24th National Award for Excellence in Energy Management 2023

13 - 15 September 2023

Bhilai Steel Plant
Steel Authority of India Ltd.

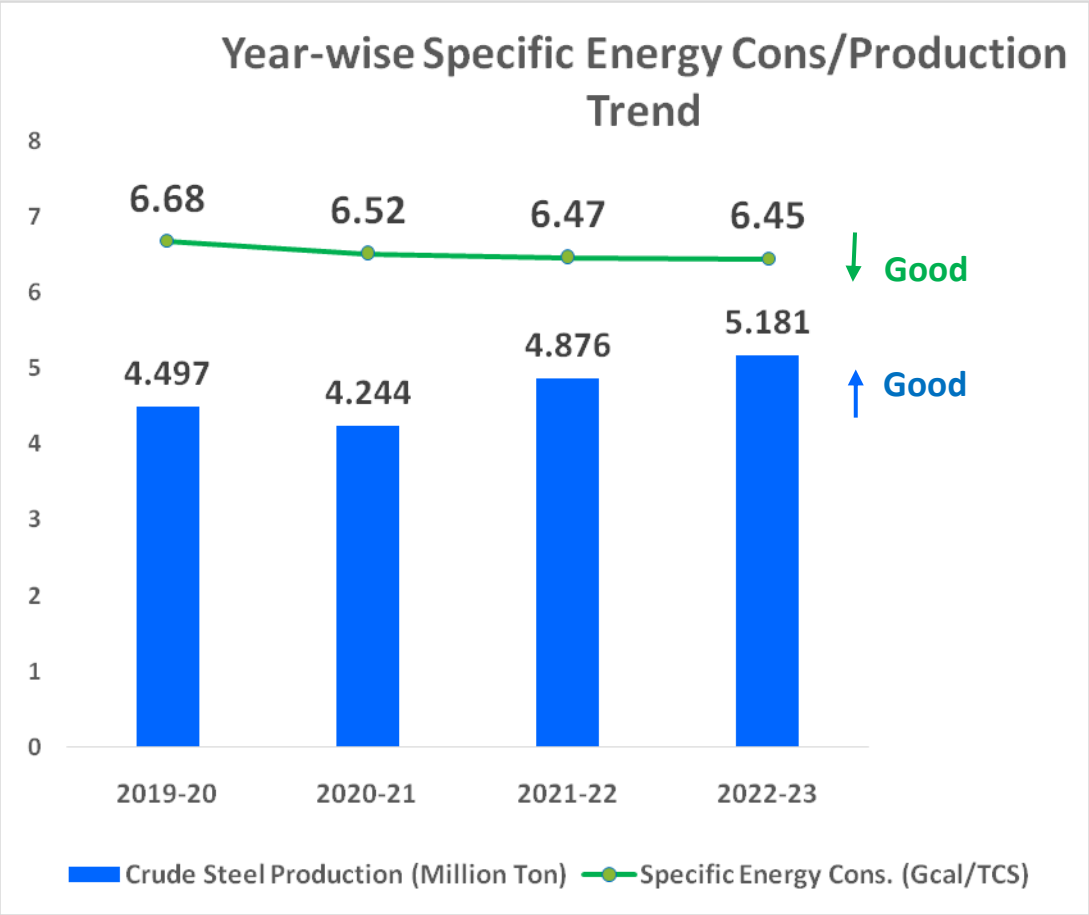
Presented By

1. *Shri Harshit Gupta,Sr.Mgr(Power Systems Dept.)*
2. *Ms Parul Diwan,Mgr(Energy Mgmt. Dept.)*

Company Profile

- Set up in 1959 with 1 MT crude steel production capacity, Bhilai Steel Plant is the flagship unit of SAIL
- Presently, BSP has completed 7 MT Expansion and Modernization and is India's largest producer and supplier of world class rails for the Indian Railways, including **World's longest 130 metres rails in single piece**
- BSP is also a major producer of a wide variety of plates,wire rods, merchant products and heavy structurals,TMT Bars & Rods
- Some of the **major energy efficient technologies** installed in BSP are
  - Coke Dry Cooling Plant with Back Pressure Turbo Generator for waste heat and power recovery
  - Coal Chemical Dept. with Claus process for desulphurization of Coke Oven gas
  - Top Pressure Recovery Turbine of 14 MW capacity in one of India's biggest BFs of 8000 TPD capacity (BF-8) with torpedo ladle facility for hot metal transfer
  - Waste heat recovery system in BF stoves of new BF-8
  - Sinter cooler heat recovery system and curtain flame burners in sinter machines
  - 3 x 120 T BOFs equipped with 24000 NM^3 storage capacity wet type LD gas holder
  - 3 x 180 T BOFs equipped with 80000 NM^3 storage capacity dry type LD gas holder
  - Continuous bloom, billet and slab casters with hot charging facility
  - Walking Beam Furnaces and fully automated efficient mills in URM and BRM
  - By-product gas fired twin shaft regenerative kilns in calcination plants
  - By-product gas fired efficient boilers and 25 MW capacity Turbo-generator in captive Power & Blowing Station

