capital and operating cost of power plants.

- Cost of energy produced using washed coal may also reduce further provided the washed coal helps in increasing PLF and washery rejects are utilized efficiently in higher capacity AFBC/CFBC boilers.

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Benefits of Thermal Coal Beneficiation

- Regulating the quality of coal feed

- Reduce the ash content resulting in improving the life of the pressure parts of the boilers, grinding parts of mill, pulverized coal pipe lines, coal burner nozzles, ducts, ESP internals, air pre-heater seals, ID fan impellers etc.

- Specific secondary oil consumption is also expected to reduce.

Some power plants may not show gains of using beneficiated coal…

- In order to attain the desired level of performance and keeping in view of the multiple sources of coal with widely varying quality parameters, power plant operators have tendency to choose equipments designed on the basis of one of the extreme possibilities of the supply. Hence supply of better coal in such plants may not show improvements in performance. Powr

- In case of washed coal, the quality of supply would definitely be uniform and operators would opt for boilers based on the coal quality parameters. The difference in capital cost between plants using RoM coal (high ash) and washed coal (low ash) is significant.

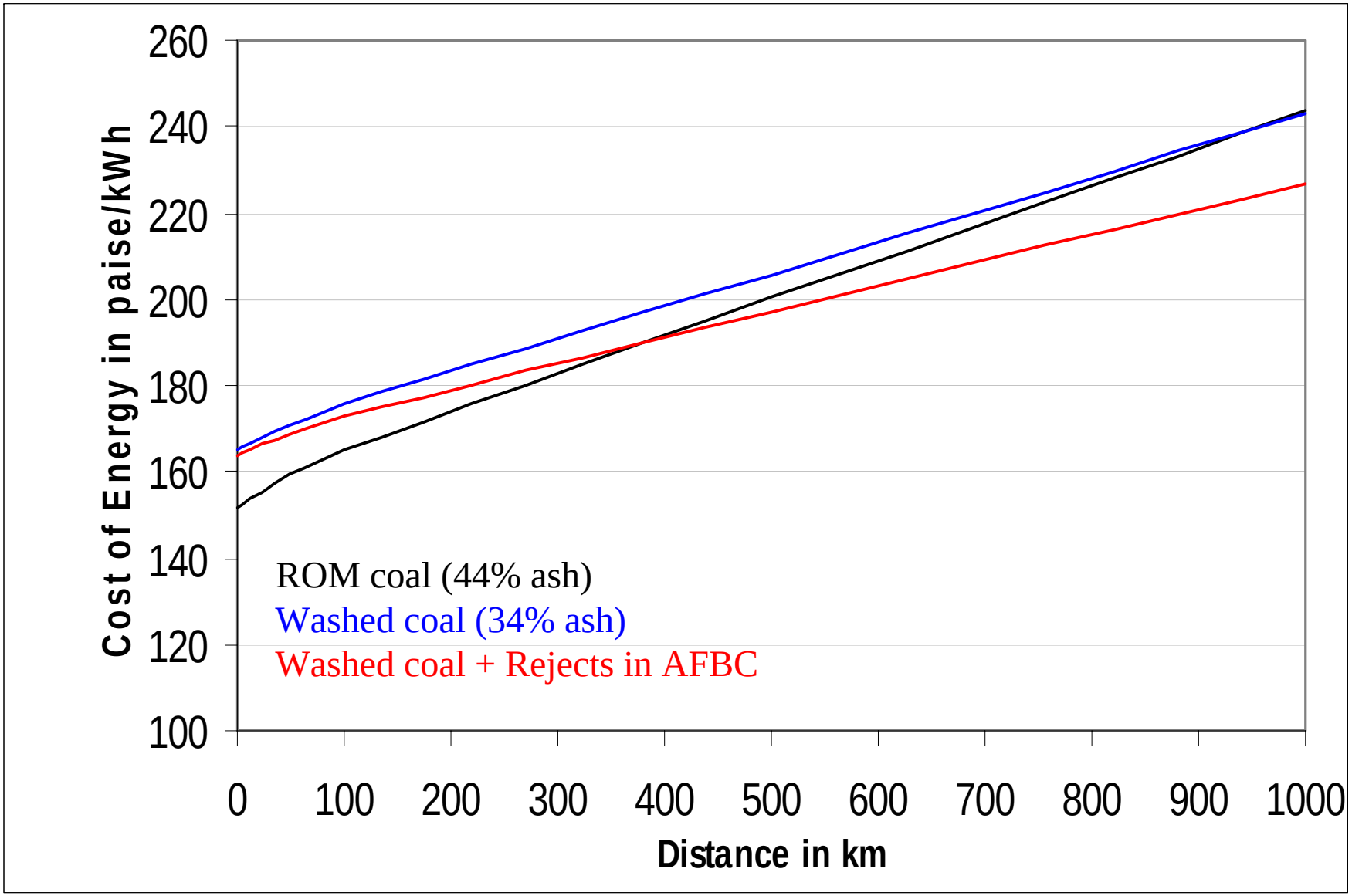
Sustainability of using washed coal in thermal power plants

