The Green Steel Story

Ost-Ausschuss der Deutschen Wirtschaft

03.06.2025

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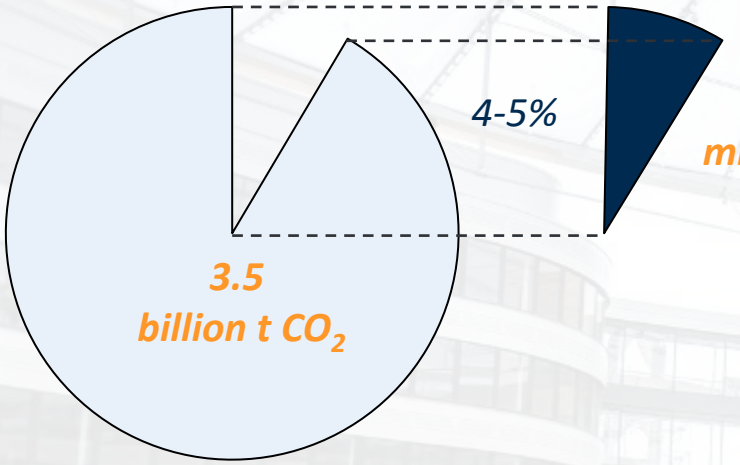
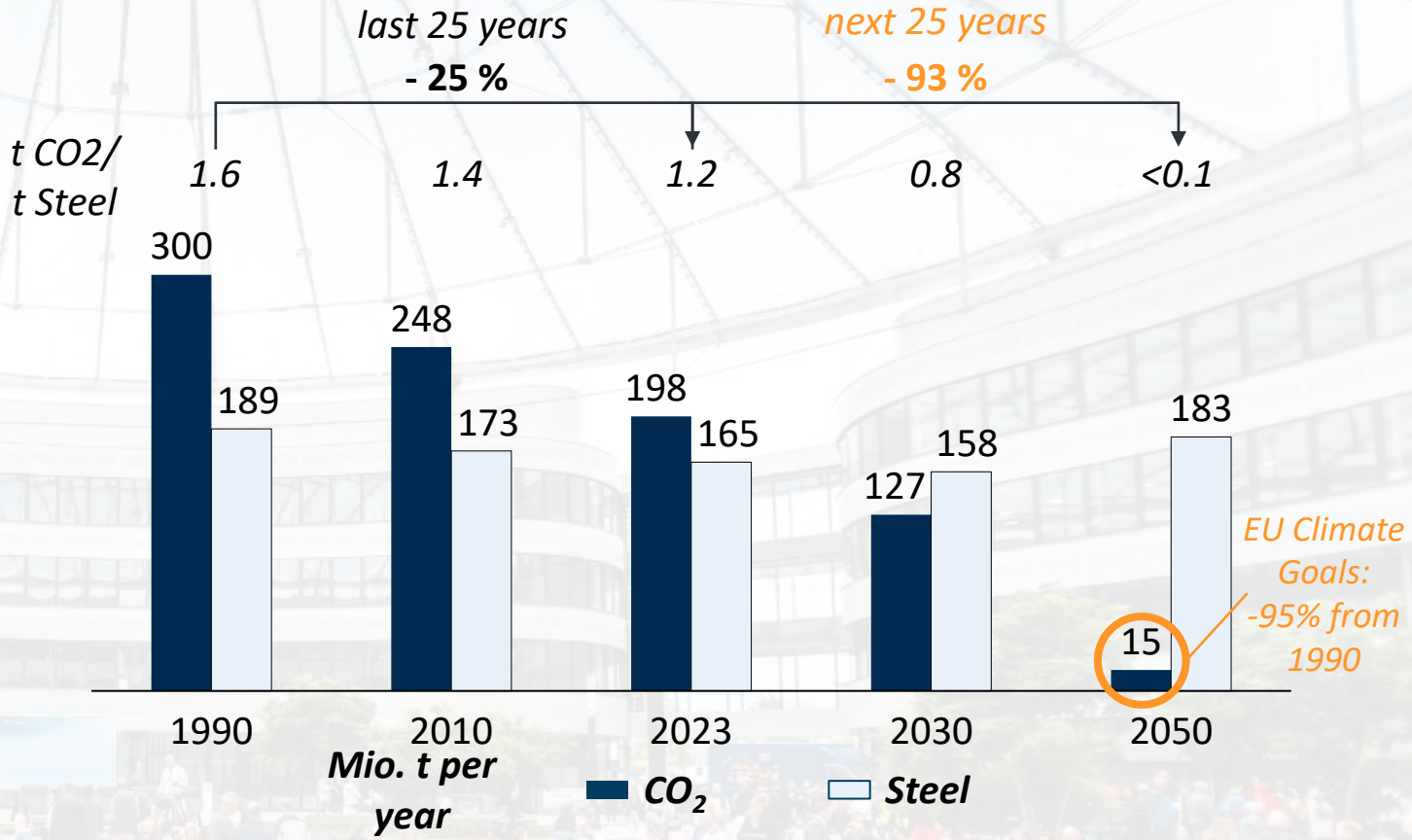
Steel decarbonization is a long-term initiative with ambitious targets



