TATA STEEL
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TATA

Coking Coal for Domestic Steel Industry

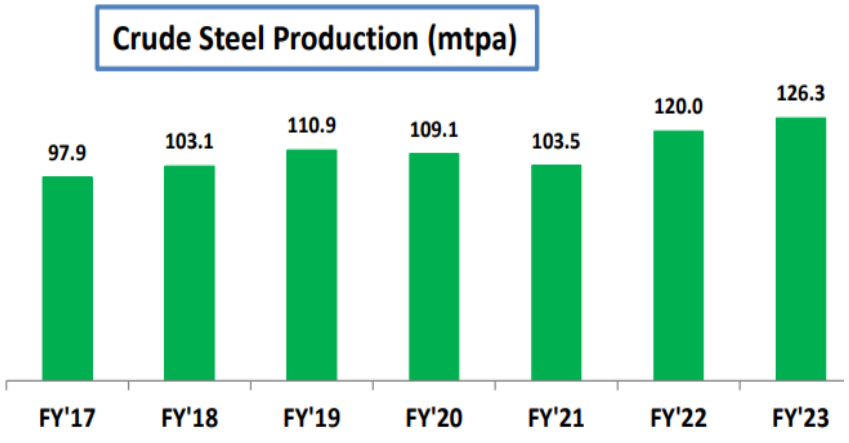
Manish Mishra
Chief Corporate Affairs
Tata Steel

Date – 28th July 2023

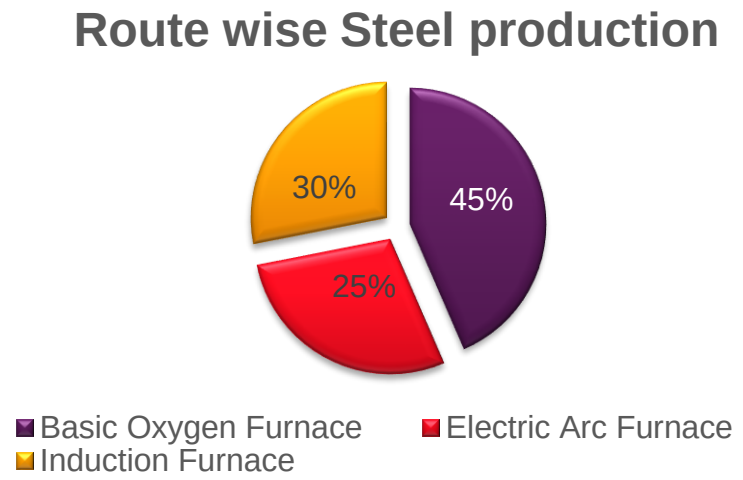
Agenda

 1	Indian Steel & Coal Industry
 2	Coking Coal Scenario, Trade dynamics, Demand Supply Gap
 3	Challenges for Coking Coal Supply in India,
 4	Quality - Indian Coking coal vs Imported Coking Coal
 5	Washability Character of Indian Coal
 6	Way forward to meet coking coal demand

Indian Steel Industry



- Steel consumption is widely considered as an indicator of economic development of a country.
- Globally 1831 Mt of steel was produced in CY2022. Global Steel demand is expected to increase by 2.3% in FY24 (WSA).
- **Indian steel industry capacity and crude steel production has increased to 160Mt and 126 Mt in FY23. (PIB, MoSteel).**
- Steel industry grew @ 8.2% in 2022, demand is expected to show healthy growth of 7.3% in 2023.
- **Production on the Blast Furnace route >67Mt out of 126Mt**.
- Total imports of met coal in FY'23 was > 56Mt (Including PCI coal).
- National Steel Policy (NSP) is targeting 300MT capacity by 2030. BF route should see scaling up to about 120MT by 2030. This translates to met coal requirement to double in the next 8-10years.

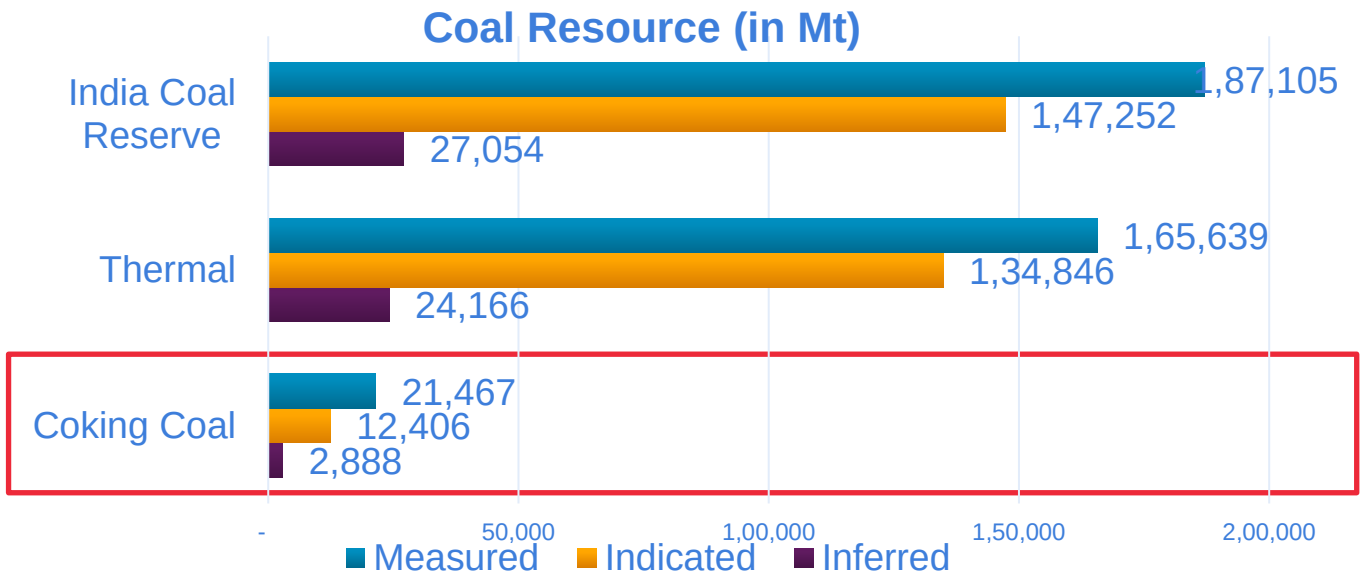


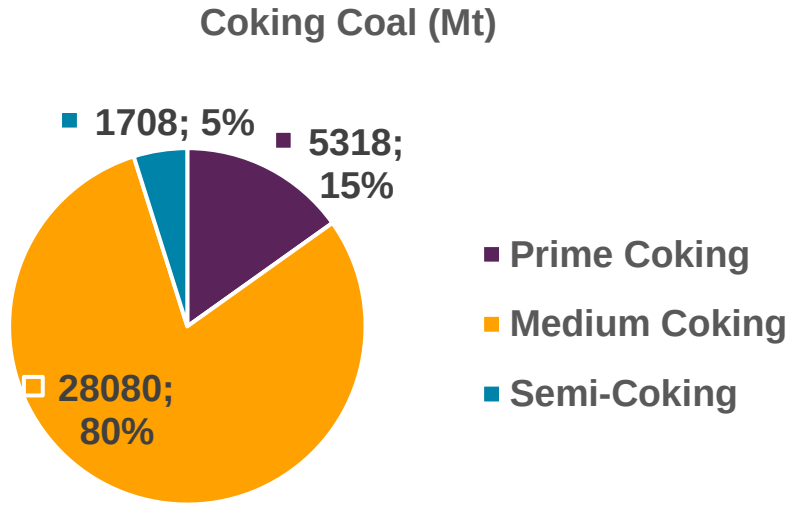
- India is 2nd largest Coal producer in the world (893 Mt in FY23). Coal currently accounts for 70% of the India's electricity generation.
- Coal is expected to contribute 54% by 2030 and 35-40% by 2050. **Coal to continue to dominate source of energy generation and steel making at least for next 3 decades.**

