Navigating sustainable pathways into a green future for steelmaking

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SMS group


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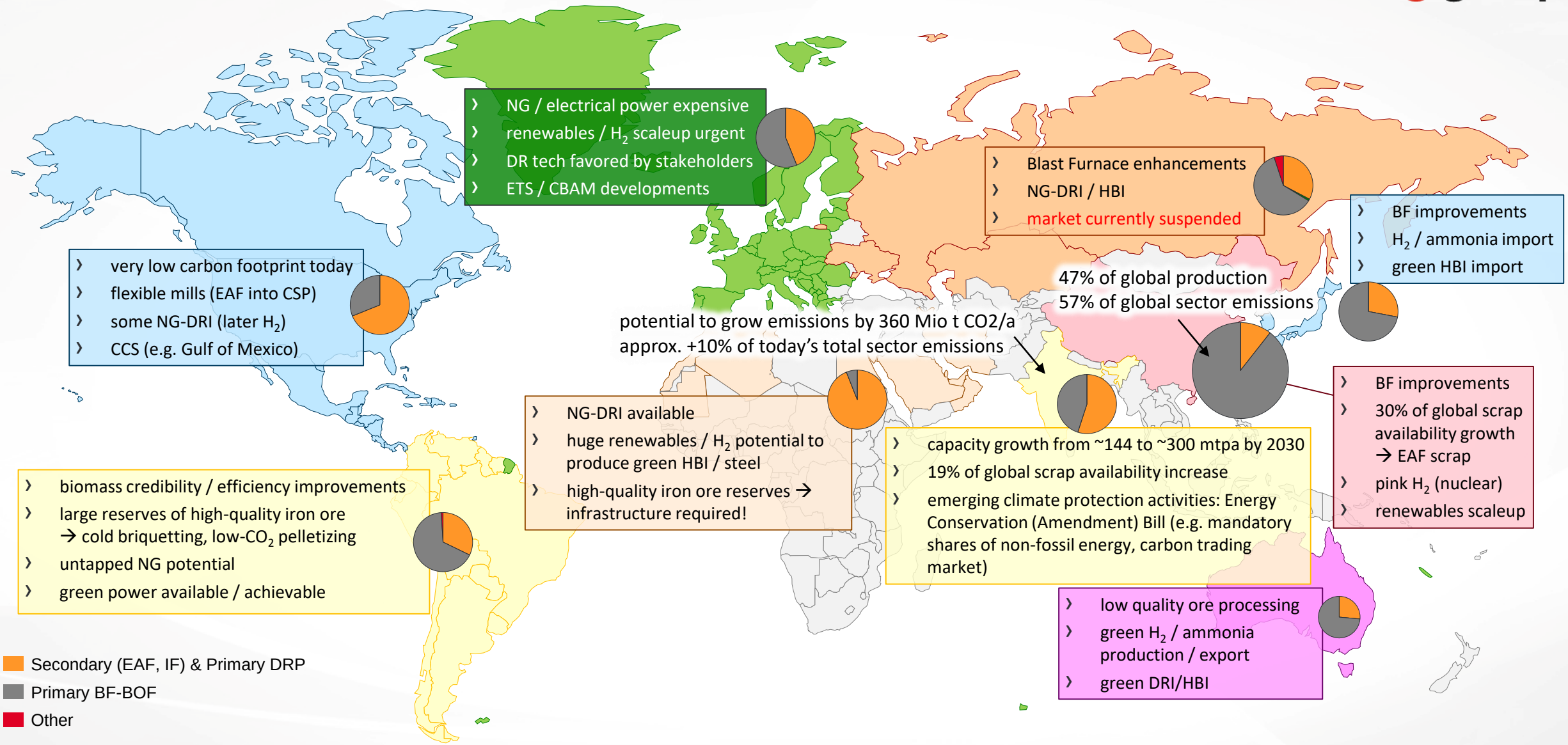
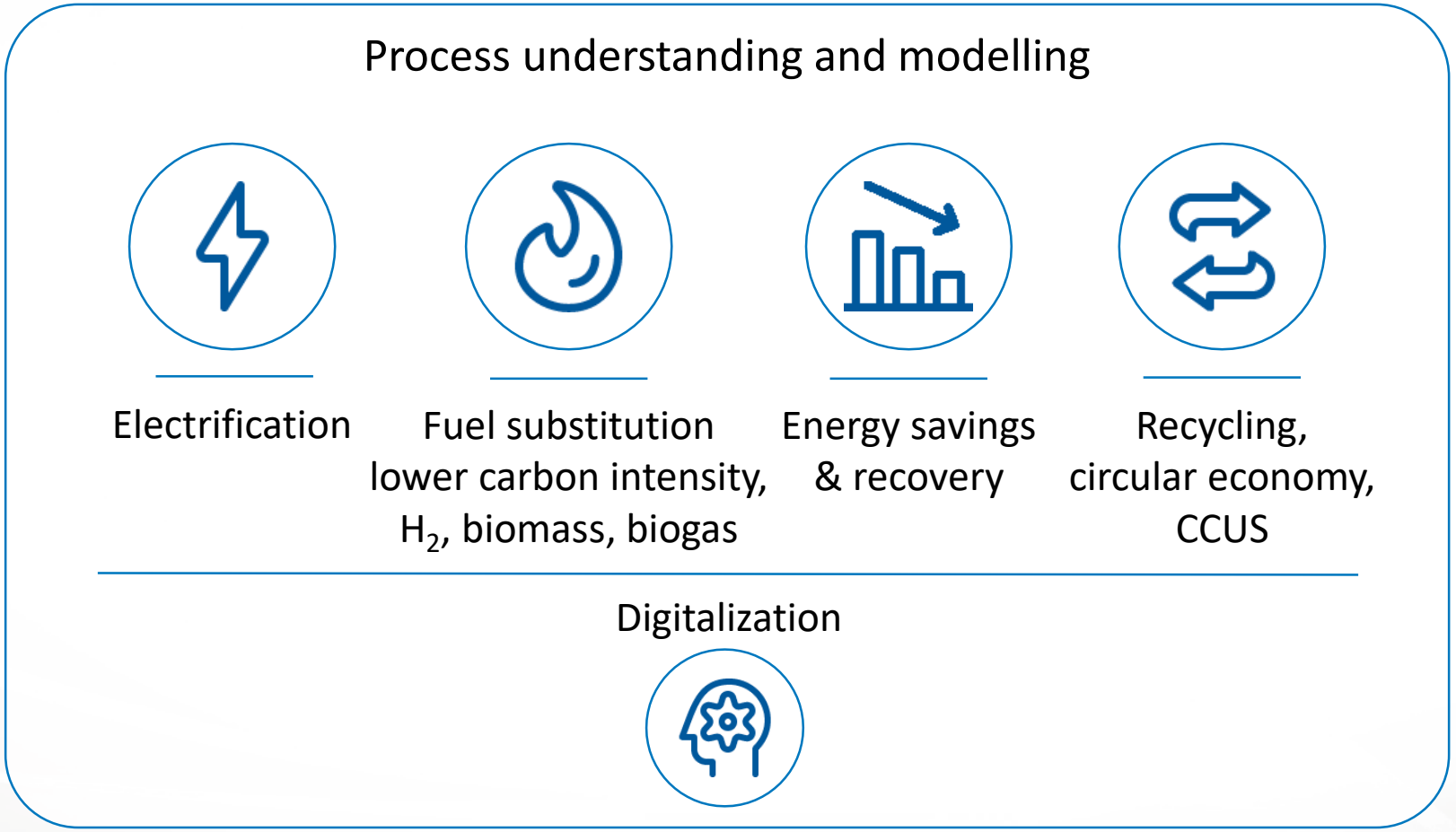
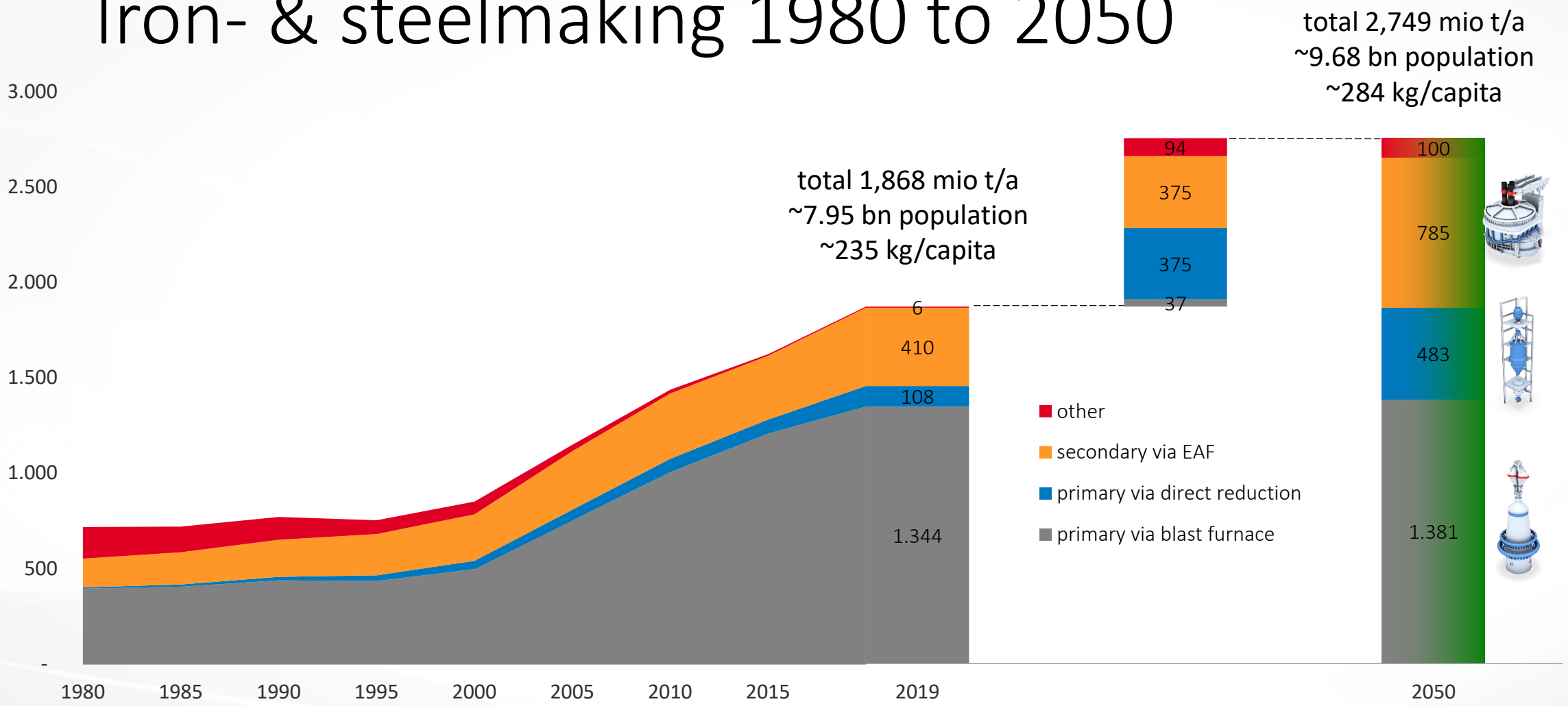
Green Steel definition?
Steel demand / type of products?
Raw materials quality / availability / price?
Green Steel premiums?
Emission regulation?
Low-carbon energy stability / availability / price?
CAPEX / OPEX support?
Trade regulation?
Reporting requirements?
Hydrogen?
Climate effects?
GRAY STEEL
GREEN STEEL
De-risking the transition is the prime target!


