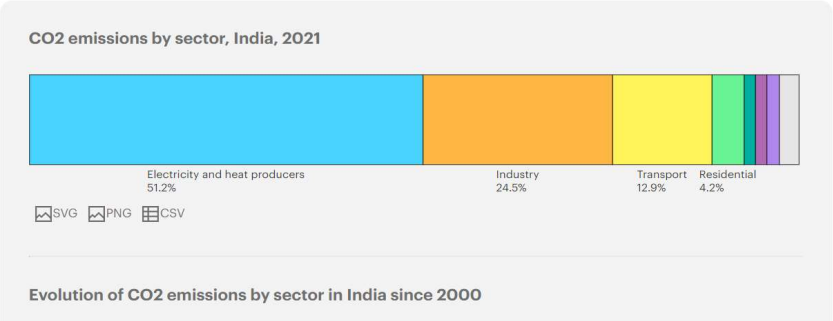
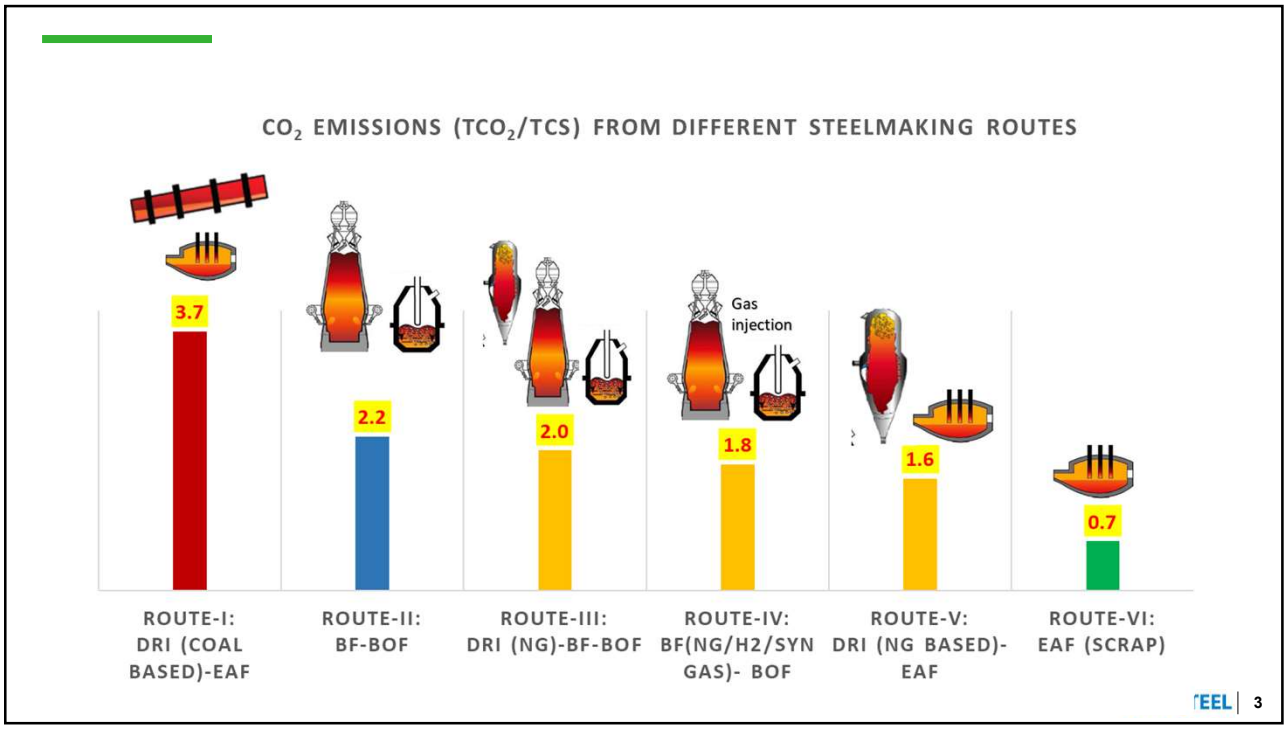
1

How much CO2 does India emit?