Source: WSA, MoSteel

Coking Coal Scenario in India

- As per coal inventory published by GSI, India has 361 Bt of Coal up to depth of 1200m.
- India produced 893Mt of coal in FY'23, CIL - 703Mt and SCCL – 67 Mt, Captive and other mines – 123 Mt. There is 88% production from opencast mines, 12% from underground mines.
- India has limited coking coal reserve (~10% of total coal reserve)
- Majority of coking coal is medium coking coal (80%)





Source: Ministry of Coal

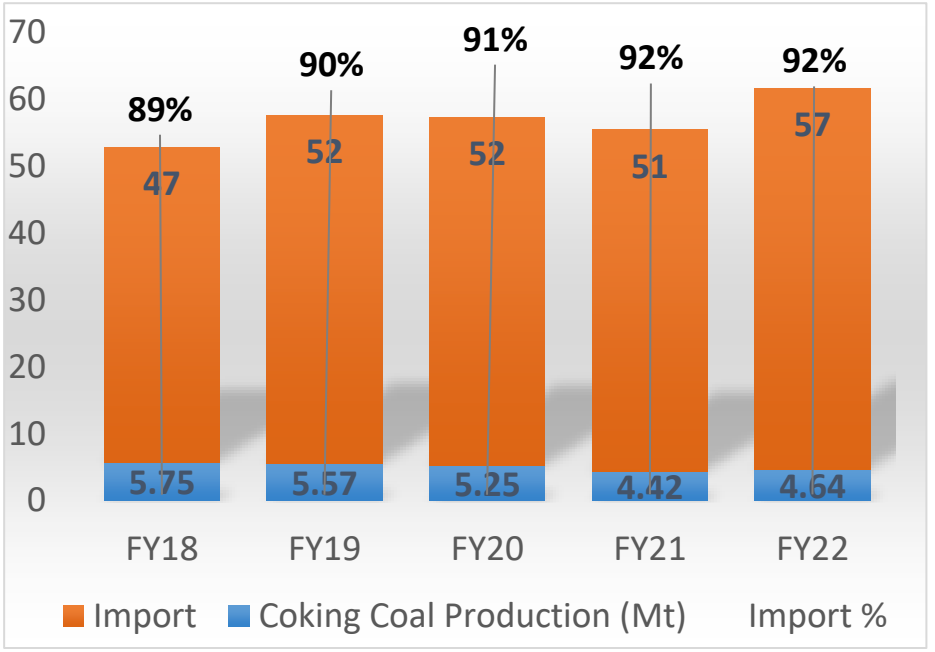
Coking Coal for Steel

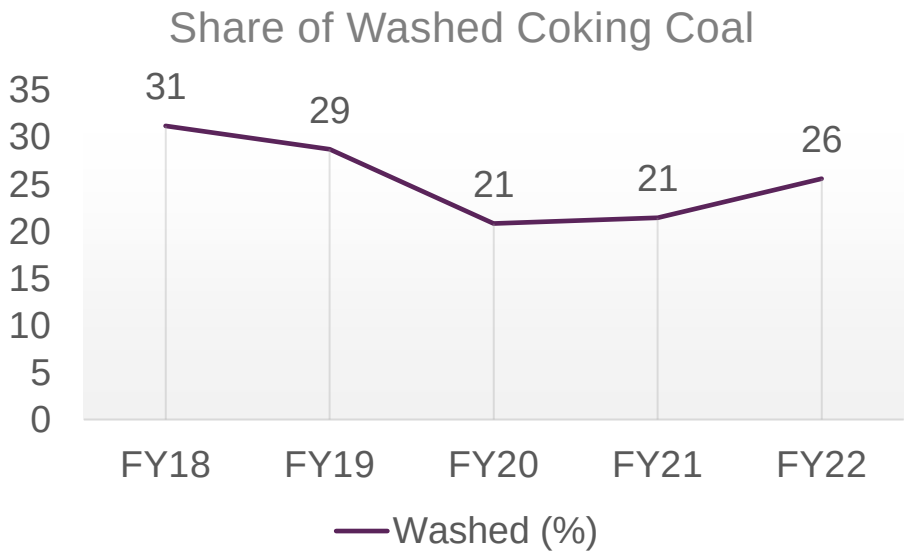
- Iron ore and coking coal are two most critical raw materials for steel production. India has surplus reserves of iron ore for long term requirement. However, the supply of coking coal needs to be enhanced on account of the following:

1. **Huge Demand Supply Gap of Coking Coal:** India's domestic reserves are inadequate to meet the demand.

2. **Increase in Domestic Steel Demand:** According to National Steel Policy 2017, to achieve steel making capacity of 300 MTPA (including 181 MTPA through blast furnace route) by FY 2030, huge volumes of coking coal (~170 MT of domestic raw coking coal) would be required.

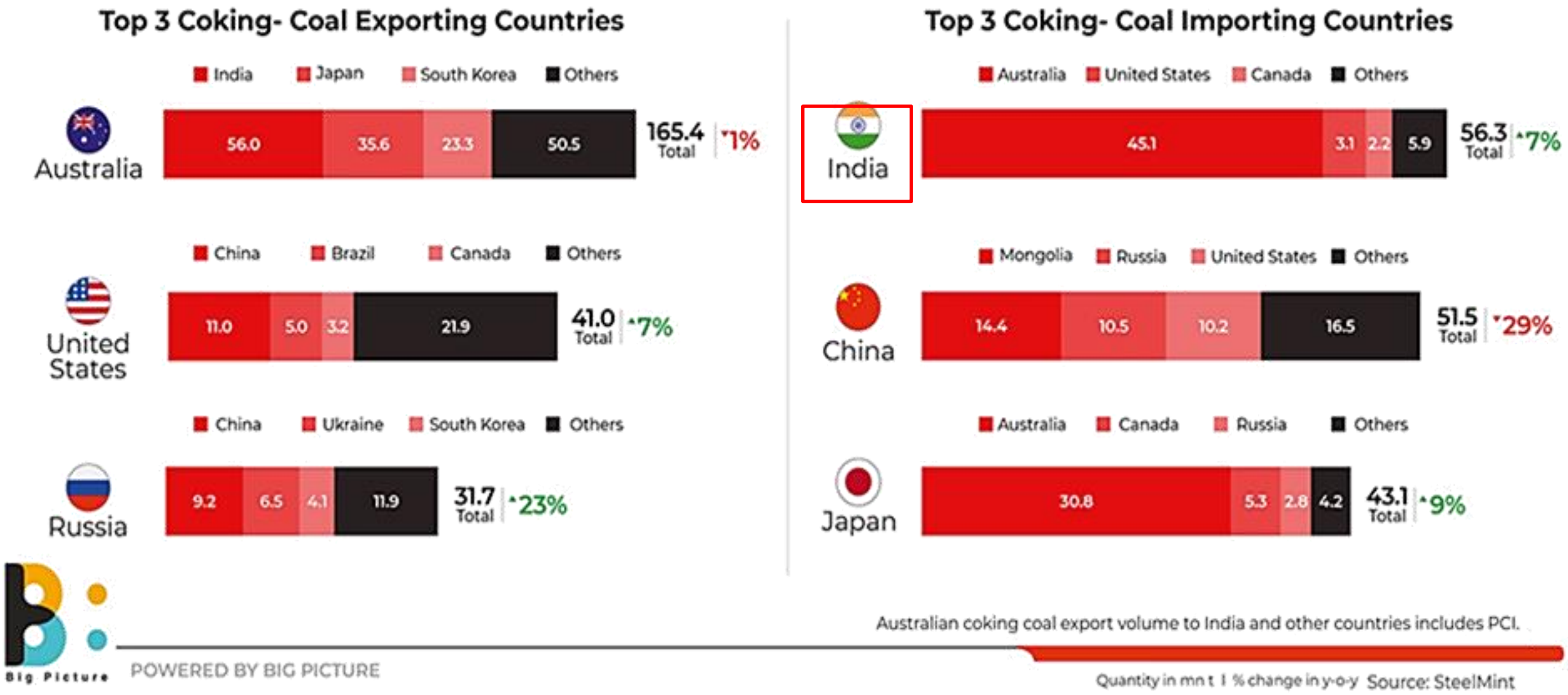
3. **Import Dependent:** India is the largest coking coal importer. Indian steel industry fulfils ~90% of its coking coal requirements through imports.