NG / electrical power expensive
renewables / H_2 scaleup urgent
DR tech favored by stakeholders
ETS / CBAM developments
Blast Furnace enhancements
NG-DRI / HBI
market currently suspended
BF improvements
H_2 / ammonia import
green HBI import
very low carbon footprint today
flexible mills (EAF into CSP)
some NG-DRI (later H_2)
CCS (e.g. Gulf of Mexico)
47% of global production
57% of global sector emissions
potential to grow emissions by 360 Mio t CO2/a
approx. +10% of today's total sector emissions
NG-DRI available
huge renewables / H_2 potential to produce green HBI / steel
high-quality iron ore reserves → infrastructure required!
capacity growth from ~144 to ~300 mtpa by 2030
19% of global scrap availability increase
emerging climate protection activities: Energy Conservation (Amendment) Bill (e.g. mandatory shares of non-fossil energy, carbon trading market)
BF improvements
30% of global scrap availability growth → EAF scrap
pink H_2 (nuclear)
renewables scaleup
biomass credibility / efficiency improvements
large reserves of high-quality iron ore → cold briquetting, low-CO_2 pelletizing
untapped NG potential
green power available / achievable
low quality ore processing
green H_2 / ammonia production / export
green DRI/HBI
Secondary (EAF, IF) & Primary DRP
Primary BF-BOF
Other