What are the main sources of CO2 emissions in India?

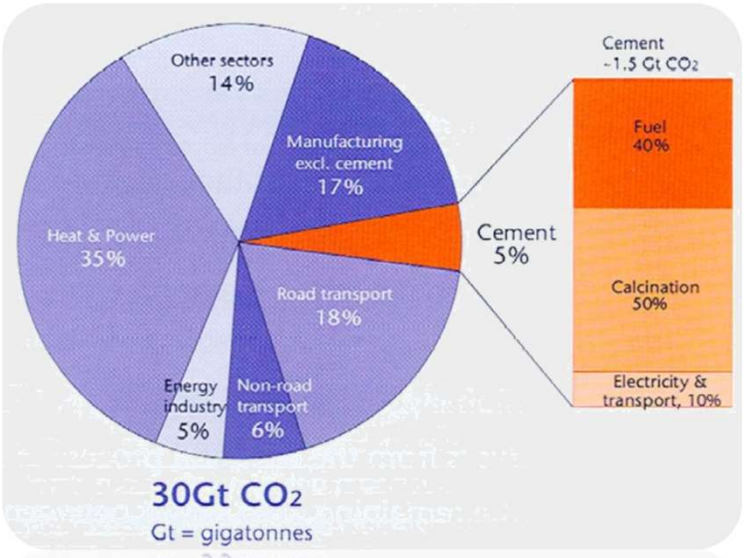


2



3

Global CO_2 emissions per region from fossil-fuel use and cement production

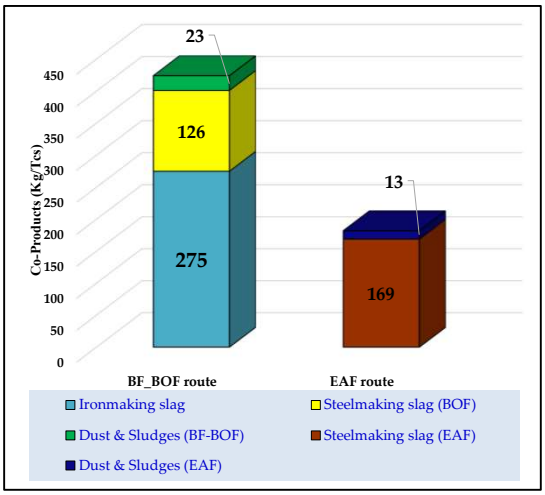


1kg of Portland cement requires 1.209 kg CaCO3
that during decarbonation consumes energy & release 0.532 kg CO2 in the atmosphere

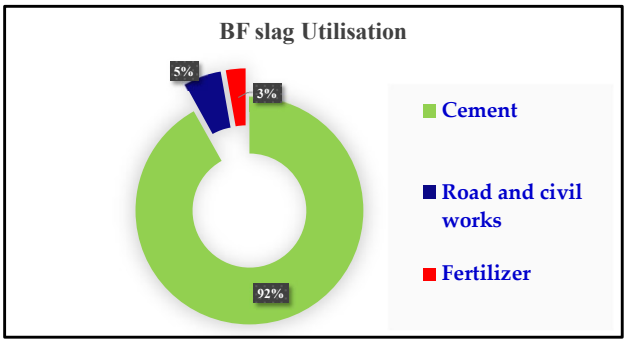
TATA STEEL | 4

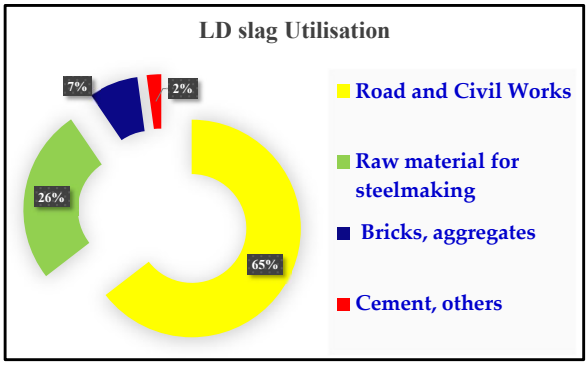
4

Co-product generation at Steel Mill



5





6

Challenges with Physical & chemical characteristics of LD slag vs cement

Constituents	SiO2	Al2O3	Fe2O3	CaO	MgO	Alkalis	SO3	Free Lime	P
OPC	19-25%	2-8%	0.3-6%	60-65%	1-6%	0.5-1.5%	1-3 %	1%	0.5%
LD slag	19±1%	1±1%	20±1%	50±1%	4±1%	1.5±0.5%	0.2±0.1%	6%	2.50%