Source: Ministry of Coal

Trade Dynamics of Coking Coal (2021)



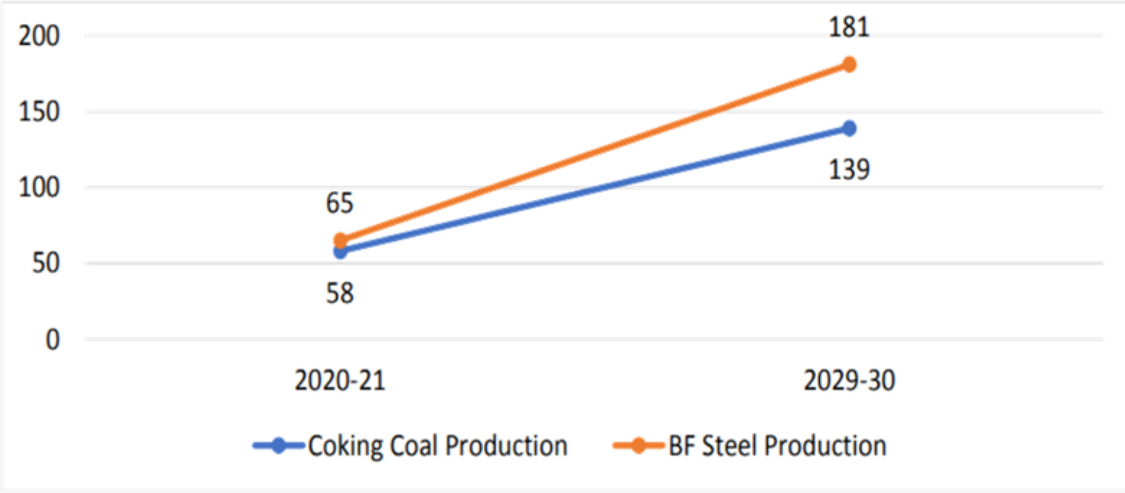
Source: Steelmint

Demand Supply Gap - Domestic Coking Coal by FY 2030

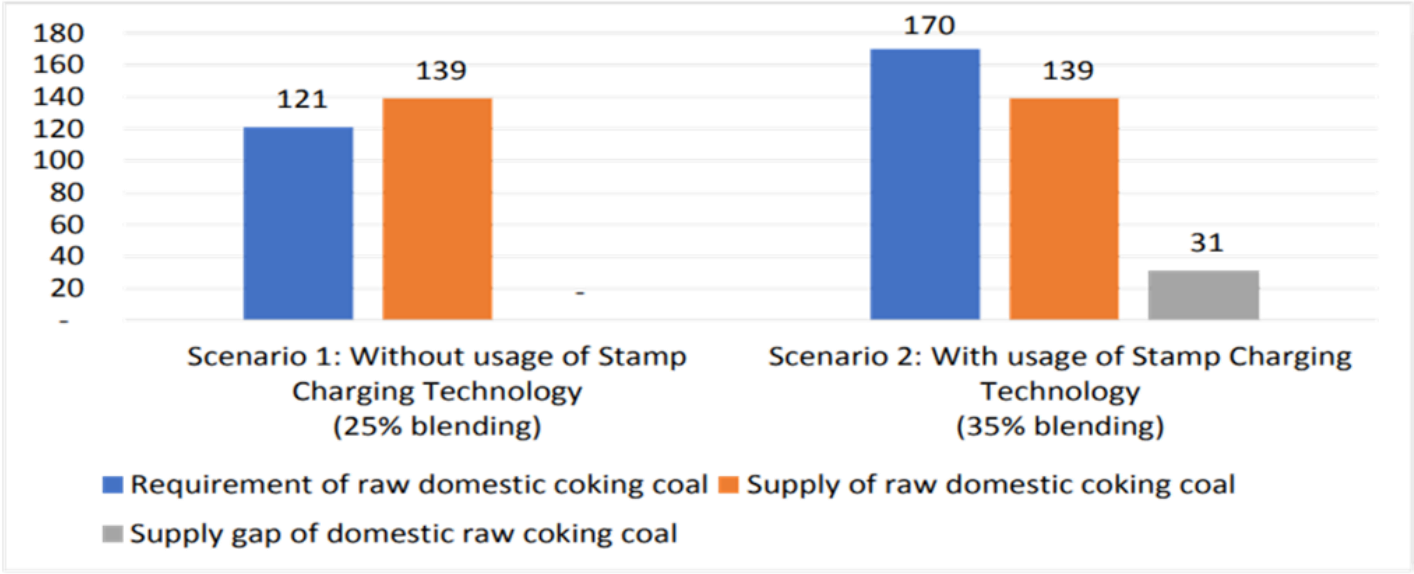
Demand of Coking Coal in India – FY 2030

Particulars (figures in MTPA)	Scenario 1: Without usage of Stamp Charging Technology	Scenario 2: With usage of Stamp Charging Technology
Blending % of domestic coking coal at 18% ash	25%	35%
Imported coking coal requirement	121	105
Requirement of washed domestic coking coal	40	56
Requirement of raw domestic coking coal for meeting remaining washed coal	121	170

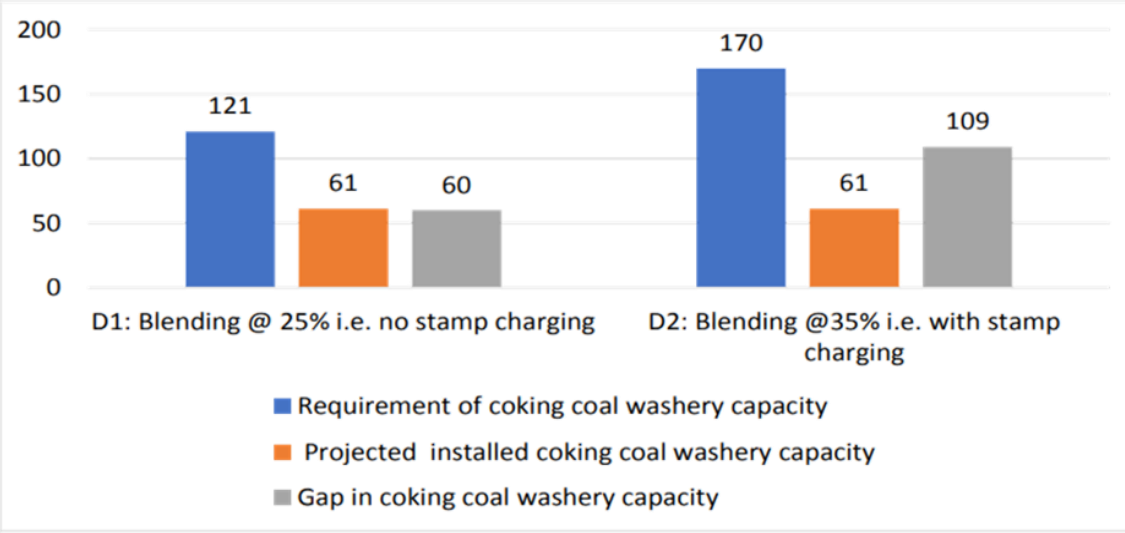
Coking Coal Production Projections (MT)