165 million t CO_2

EU CO_2 Emission p.a. > EU **Steel** CO_2 Emission



The industries decarbonization speed progress needs to **quadruple** –
the biggest transformation still lies ahead

Source: VDEH (2021); BMWK (2023); Stahl Online (2020); Worldbank (2022); Roland Berger (2020); Statista (2020, 2022); VDEH (2021)

Green Steel is complicated because of Inputs, processes and product requirements

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There are three major steel making routes that are relevant until 2050

	Primary Steel Routes		*Secondary Steel Route*
Route	***Blast furnace route (BF) ~60%***	***Direct reduction route (DRI) < 1 %***	***"Recycling route" (EAF) ~40%***
Input	Coal, Iron Ore	Iron Ore, NG or H_2	Scrap
Process	Blast furnace, Converter	Shaft furnace, E-Furnace	Electric Arc Furnace
Output	**Steel**	**Steel**	**Steel**
Emissions	~1.9 t* CO_2/t_{CS}	~0.6 t* CO_2/t_{CS}	~0.1 t* CO_2/t_{CS}

*direct CO_2 emissions per ton of crude steel

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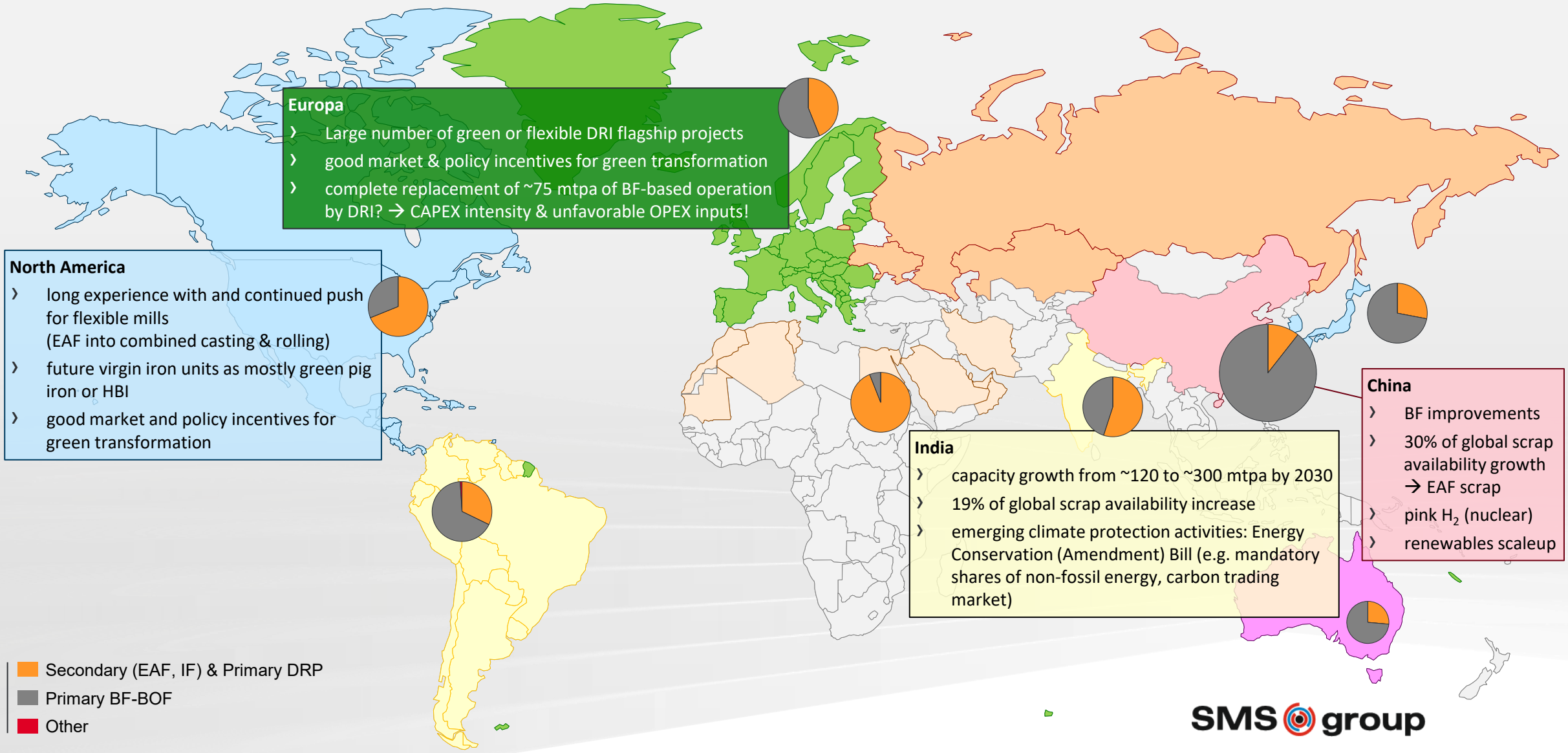
Selected regional decarbonization trends – global limitations