Mineralogy	C2S	C3S	C3A	C4AF
OPC	++	+++	++	+
LD slag	+++	+	++	+++

XRD	Glass content
OPC	+++
LD slag	+

Challenge1

Challenge 2

Challenge 3

Challenge 5

Challenge 4

7

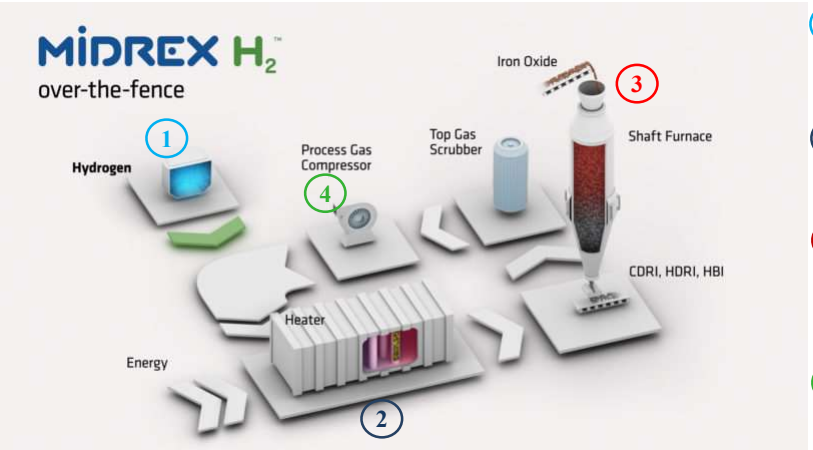
Erection of wall

8

Raw material	percentage
Pulverized fuel ash/ Fly ash	60
Aggregate/ filler- Crusher Dust	5-15
Aggregate/ filler- weathered/ un weathered LD slag	15-25
Binder (Cement) -PPC	10

IS 12894:2002 Physical chacts of bricks	M30	Our values
Appearance	free from visible cracks, warpage and organic matters	No Cracks, No red spot
Compressive strength	300 min	>>>300 min
Drying shrinkage	max 0.15%	.02-.04%
Water absorption	Max 15%	>>15%

9



Proven technology, already operates at large scale (2.5Mt/y) and with ~ 55- 75% with reducing gas

1. Hydrogen Ready:
Use up to 100% hydrogen as the reductant. Midrex has solution ready to address the plant performance for the entire range of required input composition

2. Midrex reformer:
It ensures optimum reducing gas condition throughout the entire range of transition

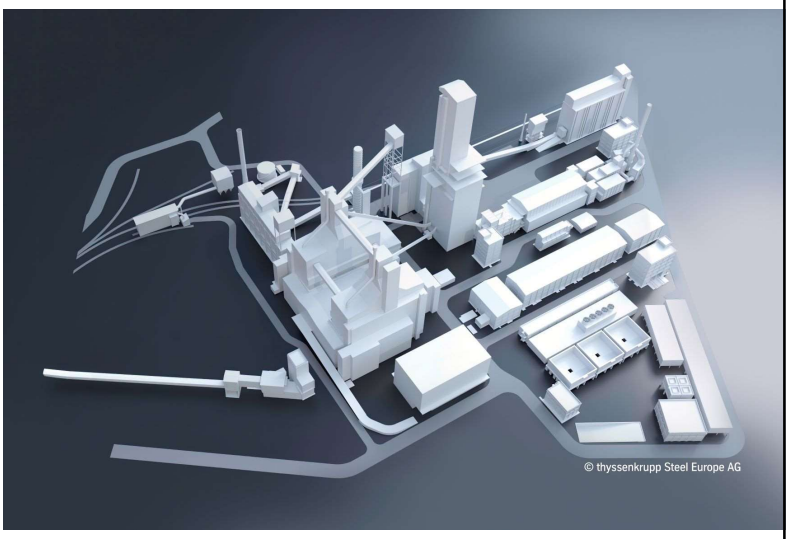
3. Midrex Shaft Furnace :
Delivers consistent product quality throughout the transition. The influence of endothermic hydrogen reduction is mitigated by the reformer and uniform burden movement that is a result of proprietary shaft furnace flow aid equipment