To understand the mechanism and attribute numbers to advantages of using beneficiated coal in thermal power plants, a study was instituted. Results of the study are encouraging in favor of using washed coal in thermal power plants. Cost of energy may become cheaper even for the pithead power plants if these use washed coal and utilize rejects in AFBC/CFBC boilers at the pithead.

Assumed data for the study

Particulars	**Unit**	**RoM Coal with 40% ash**	**Washed Coal with 34% ash**
Station Heat rate	k cal	2450	2455
Station Heat Rate for AFBC	K cal	-	3657
Auxiliary Power consumption	%	7.5	7.33
GCV of Coal	k cal/kg	3710	4268
Capital cost reduction	%	Base	4
AFBC boiler cost	Rs cr/MW	-	0.7
Washing Cost	Rs/te	-	90
RoM coal cost	Rs/te	515	
Coal yield	%	100	80
Plant size	**MW**	**2x500**	**2x500+2x40**

Impact of washing on Cost of Energy



Thermal coal washing

- Techno-economically, pithead power plants using RoM (run of mine) coal have the least Cost of Energy (COE). However, assured supply of consistent quality sized RoM coal will help in optimizing the plant cost and reduce O&M problems.
- The washing of coal and utilization of washery rejects in AFBC/CFBC plant at pithead is techno-economically viable for load centre power plants beyond a certain distance from the pithead.
- 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.

Use of washed coal in thermal power plants

- The prime technology of coal beneficiation has not been widely appreciated either by the coal or the power producers because they view the economic benefits in isolation to their own sector. By lowering the ash content of input fuel there is a definite reduction in the cost of coal and ash-handling system of conventional boilers due to reduced quantities of handled material. At the same time operation and maintenance cost would also lower by reduction of ash content due to lesser wear and tear in pulverising system. Rough estimate suggest a saving in the cost of 500 MWe conventional unit by about 25% and 30% in case the ash content in feed coal is reduced from 42% to 34% and to 24% respectively. Total project cost of such plant including cost of coal washery and AFBC for using washery rejects at ash content at 42%, 34%, 24% is likely to be cheaper by 5%, 8% and 10% respectively. Generation of 15 to 18 MWe by AFBC is an extra benefit. Larger gains may be expected if life-time cost in lieu of lower R&M is taken in to account.

- Higher thermal efficiency and better environmental performance are audible benefits of CFBC, IGCC and Super-Critical Boiler. High ash Indian Coal and high Sulfur Lignite has been found to be good for these technologies.

Status of thermal coal washing in India

In-spite of the fact that economic incentive on coal washing is apparently low, existing capacity of thermal coal washeries in the country is more than 100 Mt per year comprising of 83 Mt in private sector.

The capacity of the washeries under development (construction and proposal stage) at present is about 106.5 Mty.

Out of the projected capacity addition during XI Plan, about 27 % power plants of capacity 12735 MW would be located at more than 1000 kilometres distance from pithead.

Out of total projected coal requirement of 540.0 Mt, power stations situated beyond 1000 kilometres and others within MOEF stipulation would be consuming about 158.0 Mt of coal.

XI Plan scenario

The total non coking coal production in the country has been estimated as about 650 Mt in the terminal year of XI plan which includes around 104 Mt from captive mining. The requirement of the beneficiated non-coking coal by the turn of XI Plan period (2011-12) has been assessed:

Type of coal	Projected production (Mty)	Remarks
Superior grade	143	Need based
Pithead TPS linked low grade coal	160	Need based
Coal from captive mining.	104	Captive consumption.
Remaining low grade coal	243	Beneficiation needed