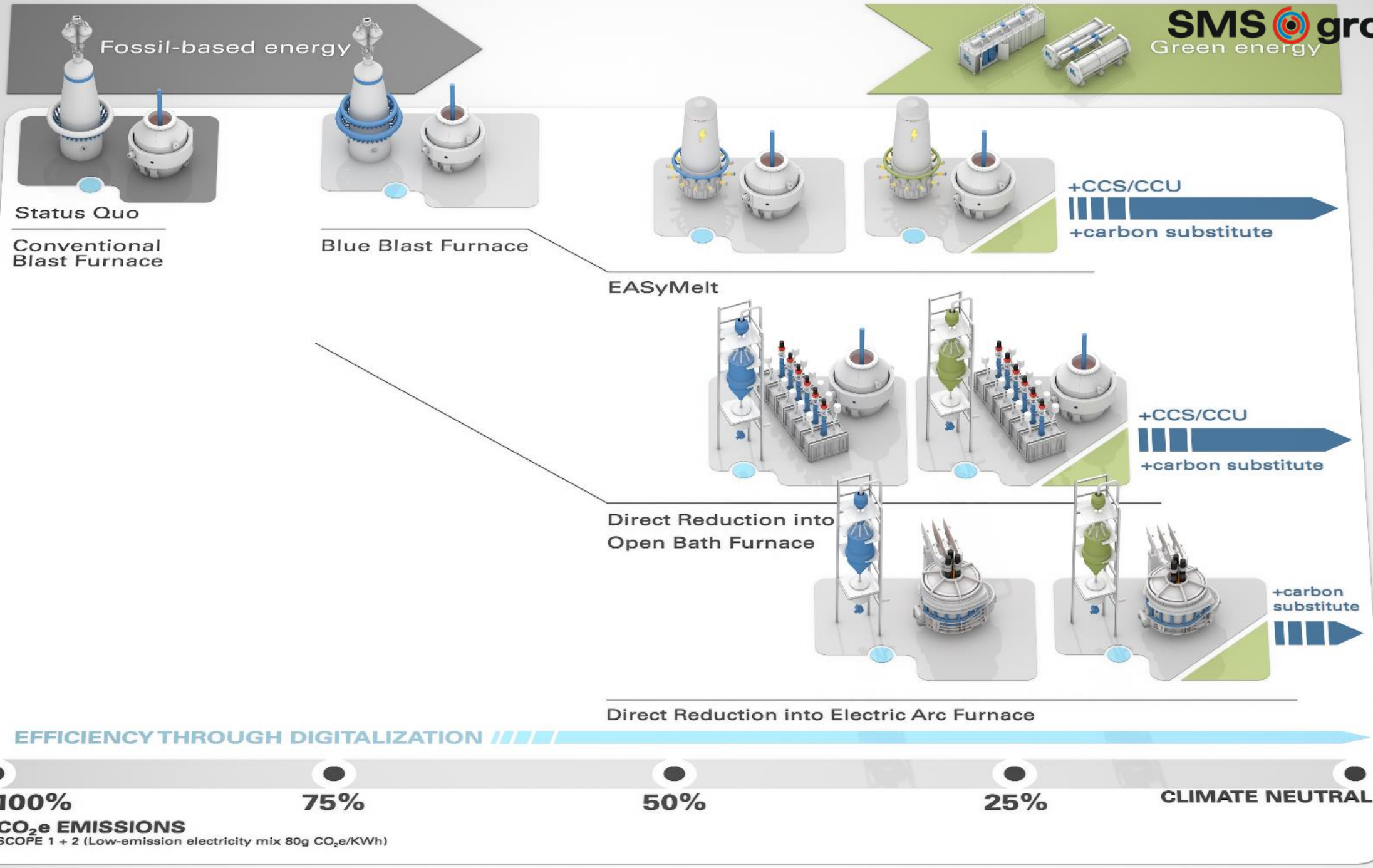
Building blocks for defossilization of metals