Demand Supply Gap of Domestic Raw Coking Coal (MT)



Demand Supply Gap of Coking Coal Washery Capacity (MT)



Source: Mission Coking Coal, MoC

Challenges of Coking Coal Supply in India for Steel Making

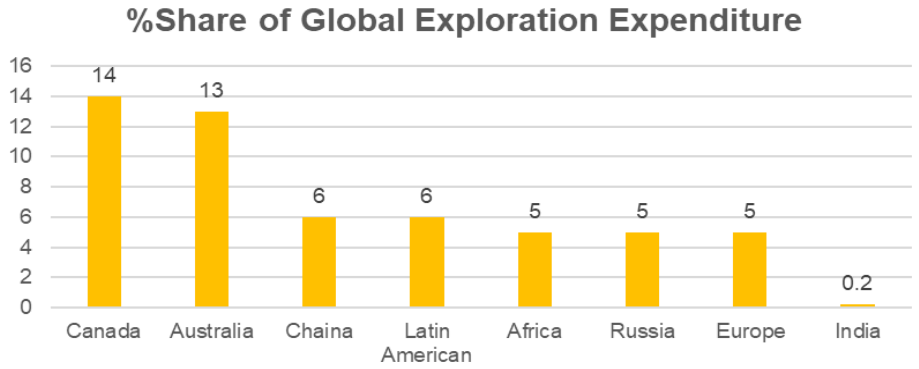
- India has limited installed coal beneficiation capacity.

140MTPA Washing capacity required by 2030	23MTPA Washing capacity right now	38 MTPA washing capacity to be added by 2030	79MTPA Gap in 2030

- Lack of Washing capacity: Capacity gap is expected to go 79MTPA.
- Underutilized Washeries at Tata Steel (up to 2.5MTPA)
- Misutilization of Coking coal:
  - Spot Auction of Coking coal should be sector specific only.
  - Coal diverted to Thermal power plants with power crisis.
- Allotment to integrated steel players through Auction process makes coal block less economical.
- Many coal blocks allotted to PSU remain unutilized.
- Unattractive blocks in terms of quality, quantity & location of deposit during previous auctions.
- High dependency on import- affected by price fluctuation and global supply chain constraints.

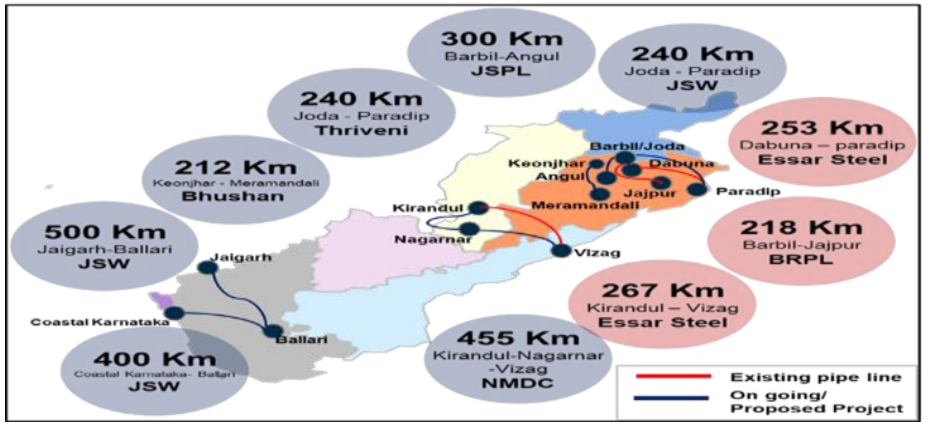
Source: Mission Coking Coal, MoC

- Limited Exploration:



- Logistics Bottleneck:

1. Congestion of Indian Railway and Availability of rake is a major issue.
2. Dedicated freight routes may ease the problem.
3. Limited number of pipelines.



Indian Coking Coal Quality Comparison

- Limited Coking Coal reserves in India - 10% of total coal reserve.
- Run of Mine has higher ash content up to 40%. ROM coal needs beneficiation for use in Blast Furnace.
- Even after beneficiation, Indian coal has disadvantage over imported coal due to low washability (High Ash, low CSN and comparable VM). Only a blend of domestic coal is usable in blast furnace.
- The comparative proximate analysis of washed Indian coking coal and imported coal shown in the table.

Quality Parameter	Unit	Domestic		Imported			
		West Bokaro Washed	Jharia Washed	PHCC	OHCC	HCC	SS
Ash	%	16	18.5	9-10	7.5-9	9-10	8-9
Moisture	%	8	8	8	8	8	8
VM	%	24	19	23-24	20-22	26-28	24-25
Dilation	%	60	10	100	10	100	35
Fluidity	ddpm	2500	200	1000-1200	20	3000	200
CSN	Min	4	5	8 – 8.5	6.5	7	7.5
MMR	%	0.98	1.23	1.2	1.35	1.04	1.18
P	%	0.12	0.09	0.01	0.05	0.06	0.04
S	%	0.7	0.68	0.56	0.45	0.4	0.55

Quality comparison of Domestic Coking Coal vs Imported Coal

Source: TSL Technology Group

Washability Character of Indian Coal

- Vertical variability and spatial variability is very high in Indian coal.
- Yield of lower seams and top seams is varying in wide range and there is no common trend between different coal basins.

Washability Character Variations:

- **Inter-basinal variation:** Variation in two different basins (e.g. Jharia coal flotation response poor to West Bokaro).
- **Intra-basinal variation:** Variation within same basin (Marked in right side picture).

Washability Character of Jharia Coal

Float & Sink test of -0.15m

Sp. Gr.	Fr. wt.	Fr. ash	Cum Wt.	Cum Ash
1.500	42.21	14.83	42.21	14.83
1.550	5.30	22.61	47.50	15.70
1.600	4.65	29.02	52.16	16.89
1.650	4.91	36.19	57.06	18.55
1.700	1.96	40.26	59.02	19.27
1.750	2.73	42.90	61.75	20.31
1.800	3.84	47.32	65.60	21.89
1.900	34.40	69.80	100.00	38.38

F.F Test of -0.25mm

	Wt	Wt %	Ash %	Cum.Wt %	Cum.Ash %
Froth-30 Sec	114	32.95	18.29	32.95	18.29
Froth-60 Sec	67	19.36	20.91	52.31	19.26
Froth-90 Sec	43	12.43	24.63	64.74	20.29
Tailings	122	35.26	46.42	100.00	29.50