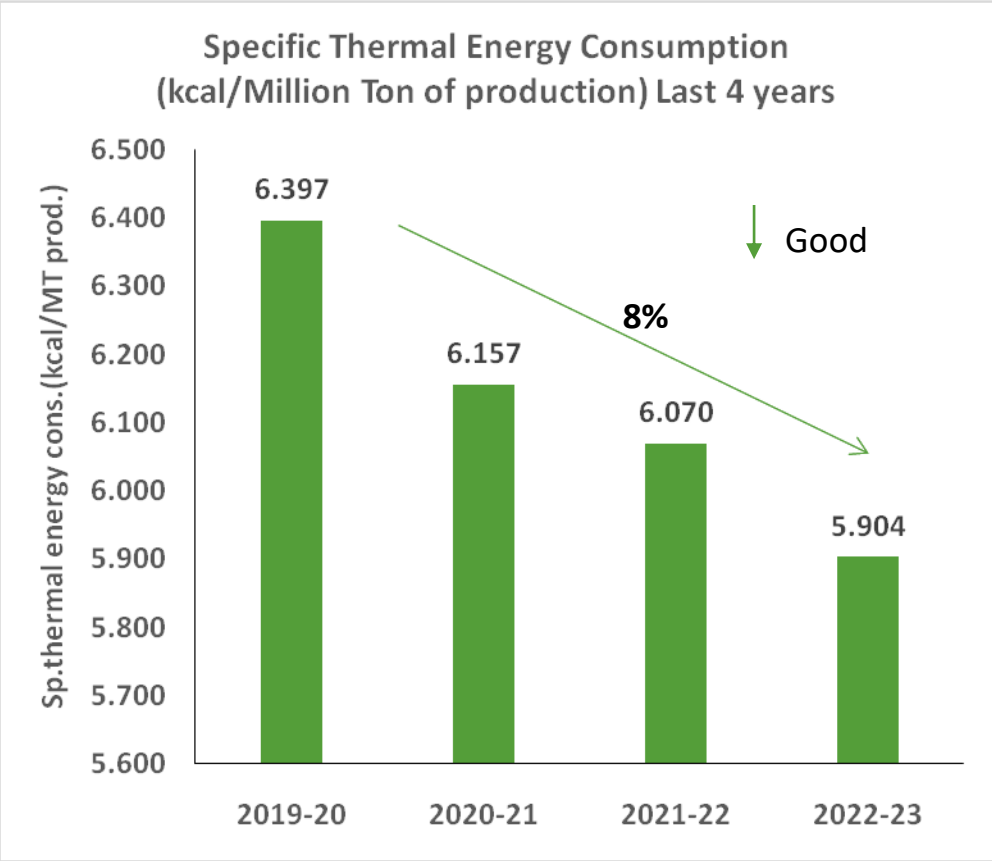
Energy performance – Past 3 Years

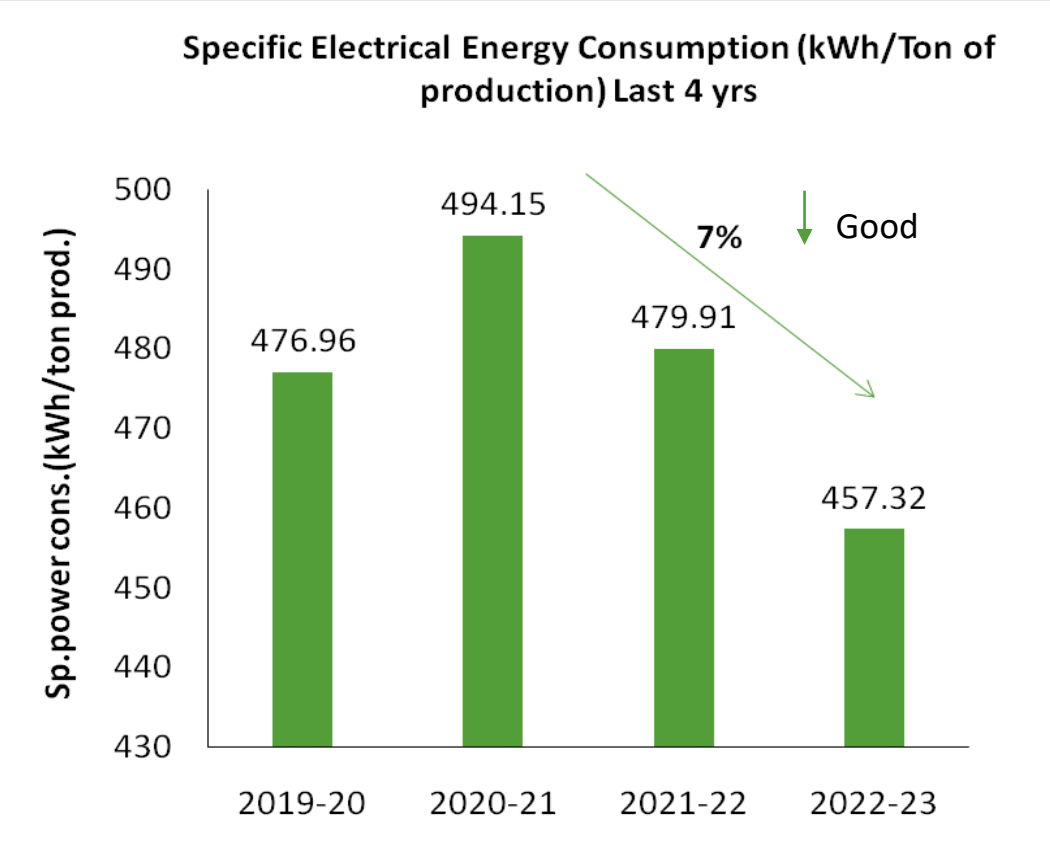


Reasons for variation

- **Energy Rate decreased by 0.3 % in FY:22-23 YOY while crude steel production increased by 6.2 %**
- **Also, old highly energy intensive units - old BFs 2 & 3, SMS-1, BBM and RMP-1 were phased out**
- **Lower production and higher energy rate in FY:2020-21 and FY:2021-22 is attributable to COVID-19 disruptions**

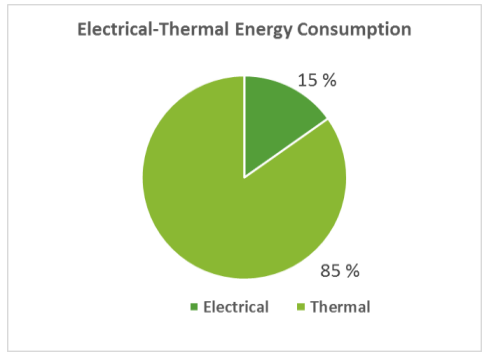
Energy performance – Past 3 Years



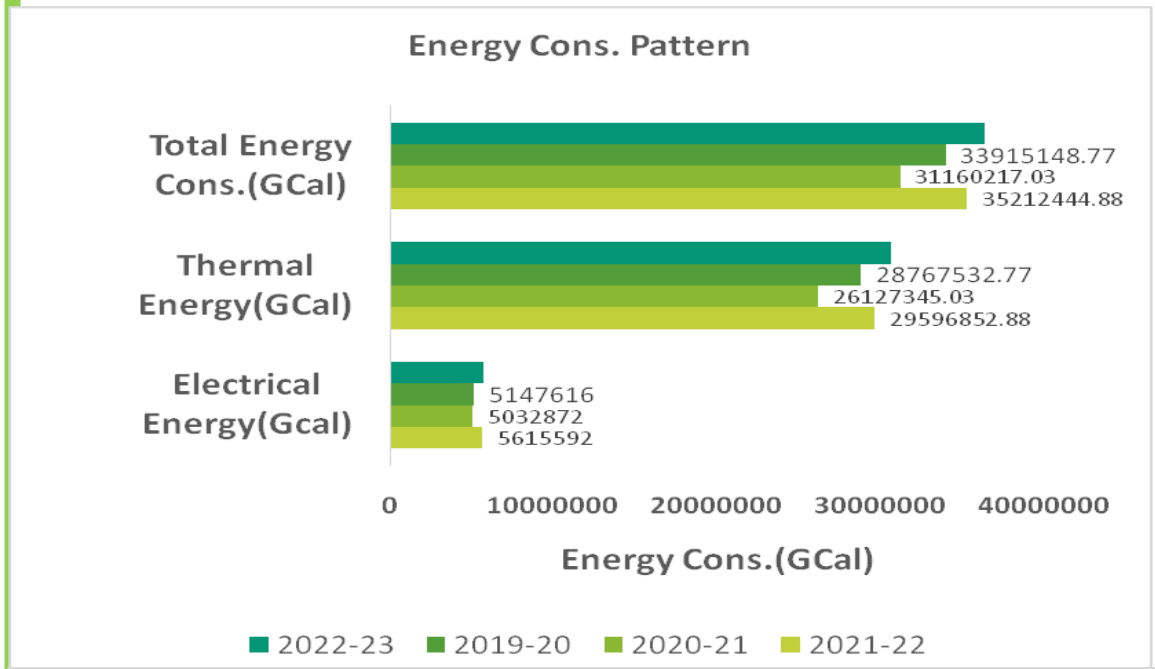


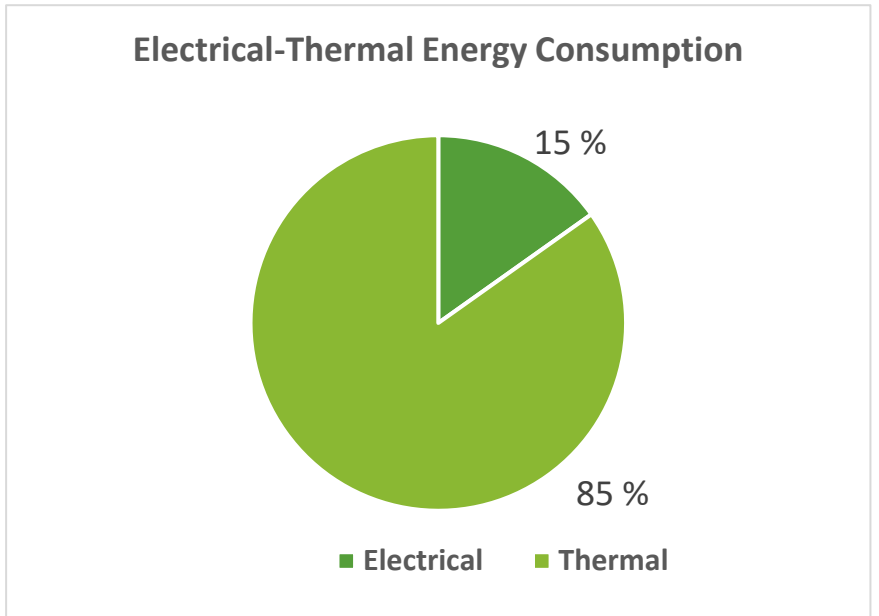
The specific power consumption in FY:2020-21 was higher due to :

