A SABIC Affiliate

STEEL MAKING AND CO2 EMISSION

16TH ARAB STEEL SUMMIT – CAIRO 2023

Ahmed AL Nazr- Saudi Iron & Steel Co. (HADEED/SABIC)
29-30 October 2023

CARBON EMISSION GLOBAL AVERAGE FIGURES

As DRI route brings considerable CO2 emissions reduction potential

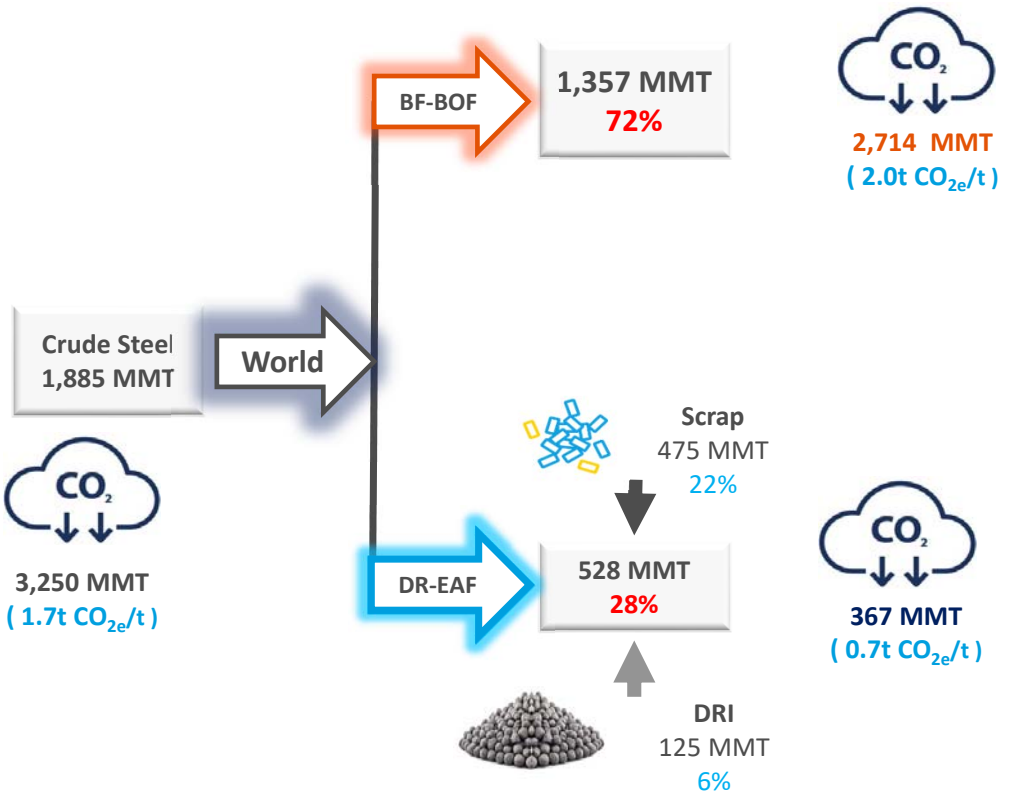
Source: Dr. Alexander Fleischanderl, Hanspeter Ofner, Johannes Rothberger, Robert Millner, Metals Magazine, 2020, "THE WINDING ROAD TOWARD ZERO-CARBON IRON", Primetals. calculations are based on emissions from electricity production on European OECD level.

The natgas DR-EAF route cuts carbon intensity for liquid steel by almost 50 % in comparison with the conventional blast furnace to basic oxygen furnace route. By using green H2 instead, emissions can be reduced by 75%

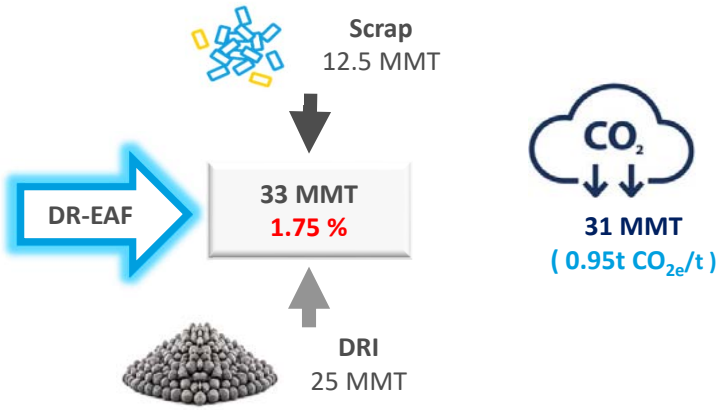
Sources : World Steel Association and The Arab Iron and Steel Union

GLOBAL CRUDE STEEL PRODUCTION & CO2 EMISSION

World



Arab Countries



- World Steel contributes for **7 %** of world total CO_2 emission
- Arab Steel contributes for less than **1%** of world total crude steel CO_2 emission

- ~500 MMT of scrap is used in steel making annually
- ~125 MMT of DRI is used in steel making annually

- Every ton of scrap used, avoid 1.5 ton of CO_2 Vs. BF-BOF
- Every ton of DRI used, avoid 1.15 ton of CO_2 Vs. BF-BOF

Sources : World Steel Association and The Arab Iron and Steel Union

FUTURE OF DRI PRODUCTION

	Hot Metal (MT)			Scrap (MT)			DRI (MT)		
	2022	2050	CAGR	2022	2050	CAGR	2022	2050	CAGR
China	864	498	-1.9%	218	338	1.6%	2	41	13%
India	80	280	4.6%	29	102	4.6%	42	47	0.4%
SEA	23	87	4.8%	35	66	2.3%	0	11	12%
JK	106	73	-1.3%	63	66	0.2%	0	10	10x
EU+UK	76	33	-3.0%	75	115	1.5%	1	22	14%
USA	21	17	-0.7%	58	71	0.8%	4	8	3%

Source: worldsteel.org, NBS, Wood Mackenzie

GREEN STEEL PATH FORWARDS AND CHALLENGES

Path Forwards

- ✓ **Maximize process optimization** to reduce the CO_2 emissions from the existing plants
  - Energy Conservation Programs
  - Heat Recovery Enhancement
  - Process parameters optimization (H_2/CO ratio)
- ✓ **Add up to 30% H_2** as a replacement to NG once becomes available with competitive price (≈ 15% less CO_2 emissions)
- ✓ **Maximize the use of renewable** energy along with implementation of energy saving programs.
- ✓ Follow present and future technology development trends toward **full H2 shift versus NG** at DR plants
- ✓ **Explore CCUS** as feasible option versus H_2

Challenges

- ❖ **High CAPEX & OPEX** for shifting to Hydrogen resulted by Equipment and process Modifications
- ❖ **Availability of H2** and at competitive price specially for countries operating with lower NG price .
- ❖ Special **safety precautions** & requirements when using Hydrogen
- ❖ **Technology Maturity** for full Hydrogen utilization
- ❖ High impact of melting **Low Carbon DRI**
- ❖ Limited channels to **storage or use** for the carbon captured


THANK YOU