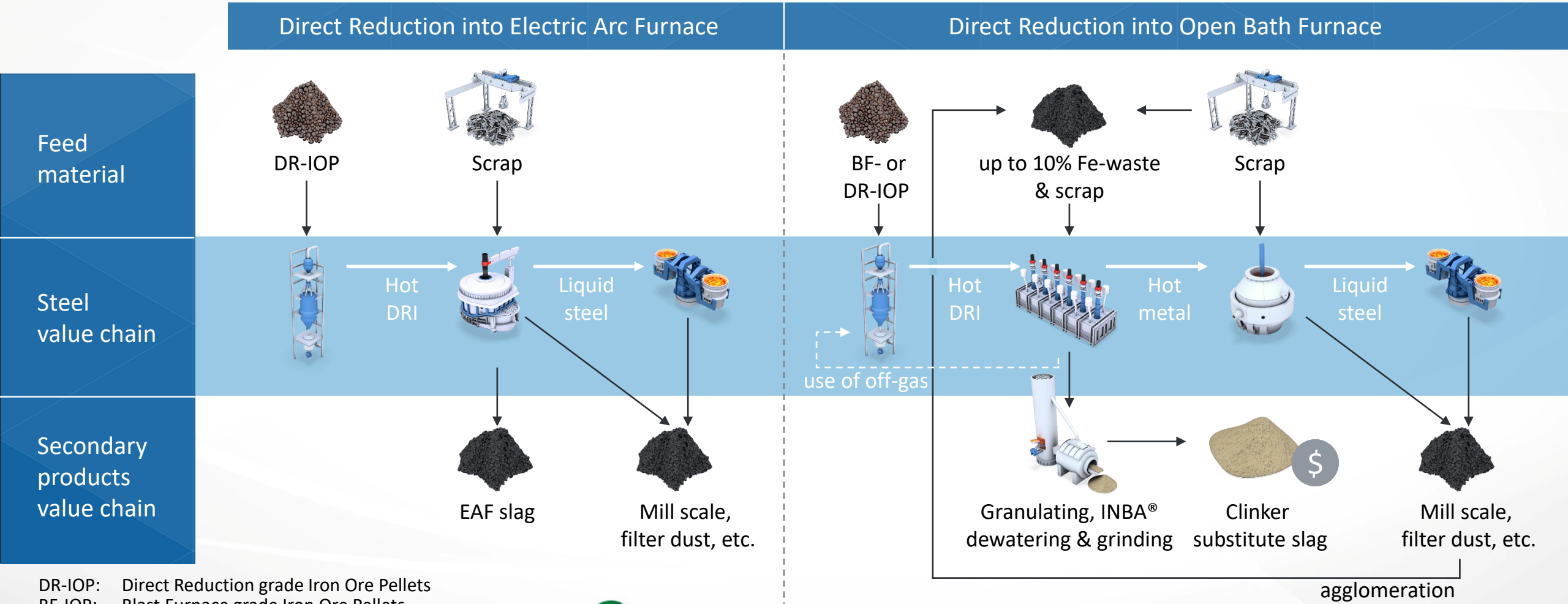
Iron- & steelmaking 1980 to 2050



World Steel Association; World Steel in Figures and own analysis


Fossil-based energy
SMS group
Green energy
Status Quo
Conventional Blast Furnace
Blue Blast Furnace
+CCS/CCU
+carbon substitute
EASyMelt
+CCS/CCU
+carbon substitute
Direct Reduction into Open Bath Furnace
+carbon substitute
Direct Reduction into Electric Arc Furnace
EFFICIENCY THROUGH DIGITALIZATION
100%
75%
50%
25%
CLIMATE NEUTRAL
CO2e EMISSIONS
SCOPE 1 + 2 (Low-emission electricity mix 80g CO2e/KWh)

Direct Reduction in the Steel Value Chain



DR-IOP: Direct Reduction grade Iron Ore Pellets
BF-IOP: Blast Furnace grade Iron Ore Pellets

Smelting Flow Sheet

0 BF grade iron ore pellet can be utilized

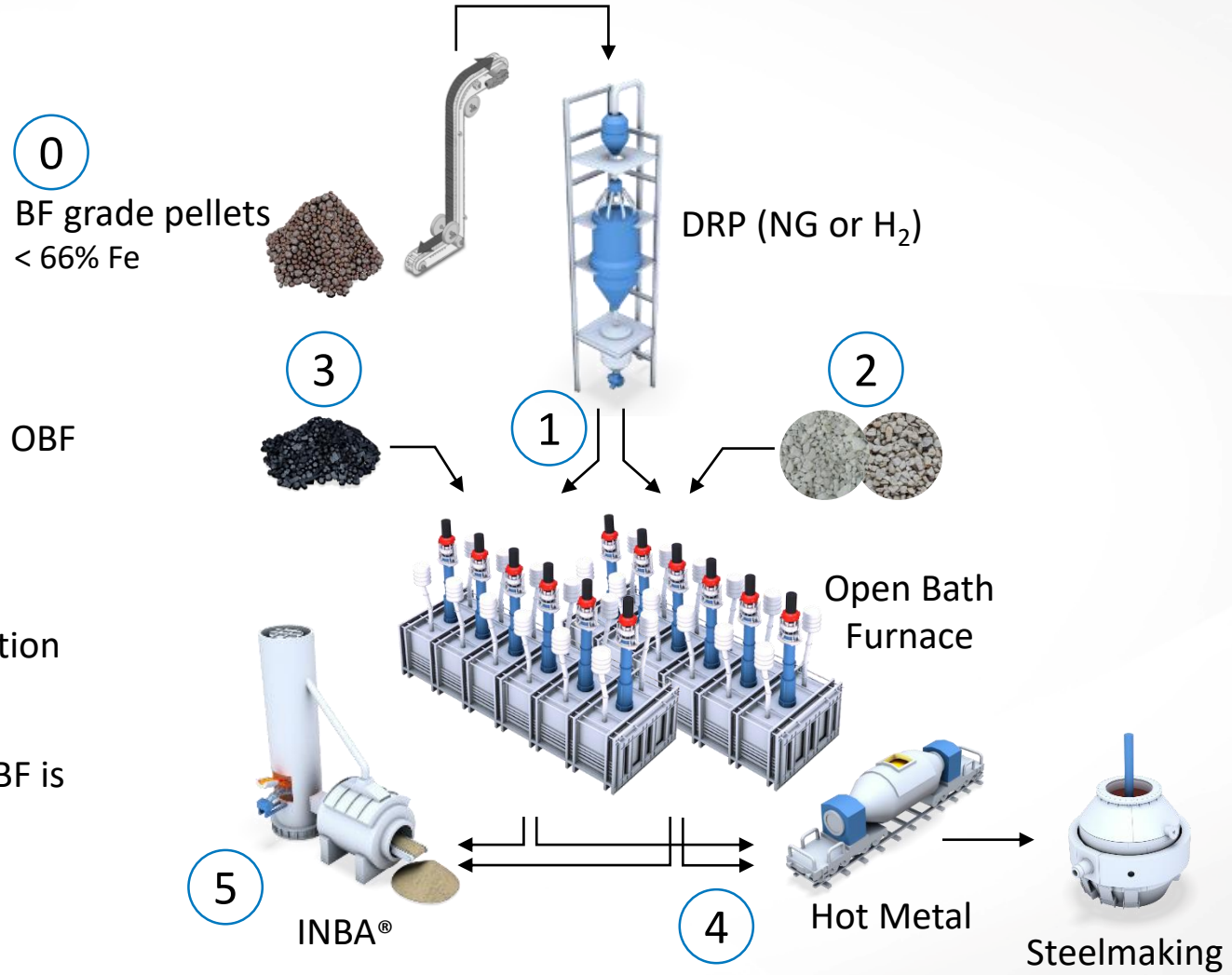
1 DRP may start with NG and switch in the future to H_2
HDRI is charged to OBF feed bins and then melted in the OBF