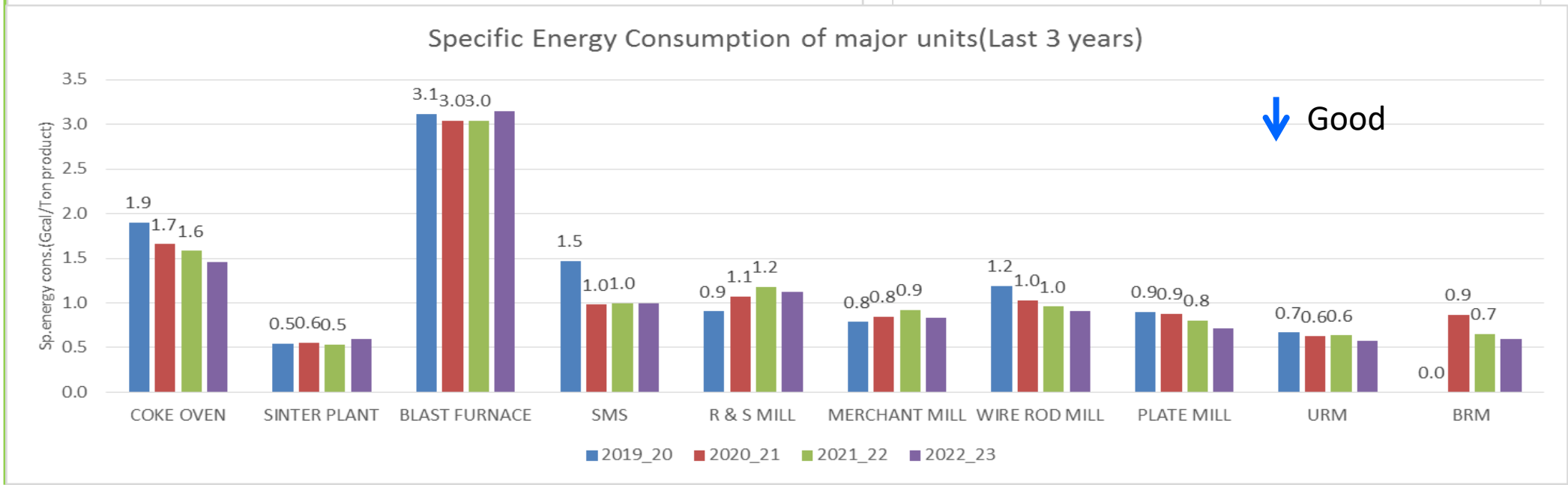
- ✓ COVID – 19 disruptions
- ✓ Commissioning activities in new units of URM,BRM & SMS-3



Energy performance – Past 3 Years







Our Competitors, National & Global benchmark, Targets

National

TATA STEEL

RASHTRIYA ISPAT NIGAM LIMITED
VIZAG STEEL
Pride of Steel

Global

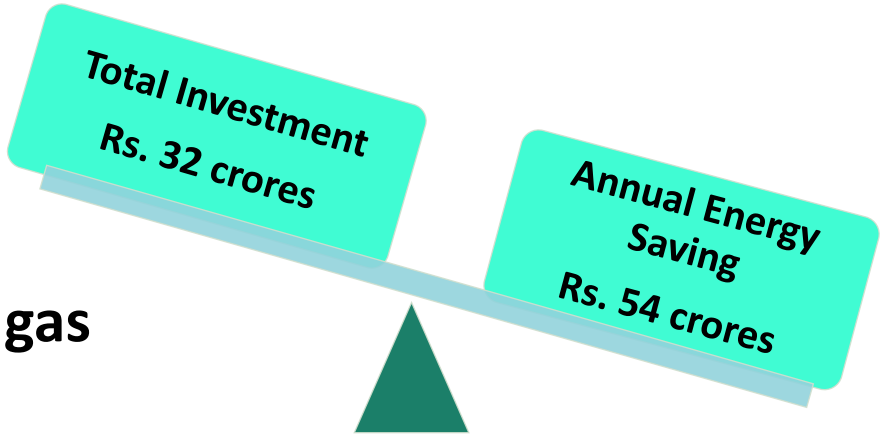
posco

	TATA STEEL (Jamshedpur)	RINL	POSCO	BSP	BSP's TARGET
Specific Energy Cons. For FY:22-23	5.4 Gcal/Ton of crude steel prod.	6.4 Gcal/Ton of crude steel prod.	5.04 Gcal/Ton of crude steel prod.	6.45 Gcal/Ton of crude steel prod.	5.95 Gcal/Ton of crude steel prod.

Major ENCON projects planned for FY:2023-24

BSP

- Installation of 500 KW capacity micro TG in BPTG of CDCP of Coke Oven Battery 11
- Installation of VFDs in 6 nos. skirt cooling pumps of converter 2 of Steel Melting Shop-2
- Installation of MV drives in combustion air fans of Blast Furnace 6
- Replacing conventional lighting fixtures with LED lamps in entire plant – phase-wise
- Installation of VFD in one motor (350 KW, 6.6 KV) for gas flow control in Rolling Mill Booster Station
- Installation of rooftop solar power generation facility of 3 MW in residential buildings and administrative buildings in BSP township



Energy Saving Projects implemented in last 3 years

BSP

Year	No. of energy saving projects	Investment (INR Million)	Electrical Savings (Million kWh)	Thermal savings (Million Kcal)	Savings (INR Million)	Payback Period (in months)
2020-21	10	44.82	7.691	89961	151.69	The payback period depends on nature of project implemented and varies from case to case basis.
2021-22	10	41.02	50.2	193391	515.81	
2022-23	8	4051.723	33.91	282346	534.94	

Energy Saving Projects implemented in last 3 years – FY:2022-23

S No.	Name of energy saving projects	Investment (INR Million)	Electrical Savings (Million kWh)	Thermal savings (Million Kcal)	Savings (INR Million)	Payback Period (in months)
1	Installation of LD gas holder of Steel Melting Shop- 3 of 80000 NM3 capacity resulting in recovery and utilization of LD gas	4000	0	239915.9	277.34	173
2	Increased waste energy recovery in the form of power generation from BPTG of CDCP of Coke Oven Battery - 11 by improving in Process	0	17.34	0	93.13	0
3	Replacement of conventional lighting fixtures with LED lighting fixtures in BSP	42.82	15.63	0	83.91	6

Energy Saving Projects implemented in last 3 years – FY:2021-22

S No.	Name of energy saving projects	Investment (INR Million)	Electrical Savings (Million kWh)	Thermal savings (Million Kcal)	Savings (INR Million)	Payback Period (in months)
1	Increased power generation from energy efficient STG-4 and TRT of BF-8	0	43.82	0	249.77	NA
2	Reduction in boiler coal consumption over previous year by judicious use of by-product gases in power plant boilers	0	0	193391	229.62	NA
3	Replacement of conventional lights with LEDs - 31385 Nos.	36.45	5.272	0	30.05	15