Green Steel projects by SMS group

Stegra

TKSE

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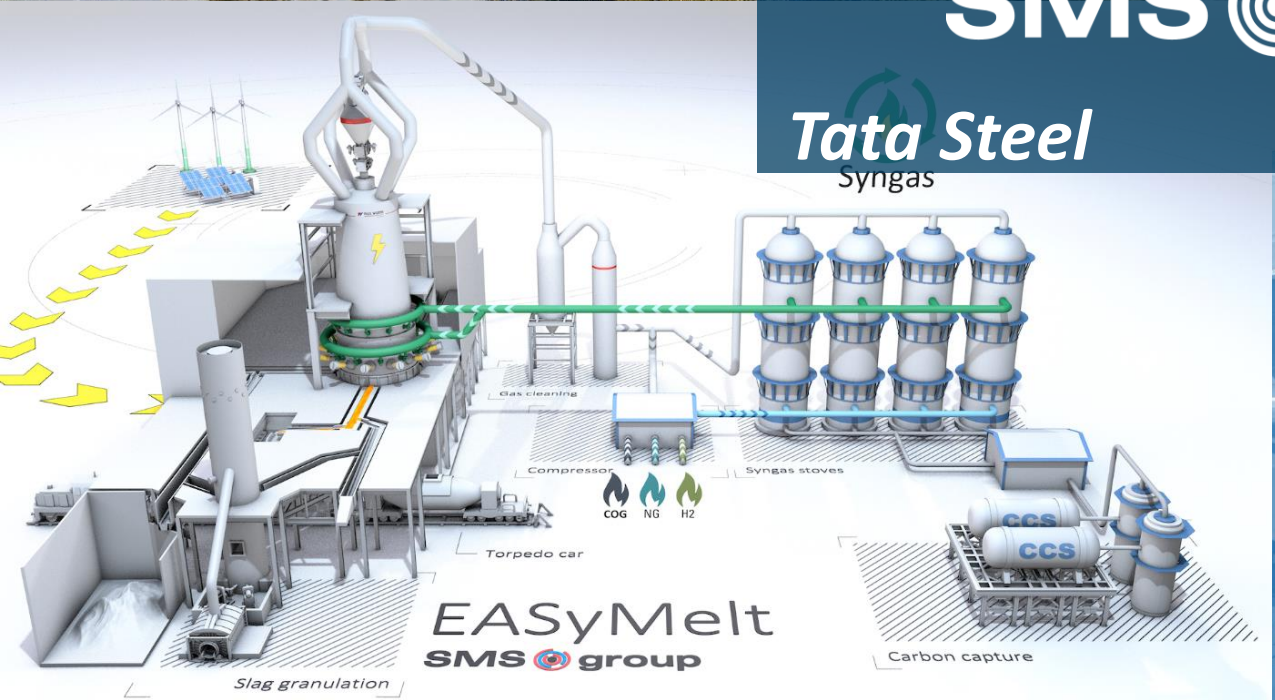