2 Fluxes added as slag modifiers

3 Carbon source added for reduction of FeO and carburization of hot metal

4 Hot metal with composition and temperature similar to BF is produced

5 Granulated slag production from OBF with composition similar to BF

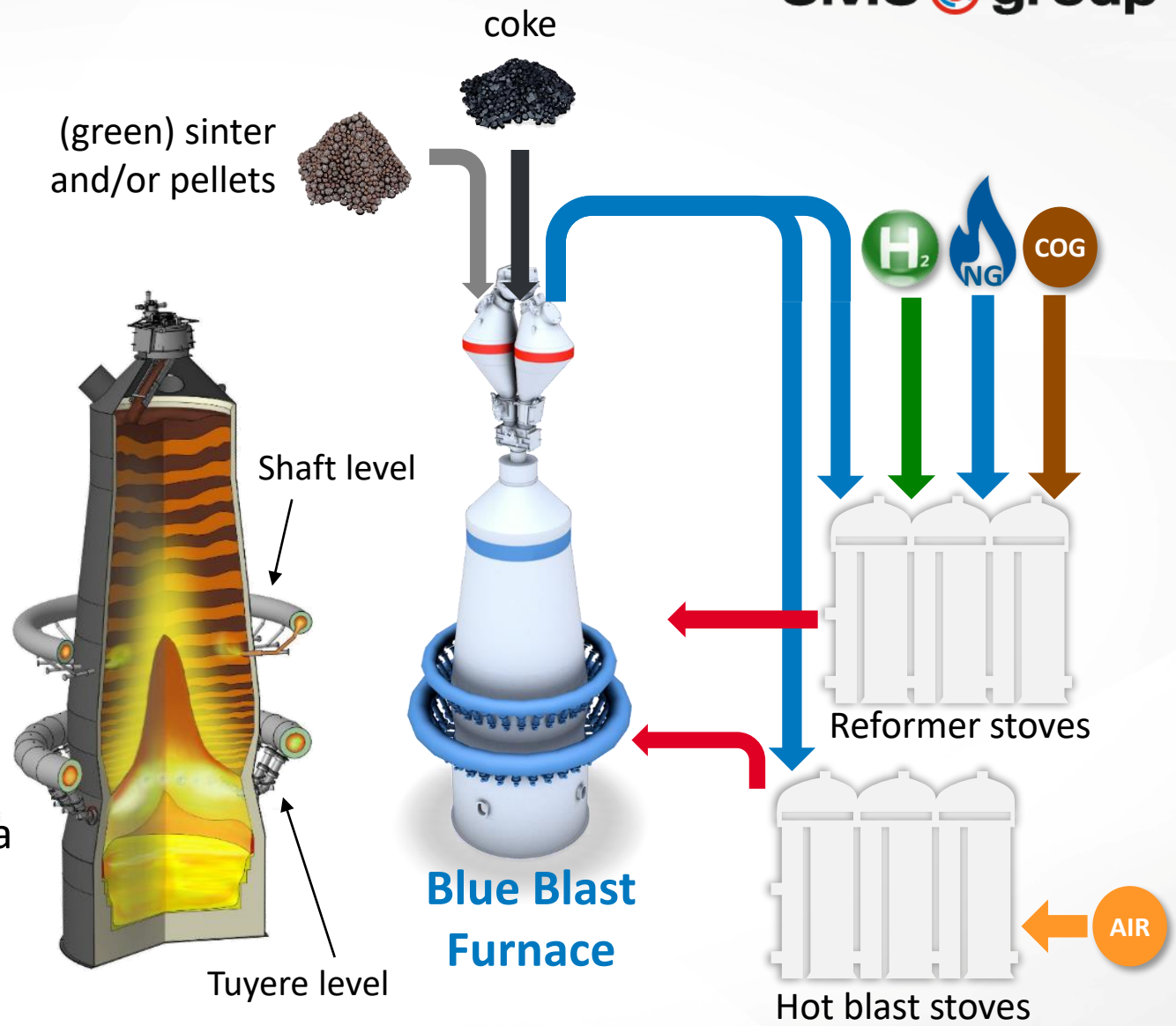


BF Conversion Step 1:
Blue Blast Furnace

Features

Shaft injection of reformed syngas

- allows larger amounts of auxiliary fuel injection (e.g. COG, NG, H_2, syngas) at tuyere level
- reduced OPEX due to coke rate decrease
- potential productivity increase due to decreased gas generation at bosh level
- add-on technology not impacting tuyere area
- **CO_2 emission reduction up to 28%**