Energy Saving Projects implemented in last 3 years – FY:2020-21

S No.	Name of energy saving projects	Investment (INR Million)	Electrical Savings (Million kWh)	Thermal savings (Million Kcal)	Savings (INR Million)	Payback Period (in months)
1	Reducing the excess air by controlling the oxygen level in the exit flue gases of Reheating furnaces of Plate Mill	10	0	85470	101.03	1.2
2	Providing VFD for the combustion air blowers of BF-6 (3 nos. of blowers)	12.9	3.54	0	19.2	8
3	14890 nos. of LED luminaires procured for replacement of conventional luminaires and resulting in energy saving	17.3	3	0	19	11

INNOVATIVE PROJECTS IMPLEMENTED - 1

BSP

Connection of newly commissioned LD gas holder with both Coke Oven gas and BF gas header for optimum utilization of recovered LD gas

Project Brief Description:

- ✓ LD gas generated from SMS3 convertors is stored in LD gas holder of capacity 80,000M3. The stored LD gas is then exported into the Blast Furnace gas pipeline of Boilers 8 and 9 of Power & Blowing Station -2 (PBS-2)

Trigger for innovation:

With hot metal production per day of 17000 Tons, BF gas yield was sufficiently high.The safe operating pressure of BF gas network is around 850 mmwc at BSP. Hence,In order to maintain BF gas network operating pressure , LD gas after injection into the BF gas network was getting flared along with the excess BF gas from the Excess Gas Burners. This was resulting in improper utilization of the LD gas.
High generation of BF gas and limitations in BF gas network capacity was limiting the LD gas recovery potential.

INNOVATIVE PROJECTS IMPLEMENTED - 1

BSP

Connection of newly commissioned LD gas holder with both Coke Oven gas and BF gas header for optimum utilization of recovered LD gas -IMPLEMENTATION

- For optimum utilization of LD gas and realize the full potential of LD gas recovery, it was therefore decided to inject some volume of LD gas from SMS-3 also in the CO gas header feeding to PBS boilers, the mills, URM and BRM, and to RSM, M Mill and WRM on a trial basis
- Care was taken to not dilute the Calorific Value of CO gas to the extent where it becomes too lean and adversely affects the flame temperature in the reheating furnaces
- **A defunct Coke Oven gas pipeline of dia 600 mm already existed which was earlier being used for supplying enriched Coke Oven gas to Soaking pits of BBM which has been phased out**
- The gas pipeline was already equipped with U-Seal for 100% safe isolation, Gas control throttle, water drainer, purge points and gate valve, which were prerequisites for injecting LD gas into the coke oven gas network
- **A new pipeline was erected and connected with the LD gas network of SMS3 with a ON/Off shutoff valve**
- **The ON/Off shutoff valve was also salvaged from the defunct Gas booster station of sinter plant no.3 and revised for usage.**

Additionally, a control valve was installed in LD gas pipeline which injects LD gas into BF gas pipeline connected to Boilers 8 & 9 so that it can be closed remotely when LD gas is being injected into the coke oven gas pipeline

Throttle and U seal
(U seal of existing C.O. gas line used)

Dia- 600 mm pipe tapping from L.D. gas line (dia-1400 mm)

INNOVATIVE PROJECTS IMPLEMENTED - 1

BSP

BENEFITS

- ✓ Optimum recovery and utilization of LD gas from SMS-3 is ensured even when the BF gas network pressure is high/optimum
- ✓ LD gas recovery from SMS-3 has increased to 90 NM3/TCS this year compared to 65 NM3/TCS FY:22-23
- ✓ LD gas can be injected into Coke Oven gas network at the rate of 15,000 NM3/hr (max.)
- ✓ Injection of LD gas into Coke Oven gas network helps in maintaining supply of CO gas at required operating pressure to boilers and helps in reducing the consumption of boiler coal and Pitch Creosote Mixture(PCM) in Power Plant.
- ✓ Boiler coal consumption in boilers is Nil after implementation of this project.
- ✓ PCM consumption in boilers reduced to 50 KL/Day (avg.) from 90 KL/Day (avg.) before the modification
- ✓ For every 1 NM3/Hr. of LD gas injection, around 0.5 kg/hr. of purchased boiler coal is saved
- ▪ Hence for 15,000 NM3/hr. of LD gas injection, boiler coal saved per hour is 7873 Kgs
- ▪ Cost of One Kg of Boiler coal = Rs. 4.747
- ▪ Saving in a year = 7873 kg x 4.747 Rs./kg x 24 hrs x 200 days = Rs. 17.93 Crores (approx.)
- ▪ Annual GHG saving = 7873 x 24 x 200 x 2.42 = 92000 T CO_2 (approx.)

- ✓ The system provides flexibility in using the LD gas recovered from SMS-3 either in BF gas network or CO gas network
- ✓ Less particulate emission from captive power plant due to less burning of PCM and boiler coal
- ✓ Greater availability of CO gas for supplying to NSPCL power plant, with potential for reduced boiler coal consumption in NSPCL also

The project has a very high replication potential and can be implemented in any of the integrated steel plant

INNOVATIVE PROJECTS IMPLEMENTED - 2

DECONTAMINATION FACILITY OF PURE POLYCHLORINATED BIPHENYLS (PCBs) IN TRANSFORMERS

- ✓ **BSP has commissioned a state of the art Polychlorinated Biphenyls (PCB) Management facility in collaboration with UNIDO & Union Ministry of Environment & Forests & Climate Change in July 2022.**

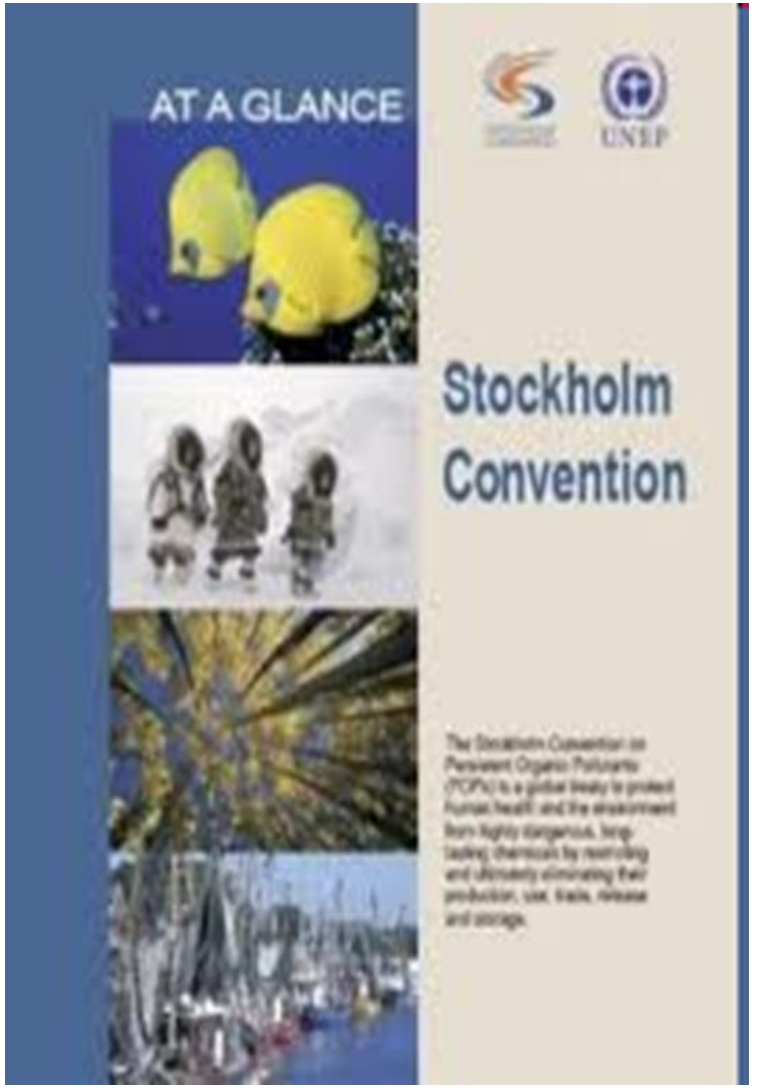
- ✓ **The facility is the largest static facility in entire South Asia.**

- ✓ PCB class of synthetic organic chemicals is found in transformer oils, heat transfer & hydraulic systems, in plastics, flame retardants, etc.