Tata Steel

Saarstahl

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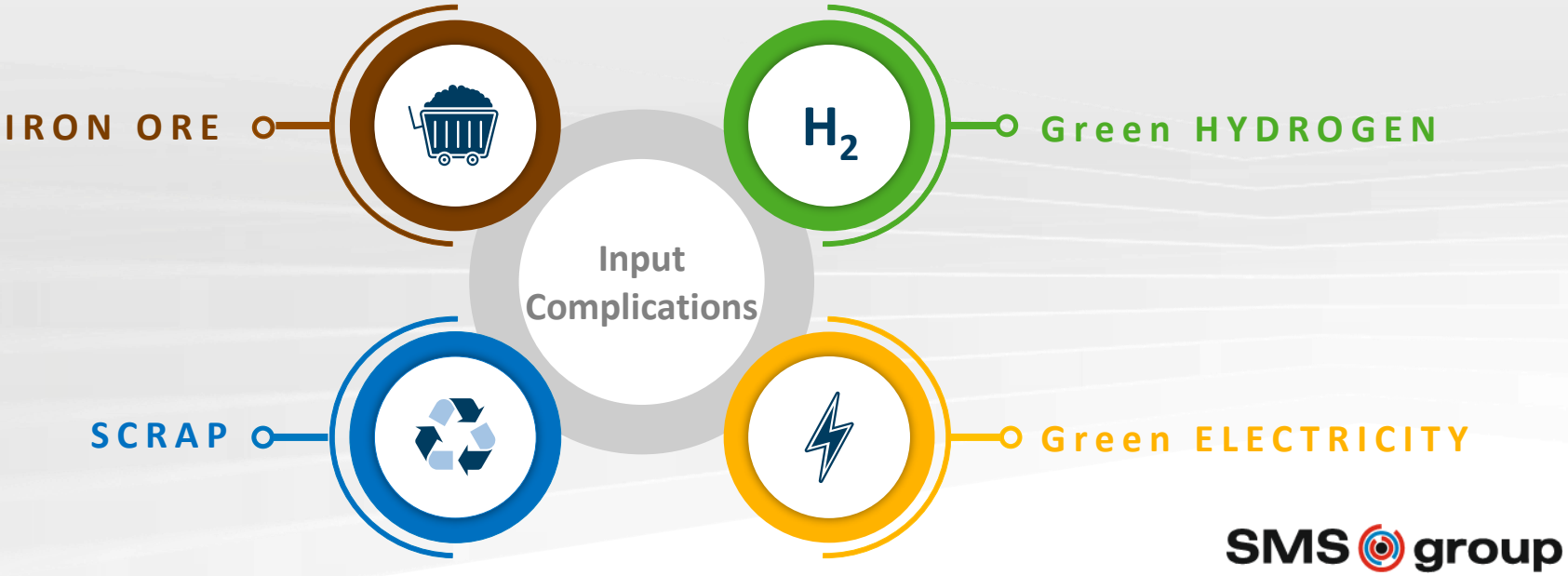
Gray steel