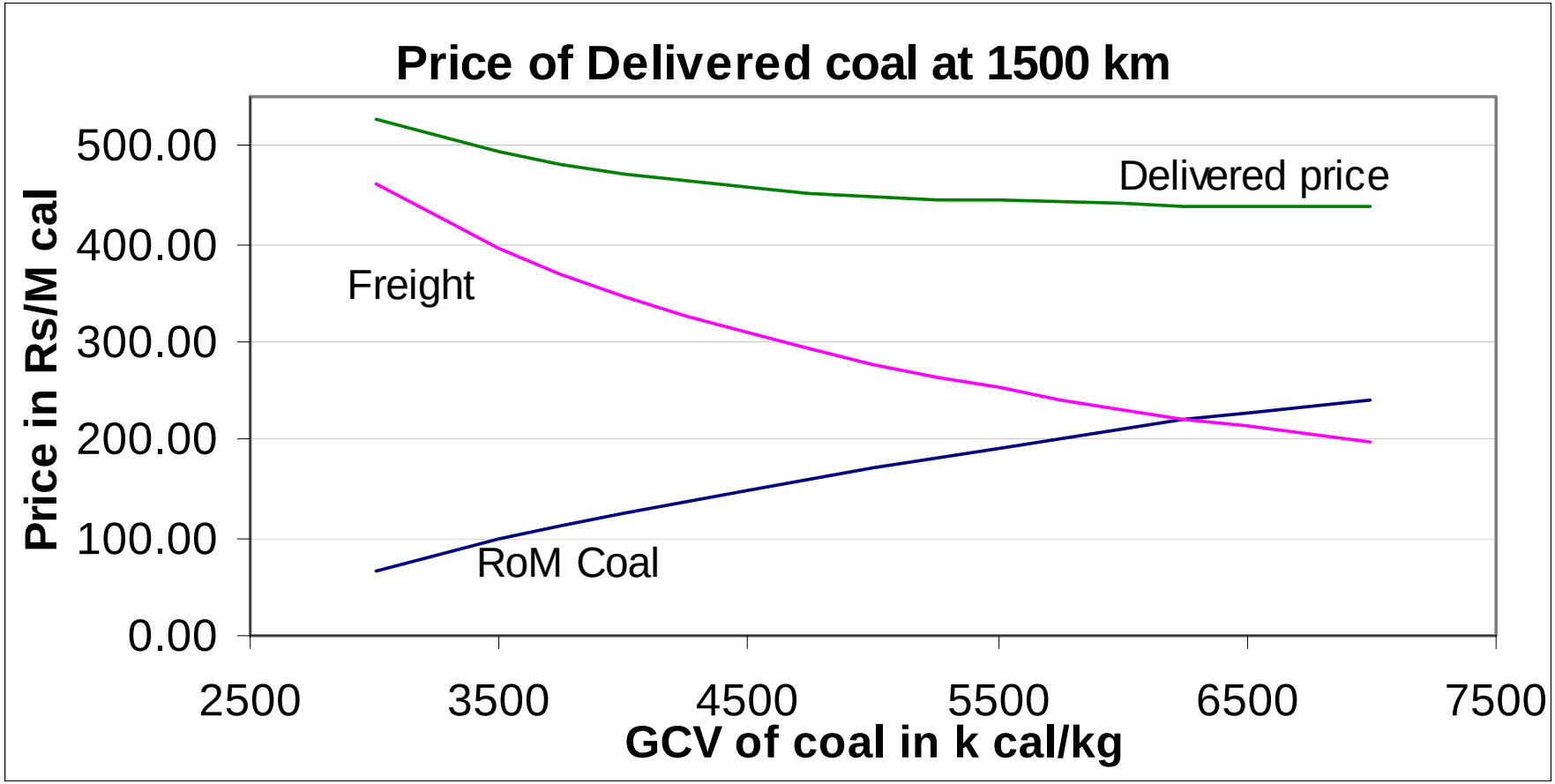
Policy initiative

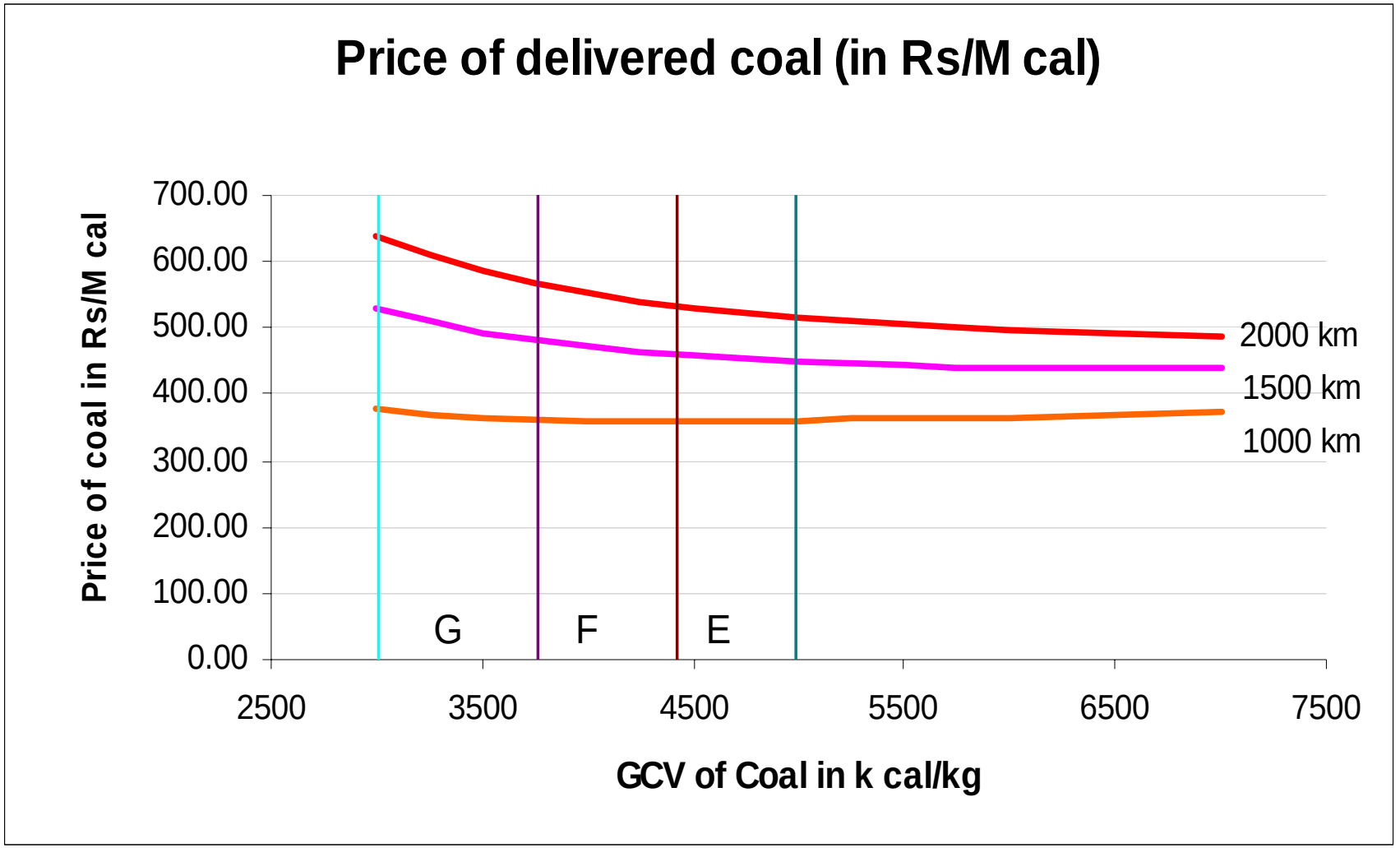
Unlike the rest of the world, Indian coal producers sell run of the mine coal. Simple de-shaling, improved mining procedures and sizing of coal could bring down the average ash content of Indian coal to around 35% from the current level of over 40%. Full washing could reduce the ash content further, thereby saving transport costs and resulting in more efficient power plant design and operation. One of the hurdles to washing in the prevailing unique practice of pricing coal on grades based on Useful Heat Value (UHV) with wide bands instead of fully variable system based on more precise internationally practiced Gross Calorific Value (GCV).

Impact on stakeholders

If price of coal is made fully variable based on its heat content measured in GCV then the producer would be encouraged to undertake coal beneficiation.

Consumers would save in cost of transportation, storage, fly ash handling in addition to above-mentioned benefits.


Price of Delivered coal at 1500 km
Price in Rs/M cal
500.00
400.00
300.00
200.00
100.00
0.00
Delivered price
Freight
RoM Coal
2500
3500
4500
5500
6500
7500
GCV of coal in k cal/kg


Price of delivered coal (in Rs/M cal)
Price of coal in Rs/M cal
700.00
600.00
500.00
400.00
300.00
200.00
100.00
0.00
2500
3500
4500
5500
6500
7500
G
F
E
2000 km
1500 km
1000 km
GCV of Coal in k cal/kg

THANK YOU