- ✓ They are categorized as Persistent Organic Pollutants (POPs)

- ✓ The disposal of these toxic substances will be done using three processes
  - ✓ PLASMA destruction system of pure PCBs
  - ✓ Indirect Thermal Desorption (ITD) System for decontamination of equipment such as capacitors, transformer cores & absorbents.
  - ✓ Closed loop low temperature atmospheric pressure chemical treatment of low level PCB rinsed oils with sodium dispersion.

- ✓ The facility will treat/eliminate more than 10,000 T of PCB based transformer Oils/PCB contaminated equipment located at different parts of the country.



PLASMA DESTRUCTION UNIT - PLASCON

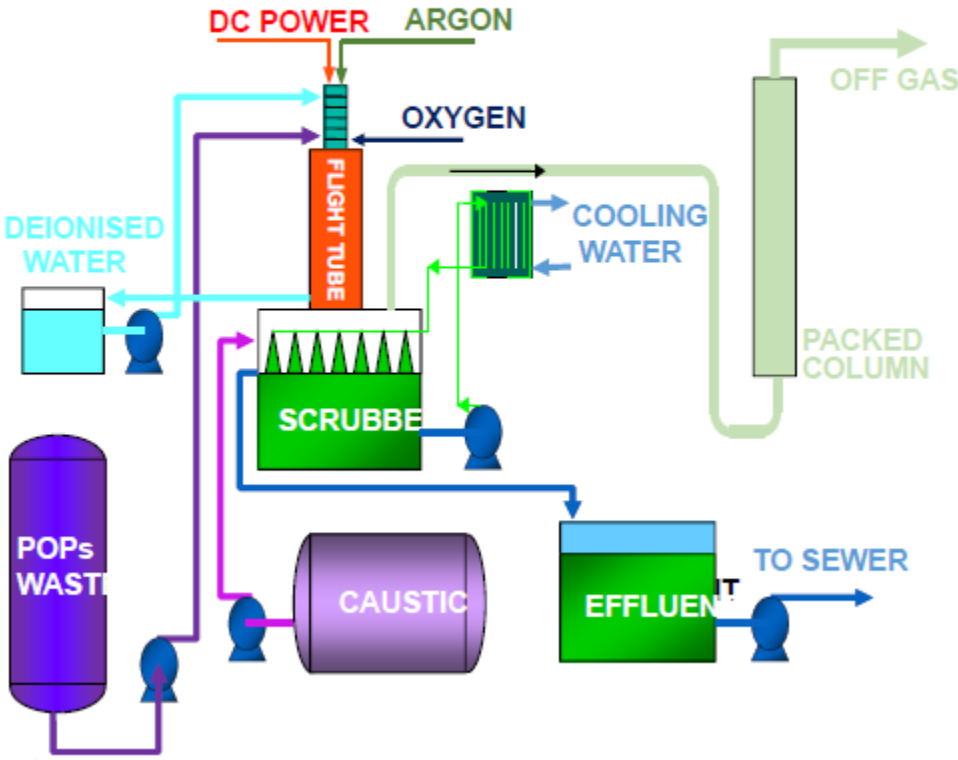
What is an electric-arc plasma?

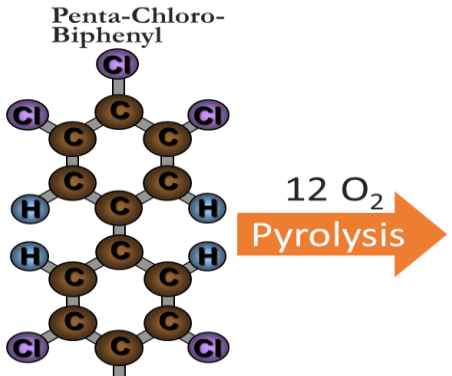
- **Ionised gas carrying an electric current (Temperature 3500-10,0000C)**

Why use plasma for waste destruction?

- **Superior destruction performance without toxic by-products**
- **Very high energy density - leads to compact process**
- **Thermal process - very versatile**
- **Safety - rapid shut down without loss to the environment**

Simple Process Schematic



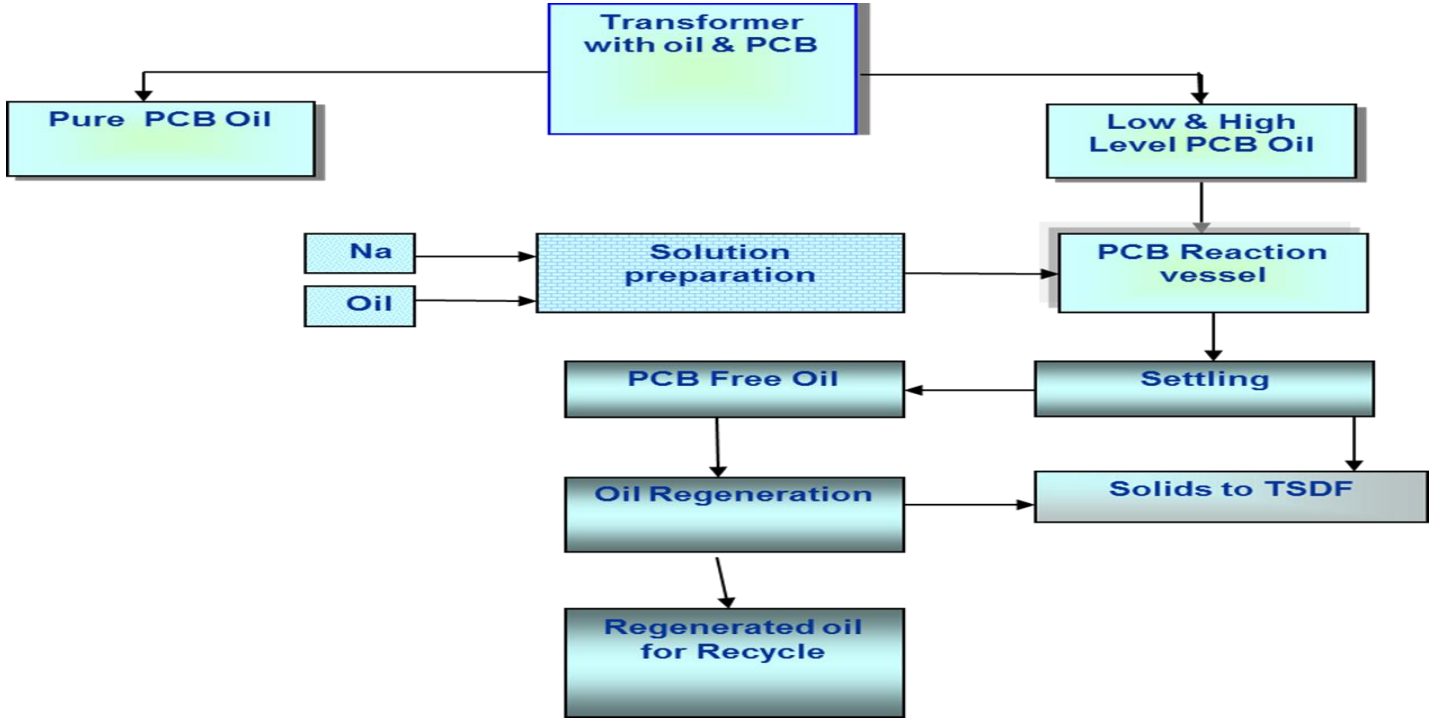


$12\ O_2$ Pyrolysis

Plasma Species	Flight Tube Species		Discharge Products
12 C atoms 24 O atoms 5 H atoms 5 Cl atoms	$12\ CO_2$	Off-gas	$12\ CO_2$
	$5\ HCl$	$5\ NaOH$ Quench	$5\ NaCl$ $5\ H_2O$