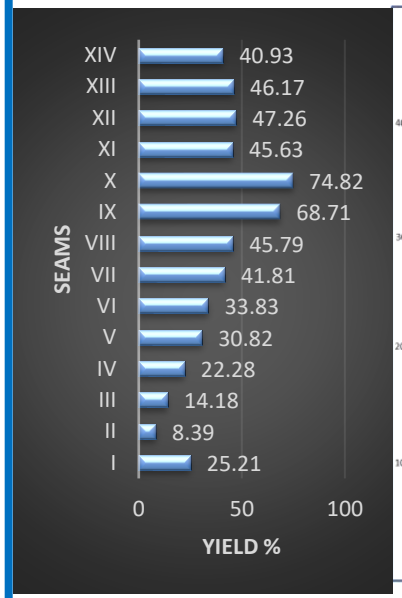
Inter-basinal variation

Washability Character of West Bokaro Coal

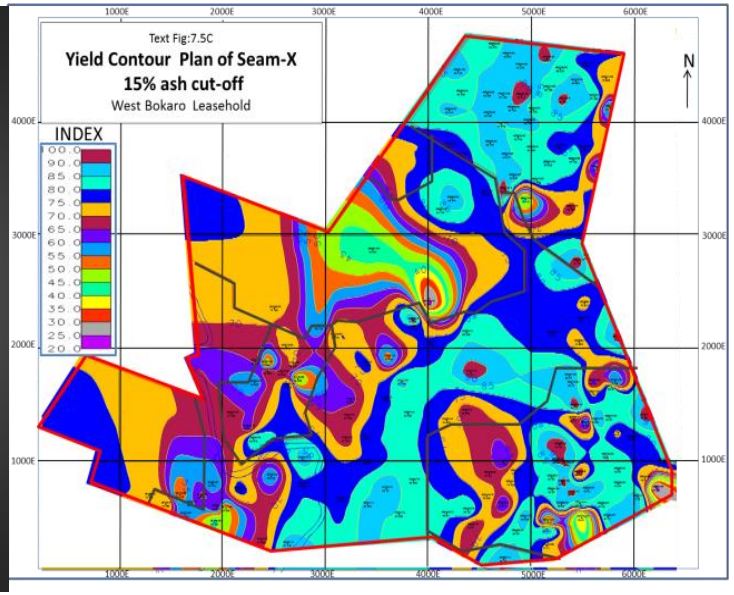
Sp. Gr.	Wt %	Ash %	Cumm Wt %	Cumm Ash %
		.91	4.71	2.91
1.35	4.74	6.80	9.45	4.86
1.40	7.19	10.54	16.64	7.32
1.43	6.89	14.10	23.54	9.30
1.45	4.68	16.94	28.22	10.57
1.48	6.71	19.63	34.92	12.31
1.50	3.55	22.42	38.47	13.24
1.55	8.47	25.45	46.94	15.45
1.60	6.26	29.34	53.20	17.08
1.65	8.06	34.43	61.26	19.36
1.70	6.40	39.54	67.66	21.27
1.75	5.63	41.54	73.29	22.83
1.85	3.02	46.74	76.31	23.77
1.90	23.69	68.40	100.00	34.35