4. **Carbon Capture and storage :**
Carbon capture and storage can be applied to several different process streams. Co 2 capture of 50% to nearly 100%. Available for addition to existing faculties are new installation.

Reference: *https://www.midrex.com/technology/midrex-process/midrex-h2/*

10

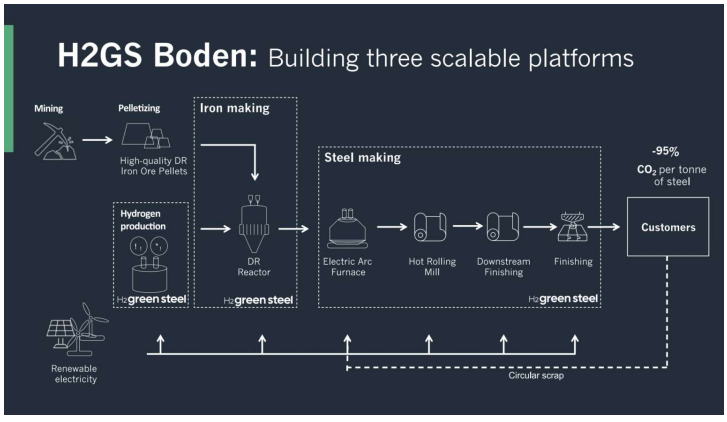
- Location : Duisburg, Germany.
- Colloboration : Midrex & Paul Wurth will engineer, Supply and Construct a DR Plant for Thyssenkrupp Steel Europe.
- Capacity : 2.5 million t/y of HDRI. Will be used in new smelter provided by SMS.
- Flexibility to operate at different ratios of Natural Gas and H2 (upto 100% H2)
- Start up : planned for late 2026.



Reference: https://www.sms-group.com/press-and-media/press-releases/press-release-detail/thyssenkrupp-steel-awards-a-contract-worth-billions-of-euros-to-sms-group-for-a-direct-reduction-plant

11

- Location : 300 hectares greenfield project, Swedish Norbotten region.
- Colloboration : Midrex Technologies, Inc. (Midrex) and Paul Wurth, an SMS Group company
- Capacity : 2.1 million t/y of HDRI. Will be used in new smelter provided by SMS.
- Product: HDRI + Green Merchant Hot briquetted Iron electric heater
- Start up: expected to produce green steel by 2025, ramping up volumes in 2026..



Reference: https://www.midrex.com/tech-article/h2-green-steel-story-the-quest-for-earths-sustainable-future/#:~:text=H2%20Green%20Steel%20(H2GS%20AB,hard%2Dto%2Dabate%20industries

12

Quality of typical BF-DR pellet available in the market

Typical pellets available on the market*							
Chemistry		Blast Furnace pellets			Direct Reduction pellets		
		min	max	demand	min	max	demand
Fe_{total}	%	61	67		67	68	>67
SiO_2 Al_2O_3	% d.b.	1.6 0.2	10 3		0.75 0.2	1.6 0.5	sum <2%
TiO_2	% d.b.	0.01	0,04		0.01	0.15	<0,15
CaO MgO	% d.b.	0 0	3,7 1,4		0,2 0,2	2 1.5	sum <3%
B2 CaO/SiO_2	-	0	1	<0.2 or >0.7			

Higher Fe & lower Gangue % in DR pellets

Thank you