Process Flow – PCB Decontamination Facility

(Non - Combustion PCB destruction Facility)



This facility is to treat contaminated mineral oil that contains chlorine content between 50 PPM to 40000 PPM

The advantages of design are:

- Better emissions control, the reaction vessel remain close until batch analytical data confirms the complete destruction of PCBs.
- The Sodium based reaction as most PCB destruction reaction, it is exothermic reaction, generates enough heat increase temperature of reaction mixture well over the mineral oil flash point.

Basel, Rotterdam and the Stockholm Convention – COP 2023

- BSP model displayed at Geneva during the PCB fair held from 3-5th May-2023.
- The fair was intended in raising awareness on the urgency to accelerate action to meet the upcoming deadlines related to the phasing-out of PCBs.
- The booth setup by “SAIL/BSP, UNIDO & MoEFCC” was adjudged the best of the fair.

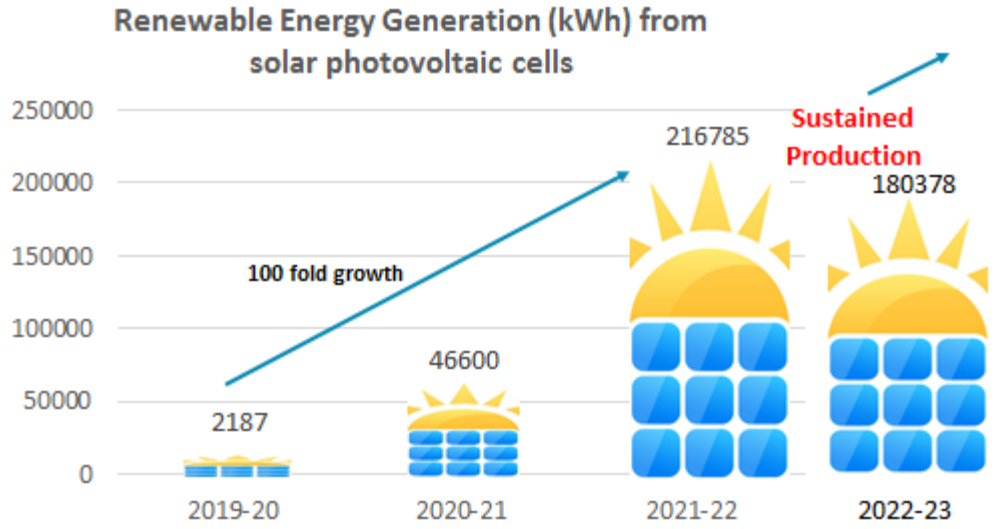
Innovative Project -3
Plastic Waste management - Blending plastic waste with Coal charge

- BSP & RDCIS, carried out Trials from 24.12.22 to 02.01.23
- 40T of granules charged along with coal in bat# 5,6, 9 & 10 **(0.2 ±0.1%)**
- Results showed no adverse impact on battery operation or battery health, and environment.
- Improvement in coke quality
- Potential : 4000 T/Year

Utilization of Renewable Energy Sources

BSP

Technology (Electrical)	Type of Energy	Onsite/ Offsite	Installed Capacity (KW)	Generation (million kWh)	% of overall electrical energy	Generation (million kWh)	% of overall electrical energy	Generation (million kWh)	% of overall electrical energy
				2020-21		2021-22		2022-23	
Electrical	Solar	On site	**2 X 100**	0.04660	0.001%	0.216785	0.008%	0.18	0.008 %
TRT	Potential energy in BF gas	On site	14000	78.955	3.8%	89.533	3.8%	91.53	3.8%
BPTG	Waste heat from CDCP	On site	4000	17.84	0.85%	11.28	0.5%	29.23	1.23%



Utilization of Renewable Energy Sources

BSP

RENEWABLE PURCHASE OBLIGATION

Sl. No.	FINANCIAL YEAR	CATEGORY	MUs	RPO, MUs
1	2021-22	Captive Consumption	2271	182
		Cogen CPP -1, Cogen CPP - 2	282.874	
2	2022-23	Captive Consumption	2195	178
		Cogen CPP – 1, Cogen CPP – 2	390.01	

GHG Inventorisation

- ***Information on GHG Inventorisation and public disclosure :***

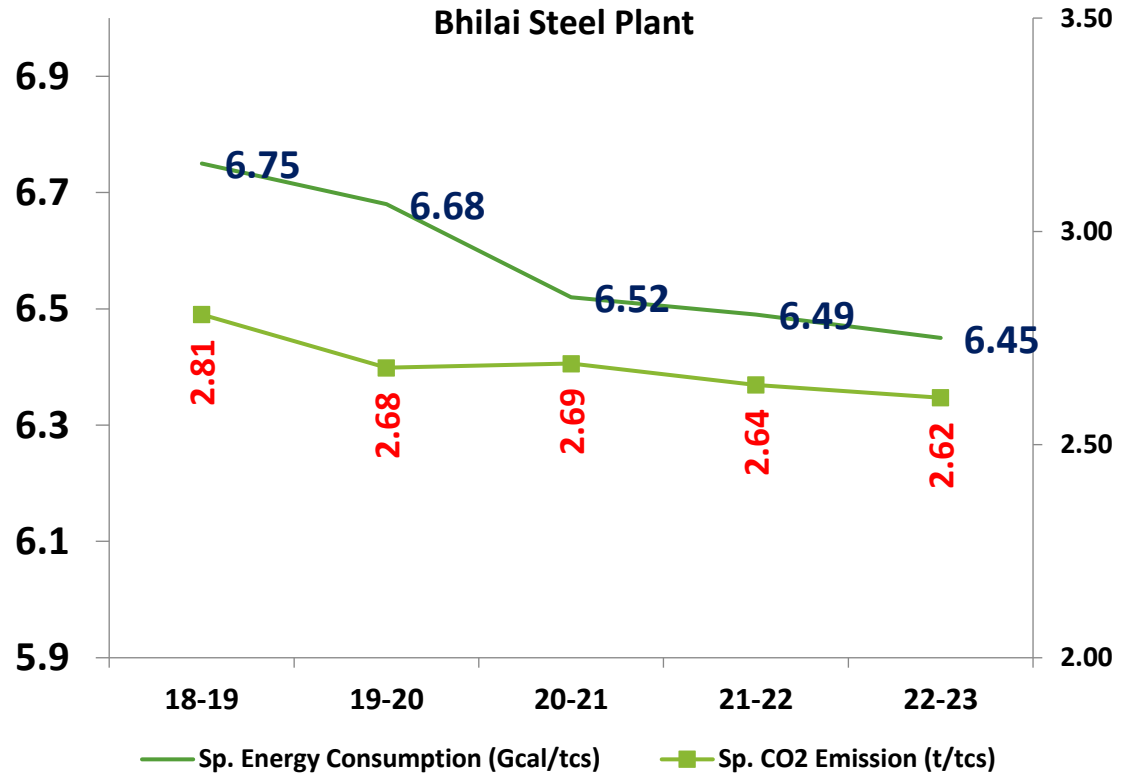
  - ***SAIL is a member of World Steel Association (WSA) and participating in the GHG disclosure project since 2010-11***
  - ***SAIL publishes its sustainability reports every year where-in GHG emissions are disclosed***
  - ***SAIL has also signed the sustainability charter of WSA in 2022***
  - **BSP was the first public sector unit to publish sustainability report in the year 2006-07 as per GRI guidelines**