BF Conversion Step 2: EASyMelt

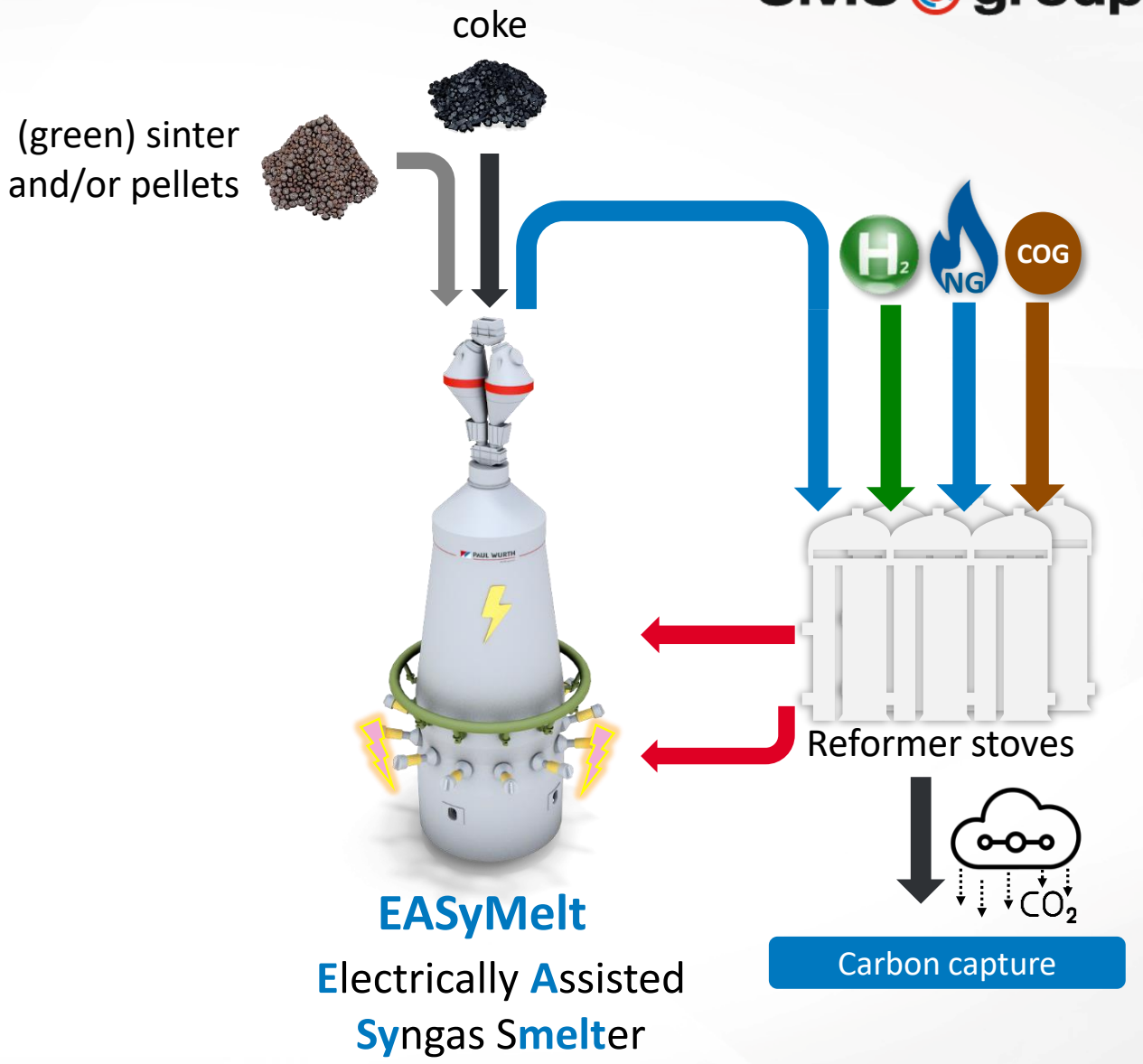
Features

Shaft injection of reformed syngas

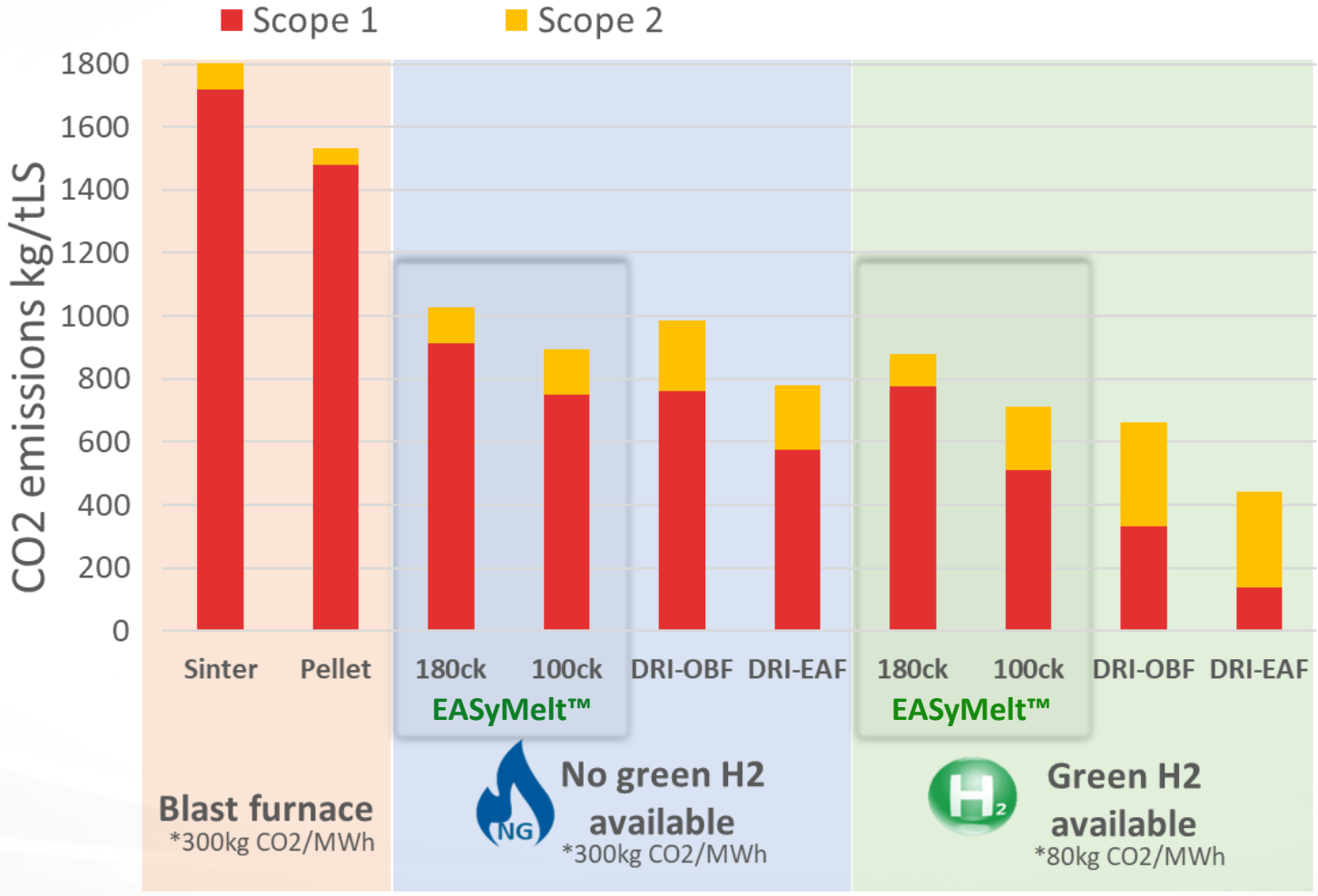
Replacement of hot blast with reformed syngas

Electrification of melting heat

- lowest CAPEX
  - integrated into existing steel plant
  - stepwise low risk approach
- lowest OPEX
- energy & ore flexibility
- waste recycling in sinter still possible
- high production rate & quality



Comparison of specific CO_2 emissions (kg/t_{LS})



Questions?