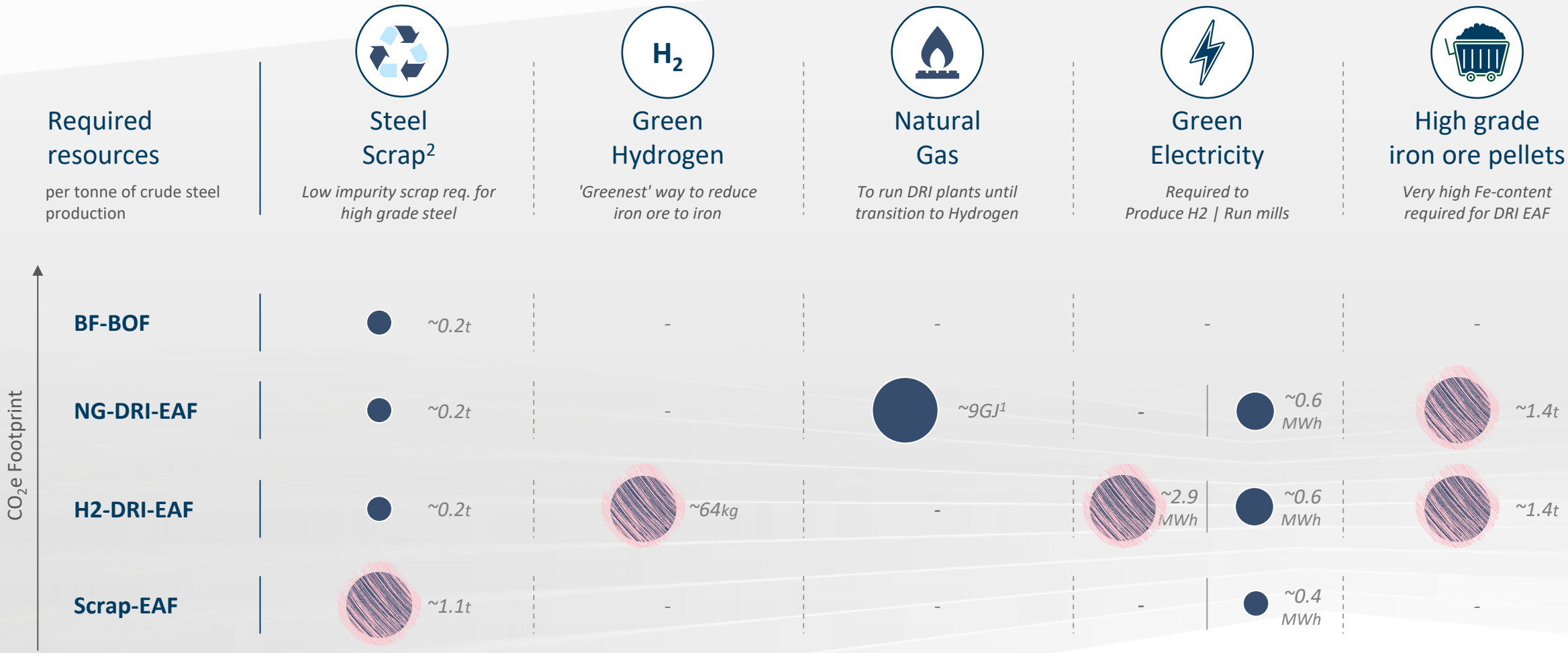
$$Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$$

Green steel

$$Fe_2O_3 + 3H_2 \rightarrow 2Fe + 3H_2O$$



Green technologies consumptions are very different and will create shortages



1. Natural Gas requirement 9GJ=235Nm^3=167kg ·2. Standard scrap requirement to produce steel, may vary for different region
Source: BCG steel model

Bubbles size represents resource requirement per one tonne of crude steel

Bubbles outline represents shortage

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Green Steel is complicated because of Inputs, processes and product requirements