- ***Scope of emissions (I,II,III) Considered:***
  - ***Direct emissions (Scope-1 emissions) i.e*** emissions from site chimneys determined by the carbon balance methodology
  - ***Energy related emissions (Scope-2 emissions) :***Upstream emissions or credits related to procurement/delivery of electricity and steam from site. Upstream
  - ***Credits (Scope-3 emissions) :***Other upstream emissions or credits related to procurement/delivery of pre-processed materials/co-products from site.

Methodology for calculation: WSA GHG emission calculation tool

Absolute Emissions and Emissions intensity of last three years

Year	Absolute emissions (Tons)	Emission intensity (Ton/Ton of crude steel)
2020-21	11,357,667	2.69
2021-22	12,850,339	2.64
2022-23	13,578,392	2.62



Target : 1.96 T/TCS by 2029-30

Bench Mark : 1.8 % (Rautraukki Steel, Finland)

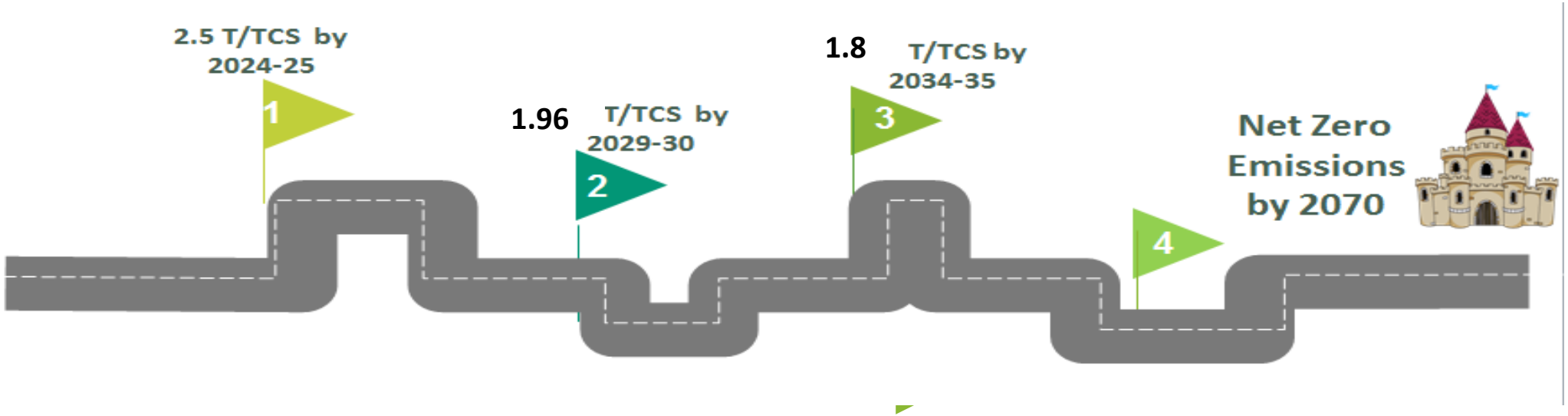
Target (short term/ long term) for CO_2 emission reduction and action plan

- Phase-1 de-carbonization by 2029-30 to achieve CO_2 emissions rate of 1.96 T/TCS (**Already reduced 34 Lac tons of CO_2 emissions over 2018-19**)
  - **Focus areas : Improvement in Raw material quality, BF-burden, BF hot blast temperature/Oxygen enrichment, Use of Renewables, solid waste utilization for a circular economy**

  (Schemes for 1 MTPA pellet plant & 5.2 MTPA slime beneficiation /silica reduction plants in mines, Sourcing of good quality ore from Raughat by December-2022)

- Phase-2 de-carbonization by 2034-35 to achieve CO_2 emissions rate of 1.8 T/TCS
  - **CCUT technologies in next phase of expansion**

NET ZERO ACTION PLAN



Proposed action plan for emission reduction till 2029-30:

- Ramping up production to rated capacity from Rowghat Mines
- Start of iron ore production from Kalwar-Nagur mining lease area
- Supply of 0.6 MTPA beneficiated fines from Slime Beneficiation plant at Rajhara
- Installation of 1 MTPA pellet plant
- Installation and commissioning of Silica Reduction Plant in Rajhara mines
- Phase wise increase in CDI injection, HBT and Oxygen enrichment in Blast Furnaces
- Installation of a new BF-9 with TRT and waste heat recovery in stoves
- Installation 2000 TPD Oxygen Plant to enable Oxygen enrichment of 6% in BFs.
- Installation of GTCC of 75 MW capacity for 100% utilization of by-product gases for captive power generation and phasing out use of boiler coal
- Installation15 MW floating Solar Power Plant in Maroda-1

Long Term Road Map for improving energy efficiency

BSP

Initiatives for reducing thermal energy consumption

- Installation of walking beam furnace of 180 TPH in Plate Mill (one no.) and 220 TPH in Rail & Structural Mill (one no.) and stopping of old reheating furnaces
- Replacement of existing reheating furnaces of Wire Rod Mill and Merchant Mill with walking beam furnace of 0.56 MT and 0.75MT production capacity
- Maximizing internal power generation from Captive Power Plants, BPTG and TRT
- Improvement in techno-economic parameters like coke rate, CDI rate and fuel rate
- Replacement of existing Power and Blowing Station with energy efficient GTCC (Gas Turbine Combined Cycle) of 75 MW capacity
- Installation of pellet plant of 2 MT capacity to improve blast furnace burden quality.
- Installation of 4th stove in BF-8 to improve HBT (Hot Blast Temperature)

Initiatives for reducing electrical energy consumption

- Installation of VFDs for combustion air blowers of BF-7.
- Installation of MV drives in Combustion Air fan of BF-6.
- Installation of VVVF Drives in Plant De-dusting Fan Motors in Machine no. 2 of Sinter Plant-3.
- Installation of 15 MW power floating solar plant over cooling pond of BSP in joint venture with NTPC
- Installation of micro TG of 500 KW capacity in place of PRDU in BPTG of CDCP