F.F Test

	Wt %	Ash %
Froath	47.30	12.87
Tailings	52.70	29.80
Cumm	100.00	21.79



Vertical Variability

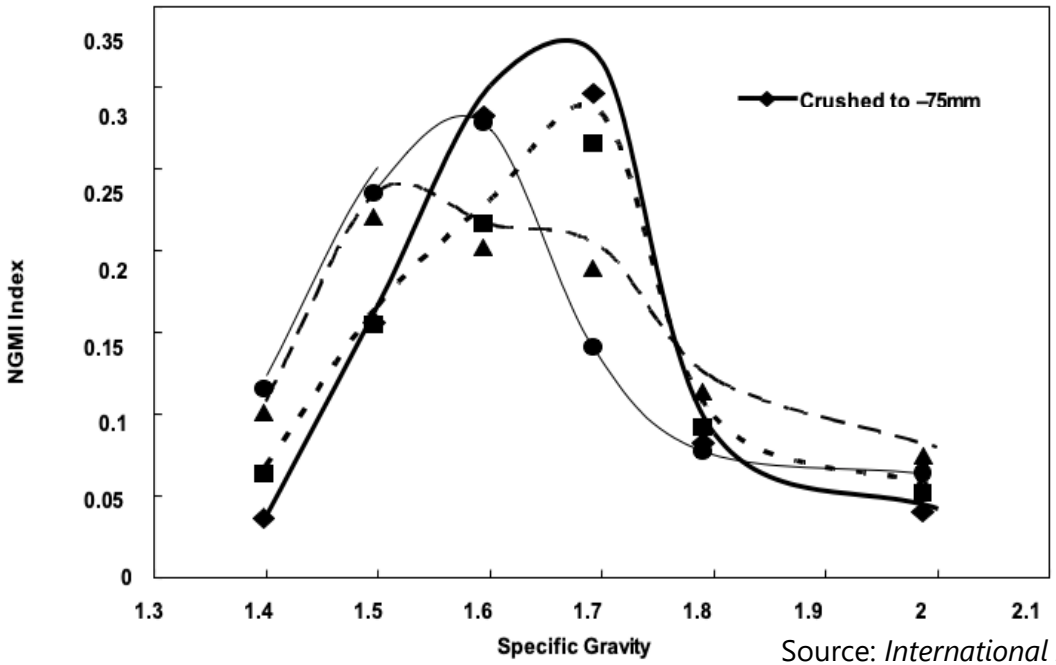


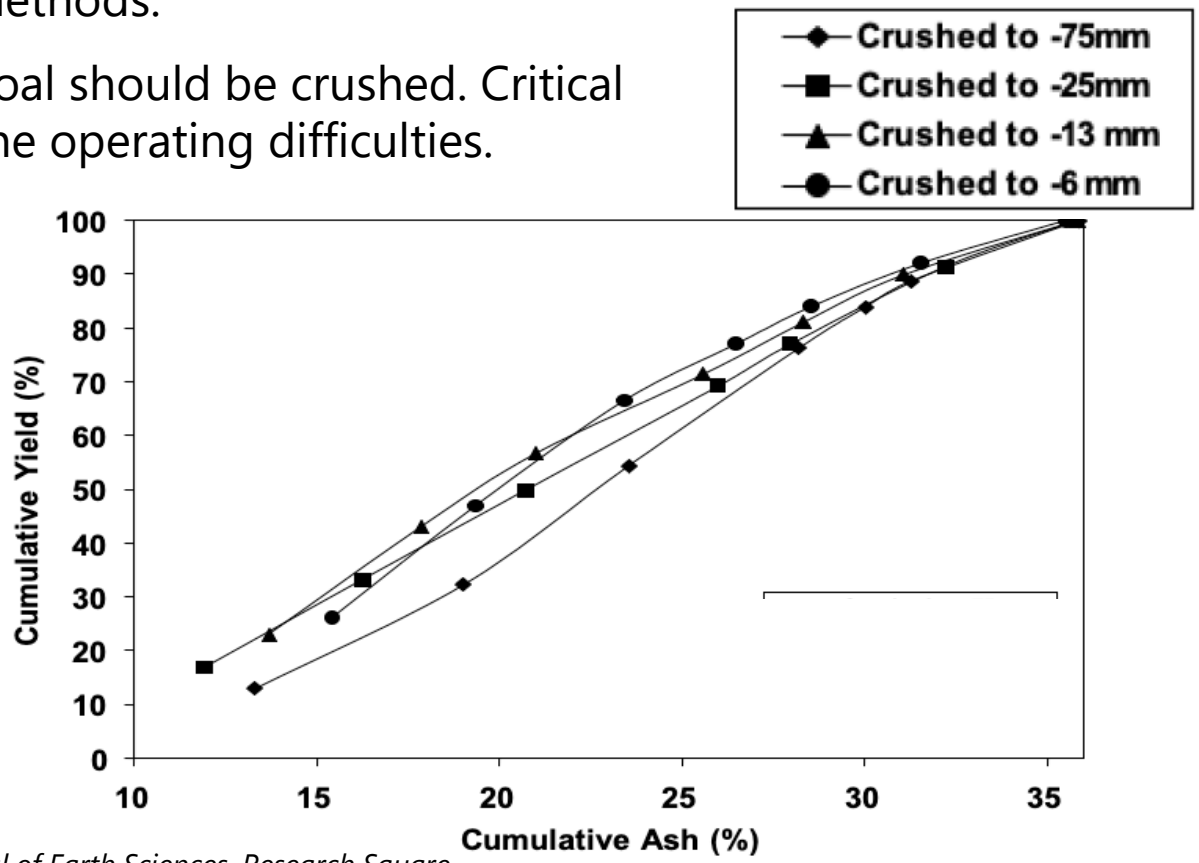
Spatial Variability

Intra-basinal variation

Washability Character of Indian Coal

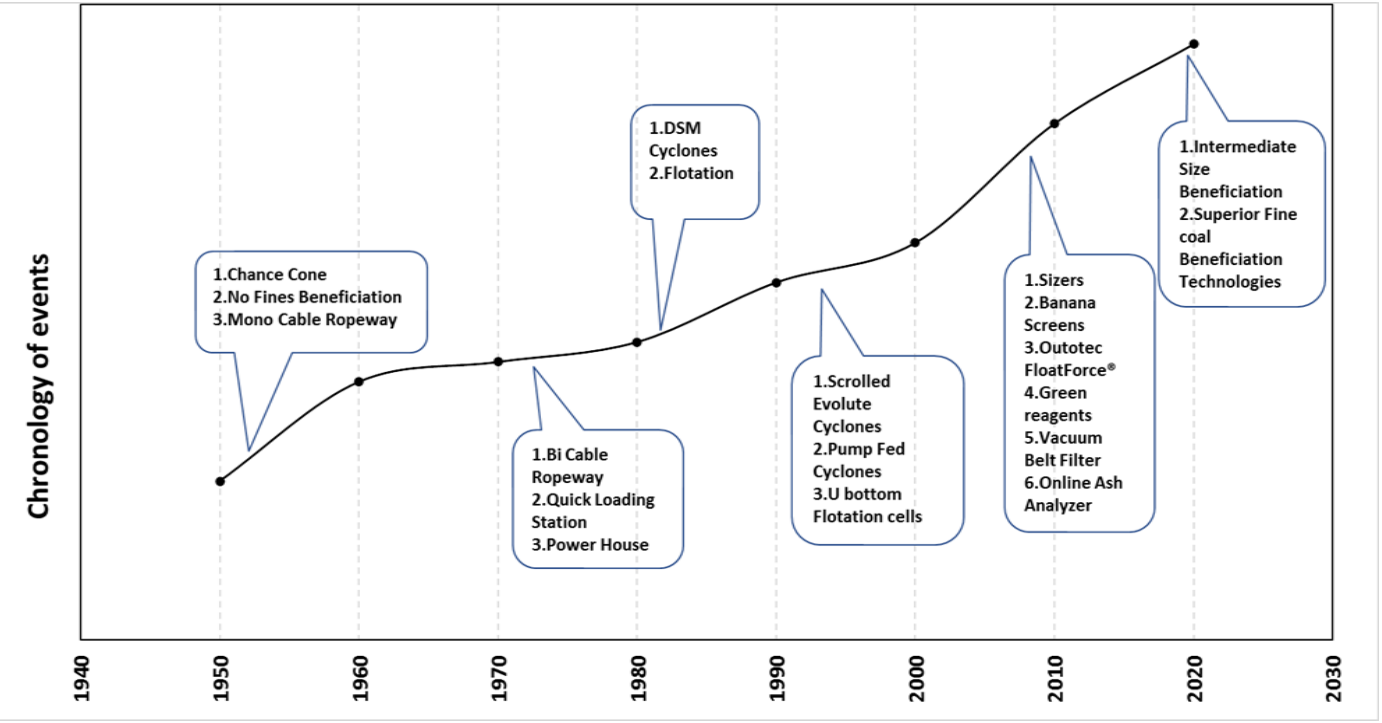
- The coal cleaning process should be chosen on the basis of raw coal properties at hand and coal quality to be achieved at the end.
- Coal liberation characteristics depends on coal size and process parameters such as Sp.Gravity.
- Combination of IW (Index of washability) and NGMI (Near Gravity Material index) could be used to evaluate the ease of beneficiation of coal using gravity methods.
- IW would determine the liberation size at which the ROM coal should be crushed. Critical specific gravity based on NGMI analysis would determine the operating difficulties.





Source: *International Research Journal of Earth Sciences, Research Square*

Coal Beneficiation at West Bokaro- Extracting best out of available resources



1940-1970s

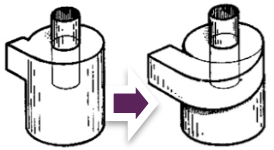
- Raw coal was crushed and -75 mm size.
- Only **top seams** (good quality) mined.
- **Mono-cable ropeway**

1980s

- Detailed studies were carried out in 1984. Chance Cone process was replaced with **gravity fed Dense Media Cyclones** (DSM Cyclones) and **flat bottom mechanical flotation** cells for processing finer raw coal fraction: -0.5mm

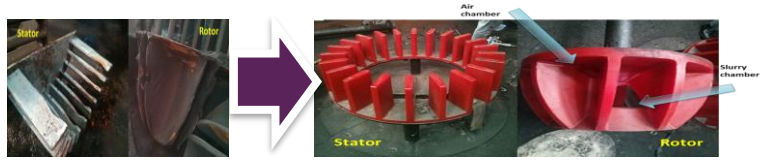
1990s

- **Low Ep Scrolled Evolute Cyclones:** Washeries switched over from **tangential inlet design** in the Dutch State Mines (DSM) cyclones to **scrolled evolute design cyclones.**
- **Introduction of Pump Fed Cyclones.**
- **Replacement of flat-bottom flotation cells with U-bottom ones.**



2000 to present:

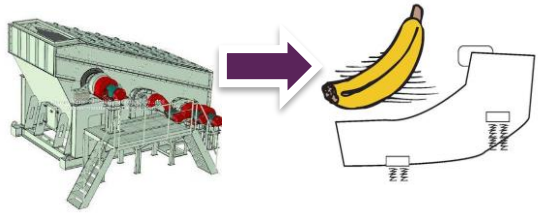
- **'Advanced new-generation mixing mechanism 'in Flotation cells.**



- **Substitution of Diesel with green reagents in Flotation.**

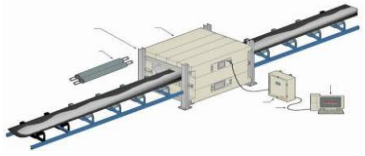
- **Introduction of Sizers to improve liberation:** Sizers were introduced in place of roll crushers to get optimum liberation at reduced noise and dust.

- **Replacement of Elliptical screens with Banana screens** to improve the desliming efficiency.



Introduction of Vacuum Belt Filter for dewatering fine clean coal: Initially, Ultra-fine coal particles were getting lost with the centrifuge effluents. The belt filter installed at West Bokaro washery#3 is also the **world's largest HVBF** with an effective filtration area of 145 m² for coal slurry.

- **Online Ash Analyzers** for consistency in product quality: Taking representative samples from conveyor belt and analyses for effective quality monitoring & control was time consuming. Online ash analyzers enable us to take corrective actions timely resulting in in controlled process output – Controlled clean coal ash product.



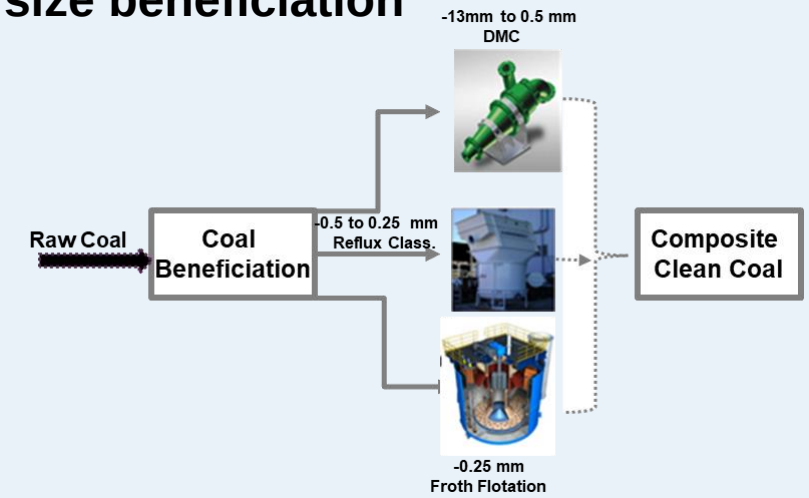
State of the Art – Upgradations at West Bokaro