Product complexity through different technologies

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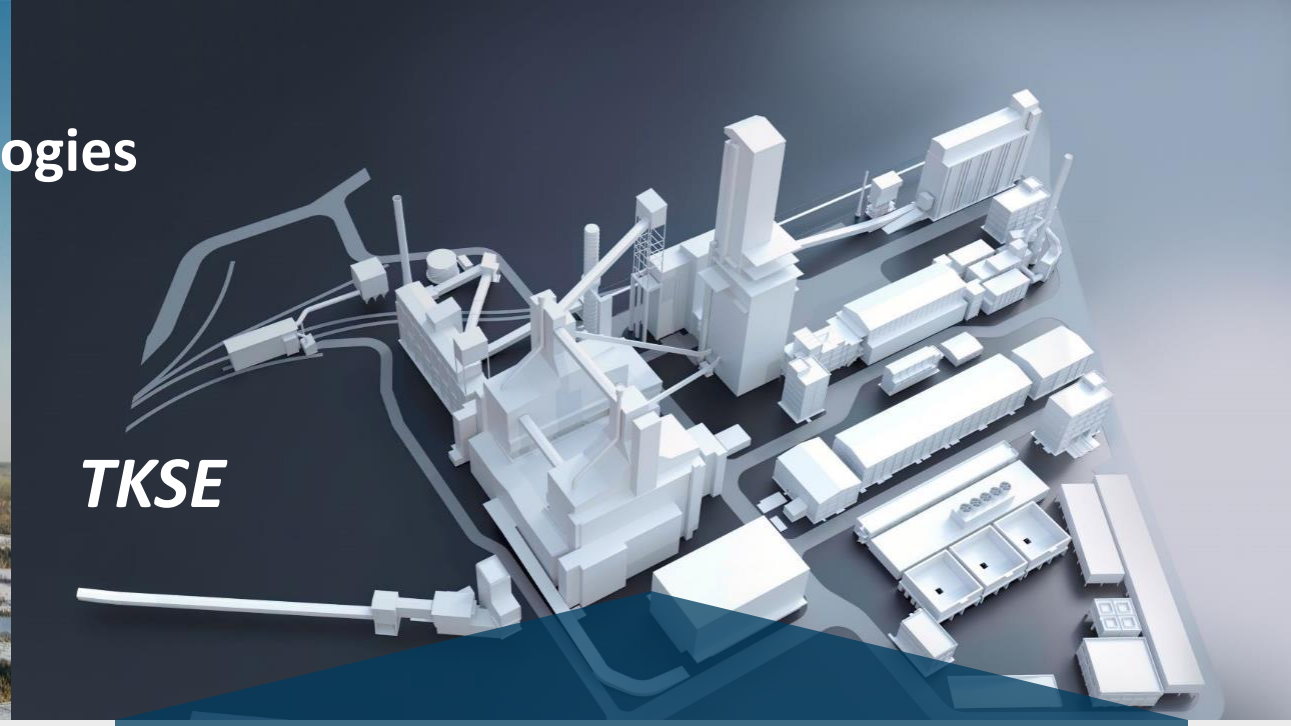
- Green Field use of of DRI-EAF
- Possibility of intermediate products (HBI)
- Different product landscape than Blast Furnace



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- Integration of DRI-OBF technology brownfield
- Continuation of BOF Use
- Unchanged product certifications

The selection of technologies will affect the product qualities and hence the business model as well as financials

The definition of Green Steel is still pending (extract of initiatives)

ResponsibleSteel Standard:
ResponsibleSteel include criteria for greenhouse gas emissions, resource efficiency, and social responsibility.

Wirtschaftsvereinigung Stahl “LESS (Low emission steel standard)”:
LESS seeks to establish a clear set of criteria for what constitutes green or low-emission steel, focusing on measurable reductions in greenhouse gas emissions during the steelmaking process.

World Steel Association Guidelines:
World steel publishes guidelines that contribute to the understanding and criteria for environmentally friendly steel.

The European Steel Association Criteria:
Eurofer focuses on establishing criteria that encompass reduced carbon emissions, energy efficiency, and the use of renewable energy sources in steel production.

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"There will be many different definitions and understandings of Green Steel..

... so we will have to live with all shades of grey and green"

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Conclusion

Our mission:
#turningmetalsgreen

Decarbonization
The current progress is not sufficient but the decarbonization potential of iron- and steelmaking is immense!

Decarbonization
The decarbonization approach will be regionally different – DRI plants, blast furnaces and EAF technology will be the main technologies of the future.

Uncertainties & Complexity
Green Steel has a higher complexity because of a more global playfield – That is why political and financial uncertainty may slow down the green transformation

“Green Steel”
In the future, there will be many shades of green when it comes to steel – this needs to be understood and embraced.