Energy Monitoring and ISO 50001:2018 Energy Management System

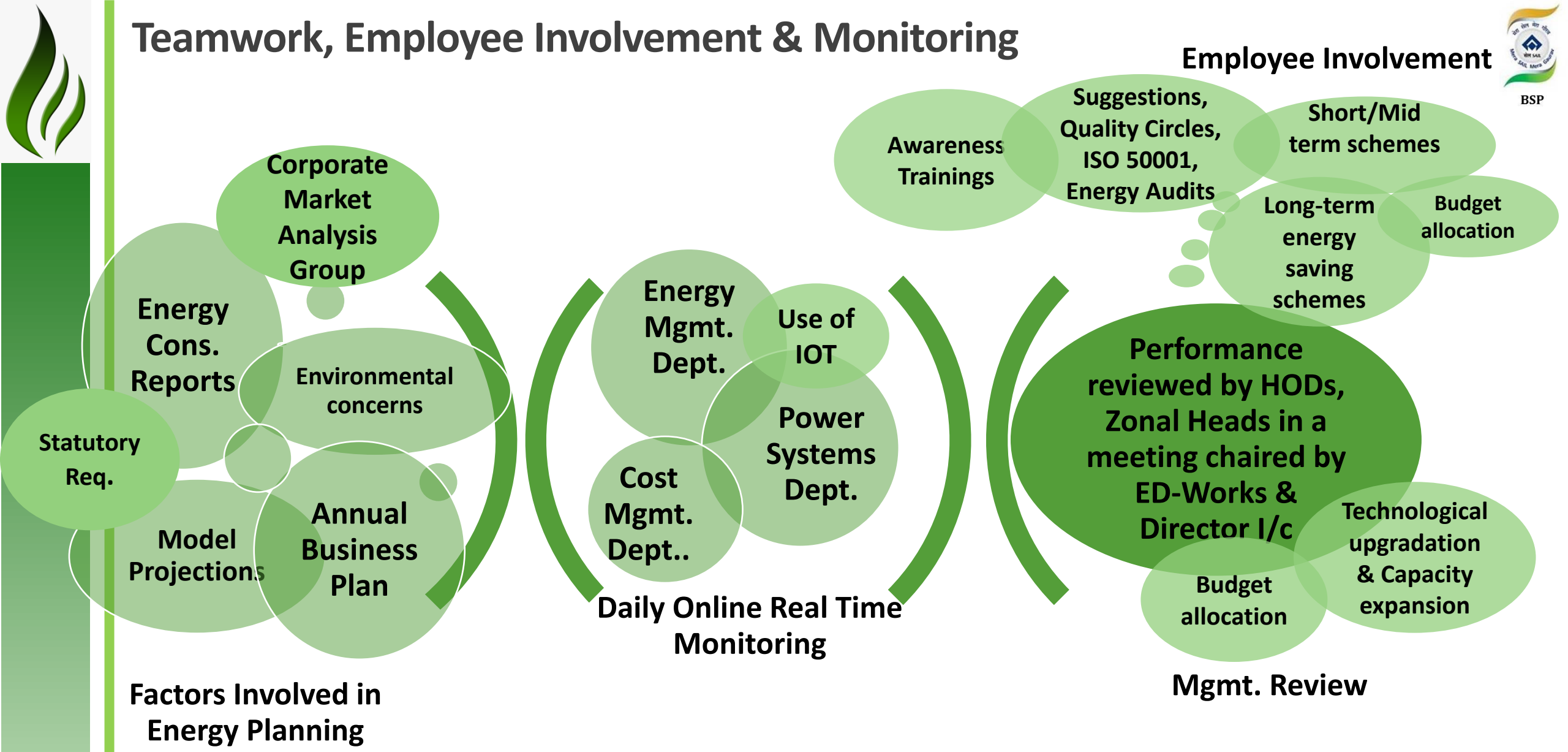
BSP

Online Energy Monitoring System

- Energy Mgmt. Dept. has a centralized online energy monitoring system with Level-1 automation for real time overview of all energy parameters
- More than 1000 signals of energy parameters like by-product gases, oxygen, nitrogen, argon, steam and compressed air are monitored online 24 x 7
- Reports and trends are also generated and stored for data mining
- Power Systems Department monitors electrical energy consumption patterns across the plant through a Plant wide Power Monitoring System
- Enertics sensors are installed in 100 critical motors in BSP for continuous real time monitoring
- MIS section of Energy Mgmt. Dept. prepares energy performance report of the plant on daily, weekly , monthly and annual basis
- Cost Control department carries out cost analysis on a monthly basis to translate the deviation in energy performance indices in terms of cost and spell out its impact on the profitability of the plant

- ISO 50001:2011 Energy Management System(EnMS) was implemented in Bhilai Steel Plant in 2017
- **In July 2020, the EnMS was upgraded to ISO 50001:2018**
- **Bhilai Steel Plant is the only Integrated Steel Plant in India to have ISO 50001:2018 certification for entire integrated steel making process covering production of coke, sinter, iron and steel making and rolling of finished steel products**
- In total, 15 depts. of BSP are in the scope and boundary of ISO 50001
- **Mandatory energy audits** conducted every three years. Last energy audit conducted in 2021-22. Recommendations are being implemented phase wise
- **BSP received 32000 ESCerts in PAT Cycle 2**

Teamwork, Employee Involvement & Monitoring



Awards Won by BSP during Last 3 Years

Awards and Accolades

- BSP has bagged **Energy Efficient Unit Award** in Metals sector in 23rd CII National Award for excellence in energy management – 2022 organised by CII-Godrej GBC, Hyderabad.
- BSP has also won the **"Energy Excellence" and "State Champion – Chhattisgarh" award** with 4.5 stars out of 5 stars for energy efficiency in the Manufacturing Category at the CII Energy Conservation Awards – 2022 for the Eastern Region at the 15th CII ENCON Awards – 2022 organised in Kolkata during 22 – 25 August 2022
- BSP mines have won as many as 13 prizes for Performance of Mines in categories of Mines Environment Mineral Conservation, Systematic & Scientific Development, Sustainable Development, Reclamation & Rehabilitation, Mineral Beneficiation, Environmental Monitoring in the **Mines Environment Mineral Conservation Awards 2021-22**
- **Indian Steel Association's 'Wings of Steel' award** - Ms. Shruti Menon (Manager BRM) has been conferred Indian Steel Association's 'Wings of Steel' award under the 'Gender and Diversity' category from Central Steel Minister Shri Jyotiraditya Scindia at New Delhi.
- **International Convention on Quality Control Circle (ICQCC)** - Team Navodaya SMS-3 won the 'Gold' (ICQCC) organized in Jakarta by the Indonesia Quality Management Association (IQMA).
- **Productivity Excellence Award** - The Coke Ovens team was awarded 5 Star Productivity Excellence Award. the Blast Furnaces team was awarded 4 Star Productivity Excellence Award in the contest on Productivity, Green Growth & Sustainability organised by Odisha State Productivity Council, Bhubaneshwar.

BSP

Thank You

Name	Email id	Contact
Shri Harshit Gupta	harshitgupta@sail.in	9407983069
Ms Parul Diwan	paruldiwan@sail.in	9407981944

Implementation of EMS Systems

% investment of energy saving projects on total turnover of the company (FY 22-23) = 1.5 %

TÜV NORD

CERTIFICATE

Management system as per
ISO 50001: 2018

In accordance with TÜV INDIA procedures, it is hereby certified that

BHILAI STEEL PLANT
(A UNIT OF STEEL AUTHORITY OF INDIA LIMITED)
Bhilai Steel Plant, Bhilai - 490 001,
Chhattisgarh,
India

applies a management system in line with the above standard for the following scope

Integrated Steel Making Covering Production of Coke, Sinter, Iron and Steel Making and Rolling of Finished Steel Products

Certificate Registration No. ENMS 04 00008
Audit Report No. Q 10388/2020

Valid until 12.07.2023
Valid from 14.12.2020
Initial Certification 12.07.2017

Certification Body
at TÜV INDIA PVT. LTD.

Issue 14.12.2020
Place : Mumbai

This certification was conducted in accordance with the TÜV INDIA auditing, and certification procedures & shall be valid subject to regular Surveillance Audits.

TÜV India Pvt. Ltd., 801, Raheja Plaza – 1, L.B.S. Marg, Ghatkopar (W), Mumbai - 400 086, India cert.helpdesk@tuvindia.co.in

Process flow diagram of Indirect Thermal Desorption System – For Treatment of Transformer Core