Commissioning of Long pipe Conveyor for cleaner Dispatch

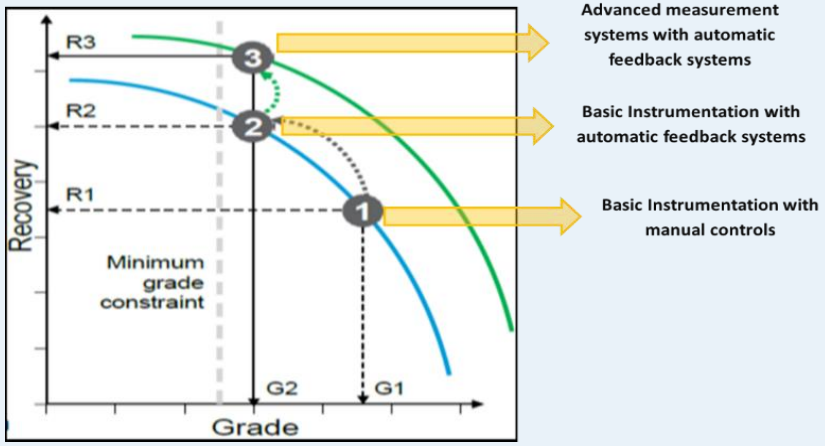
Centralized Control Room

Technological Upgradations in progress

Intermediate size beneficiation

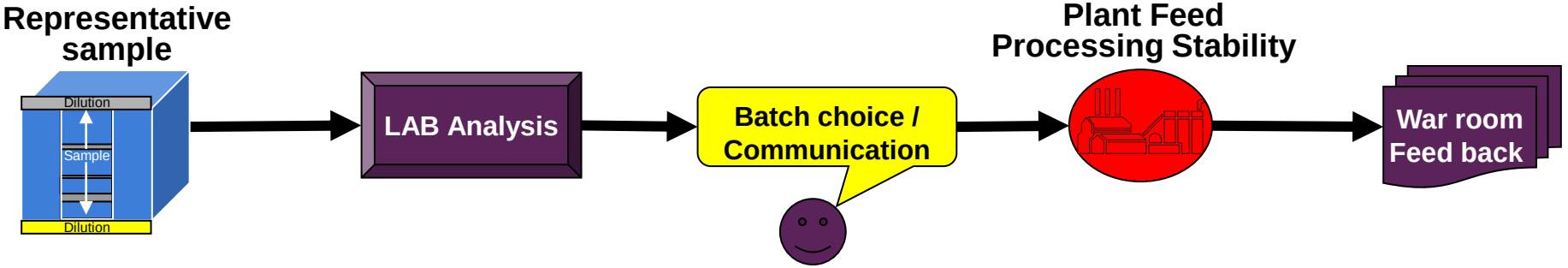


Fully automated plant



Quality assurance process at West Bokaro

-To provide a stable and predictable feed to the constraint
-To protect Washery against variability



9SE/922 +SHALE +8SE/823

FROM	TO	THICKNESS	CORE SAVED	CR	LITHOLOGY	
0.00	0.98	0.98	0.93		MAINLY BRIGHT COAL (BROKEN CORE)	
0.98	1.00	0.02	0.02	0.95	CARB SHALE	IX SEAM
1.00	1.19	0.19	0.18		DULL & BRIGHT COAL (BROKEN CORE)	
1.19	1.52	0.33	0.31		MAINLY BRIGHT COAL (BROKEN CORE)	
1.52	1.81	0.29	0.28		DULL & BRIGHT COAL (BROKEN CORE)	
1.81	1.97	0.16	0.16		MAINLY BRIGHT COAL (BROKEN CORE)	
1.97	3.00	1.03	1.00	1.93	CARB SHALE (BROKEN TOWARDS TOP)	
3.00	3.15	0.15	0.14		CARB SHALE (BROKEN CORE)	
3.15	3.24	0.09	0.09		DULL & BRIGHT COAL (BROKEN CORE)	
3.24	5.37	2.13	2.04		CARB SHALE (BROKEN CORE)	
5.37	5.73	0.36	0.35		MAINLY DULL COAL (BROKEN CORE)	
5.73	6.00	0.27	0.26	2.88	DULL & BRIGHT COAL (BROKEN CORE)	VIIISEAM
6.00	6.16	0.16	0.15		DULL & BRIGHT COAL (BROKEN CORE)	
6.16	6.36	0.20	0.19		DULL COAL (BROKEN CORE)	
6.36	6.59	0.23	0.22		DULL & BRIGHT COAL (BROKEN CORE)	
6.59	6.71	0.12	0.11		MAINLY BRIGHT COAL (BROKEN CORE)	
6.71	7.16	0.45	0.43		DULL & BRIGHT COAL (BROKEN CORE)	
7.16	7.26	0.10	0.09		BRIGHT COAL (BROKEN CORE)	
7.26	7.35	0.09	0.09		DULL COAL	
7.35	7.84	0.49	0.46		MAINLY BRIGHT COAL (BROKEN CORE)	
7.84	8.23	0.39	0.37		DULL & BRIGHT COAL (BROKEN CORE)	
8.23	8.30	0.07	0.06		BRIGHT COAL (BROKEN CORE)	
8.30	8.58	0.28	0.27		DULL & BRIGHT COAL (BROKEN CORE)	
8.58	8.66	0.08	0.08		DULL COAL	
8.66	9.00	0.34	0.32	2.84	DULL & BRIGHT COAL (BROKEN CORE)	
9.00	9.21	0.21	0.19		DULL & BRIGHT COAL (BROKEN CORE)	
9.21	9.45	0.24	0.22		MAINLY BRIGHT COAL (BROKEN CORE)	
9.45	9.74	0.29	0.26		DULL & BRIGHT COAL (BROKEN CORE)	
9.74	9.92	0.18	0.16		DUL COAL WITH BRIGHT STRINGES	
9.92	10.00	0.08	0.08	0.91	SANDY SHALE	
		10.00	9.51	9.51		
CORE RECOVERY %				95.10		

Batch- 99	Yield from Pulp Partition Model (Primary cut point at 1.8)									
	Cl.coal	77.92	15.00	Recovery (-0.5mm)		Recovery (+0.5mm)		Composite data	
	Middlings	0.00	0.00	Yield (%)	Ash%	Yield (%)	Ash%	Yield (%)	Ash%
	Tailings	14.44	25.84	65.07	7.40	83.37	16.63	78.79	15.00
	Rejects	11.64	65.48	SEC CUT POINT		1.4694	YIELD% (COARSE)		62.52
		104.00		PRI. CUT POINT		1.8000	YIELD% (FINES)		16.27

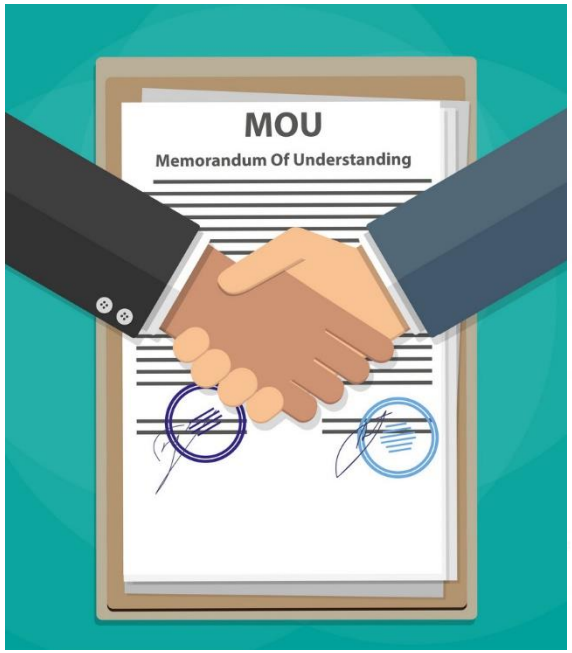
IXSE CORE SAMPLE — CORE RECEIVED ON - 03.09.2011
DATE OF ANALYSIS -04.09.2011 — BATCH NO - 105
SAMPLE NO: 9SE/922/11 — F. FLOTATION TEST

SIZE(mm)	WT(Kg)	WT%	ASH%	WT%	ASH%
+0.5mm	3.279	82.26	24.76	65.07	7.40
-0.5mm	0.707	17.74	13.84	34.93	25.84
TOTAL	3.986	100.00	22.83	100.00	13.84

Raw coal 'direct ash%= 22.60 — Raw coal '-0.5mm ash%= 13.93

SG	WT	WT%	ASH%	CUM.WT%	CUM ASH%
1.30	0.389	11.86	3.39	11.86	3.39
1.35	0.621	18.94	7.97	30.80	6.21
1.40	0.537	16.38	12.18	47.18	8.28
1.43	0.252	7.69	15.91	54.86	9.35
1.45	0.151	4.61	18.38	59.47	10.05
1.48	0.270	8.23	21.19	67.70	11.40
1.50	0.123	3.75	24.26	71.45	12.08
1.55	0.108	3.29	27.05	74.75	12.74
1.60	0.076	2.32	32.29	77.07	13.33
1.70	0.045	1.37	39.67	78.44	13.79
1.80	0.071	2.17	46.18	80.60	14.66
>1.80	0.636	19.40	66.76	100.00	24.76
TOTAL	3.279	100	24.76		

Customer based approach leads to quality fulfilment



Memorandum of Understanding (MoU)

MEMORANDUM OF UNDERSTANDING (MoU) WITH WORKS & HMCL
(FY '19)

Internal Customer :- Coke Plants of TSJ Works & HMCL	Supplying Partner : West Bokaro

	Sl. No	MOU Parameter		Unit of Measurement	Base Level	Target Level	Responsibility	Review Frequency
Product Parameters	1.1	Clean coal despatch to TSJ Works & HMCL (Own)		Lakh Tons	18.19	18.87	Chief(CB)	Quarterly
	1.2	Clean coal despatch to TSJ Works & HMCL (CCL)		Lakh Tons	1.71	2.60		
	1	Total Clean coal despatch to TSJ Works & HMCL		Lakh Tons	19.90	21.47		
	2	SD of clean coal despatch		%	0.316	0.300	Chief (CB)	Monthly
	3	Clean coal avg despatch ash		%	17.37	18.00	Chief (CB)	Monthly
	4	Clean coal Ash range < 18.2 % ash		%	89.50	90.00	Chief (CB)	Monthly
	5	Clean coal avg despatch Moisture	During monsoon (July - Oct)	%	10.60	10.60	Chief (CB)	Monthly
			FY (rest month)	%	10.22	10.30	Chief (CB)	Monthly
	6	Clean coal VM >23.0 & < 26.0		%	91.00	91.00	Chief (CB)	Monthly
	7	Clean coal CSN >=3.5 & <=5.5		%	97.79	90.00	Chief (CB)	Monthly
	8	Clean coal Fluidity range 1800 - 5000 ddpm		%	86.56	87.00	Chief (CB)	Monthly

	Sl. No	MOU Parameter	Unit of Measurement	Base Level	Target Level	Responsibility	Review Frequency
Service Parameters	4	Customer Visit	Nos.	3	3	Head (Logistics)	Half yearly
	5	Information of ash and other quality details before rake arrival at customer end	%	100	100	Principal Geologist (NRD)	Monthly

Name : Mr. Sahabji Kuchroo
Designation : Chief(Operation) WB
Signature

Name : Sanjay Singh
Designation : General Manager (Coal)
Signature

Name : Mr. Prakhar Mishra
Designation : Chief, Coke Plants, TSJ
Signature 03/05/2018

MoU Compliance Monitoring

SUMMARY							
DATE	DESPATCHED ON DATE (Qty)	CUM.ASH%	CUM.MOI%	CUM.VM%	CUM.CSN	MAXDDPM	DESPATCHED TILL DATE (Qty)
31-May	7941.62	15.05	10.09	25.36	4.95	3590.69	151993.83

Sample

RAKE NO	DESPATCHED ON	DESPATCH TIME	QUANTITY (MT)	ASH%	MOIST%	VM%	LOT							Fluidity test results				
				CLEAN COAL			Reported	1	2	3	4	5	6	Softening Tep(T)	Max.Fluid DDPM	Max.Fluid Temp	Plastic range	Soildificati Temp
85	24-May	15:45	3912.30	14.94	10.00	25.46	5.0	5.0	4.5	5.0	5.0	4.5	5.5	403.8	3528	451.3	85.1	488.9
92	26-May	08:00	2621.40	15.09	10.12	25.13	5.0	5.0	4.5	5.0	5.0	4.5		403.3	3246	449.5	86.8	490.1
94	27-May	02:00	3953.30	15.03	10.07	25.22	4.5	4.0	4.5	5.0	5.0	4.5	4.5	404.9	2938	445.3	84.6	489.5
95	27-May	18:30	3988.50	14.68	10.03	25.13	4.5	4.5	5.0	4.0	4.5	4.5	4.5	401.8	2832	450.3	88.4	490.2
96	27-May	22:15	4025.00	14.85	10.14	25.87	5.0	5.0	4.5	5.0	5.0	4.5	5.0	405.8	3429	442.8	83.3	489.1
100	29-May	05:30	3985.80	15.03	10.18	25.65	5.0	5.0	4.5	5.0	5.0	4.5	5.0	401.1	3400	450.1	87.8	488.9
102	29-May	18:45	3981.25	14.79	10.20	25.23	5.0	5.0	5.0	4.5	4.5	5.0	5.0	401.0	2455	447.3	86.2	487.2
103	30-May	04:45	2320.30	14.90	10.03	25.44	5.0	5.0	5.0	4.5	5.0			407.5	2524	454.5	85.4	492.9
104	30-May	09:15	4053.20	14.48	10.07	24.66	5.0	5.0	5.0	5.5	5.0	5.0	5.0	404.9	3130	451.7	85.1	490.0

- **Voice of customer** is properly captured through various forum.
- **NABL accredited lab-** for quality assurance.
- **Compliance Monitoring-** Compliance to customer requirements is continuously monitored.
- **Reporting System-** Rake wise report to the customer is communicated through IT based system. Deviation is additionally reported through mail and SMS and confirmation is taken.
- **Complaint Management System-** There is a dedicated IT based customer complaint handling system and resolution to the compliant has to be done within 48 Hours.

This compliance is monitored at top management level.

Way Forward to Meet Coking Coal Demand for Steel Making

- Increase in domestic coking coal supply –
  - Production enhancement by CIL and
  - Long-term contracting with Steel makers for supplying coking coal at an attractive price.
- Auction of Coal Mines with good reserve of coking coal (Quality, Quantity & Connectivity).
- Washing Capacity - Increase washing capacity of coal in India & Utilization of existing capacity
- Finding a solution to the Jharia issue (Estimated Deposits: 5313.06 Million Tonnes), Underground fires burning for centuries and the inability to relocate and rehabilitate.
- Focus on Coking Coal exploration for Steel making
- Increase usage of PCI in blast furnaces, Incentives to Steel players for Stamp charging and recycling and use of more scrap.
- R&D for Utilization of LVC (Low Volatile Coking) Coals,
- Industry academia partnership: Actively pursue new and alternate technologies including Natural Gas, Syngas and Hydrogen as substitute fuel in DRI route.


Thank you