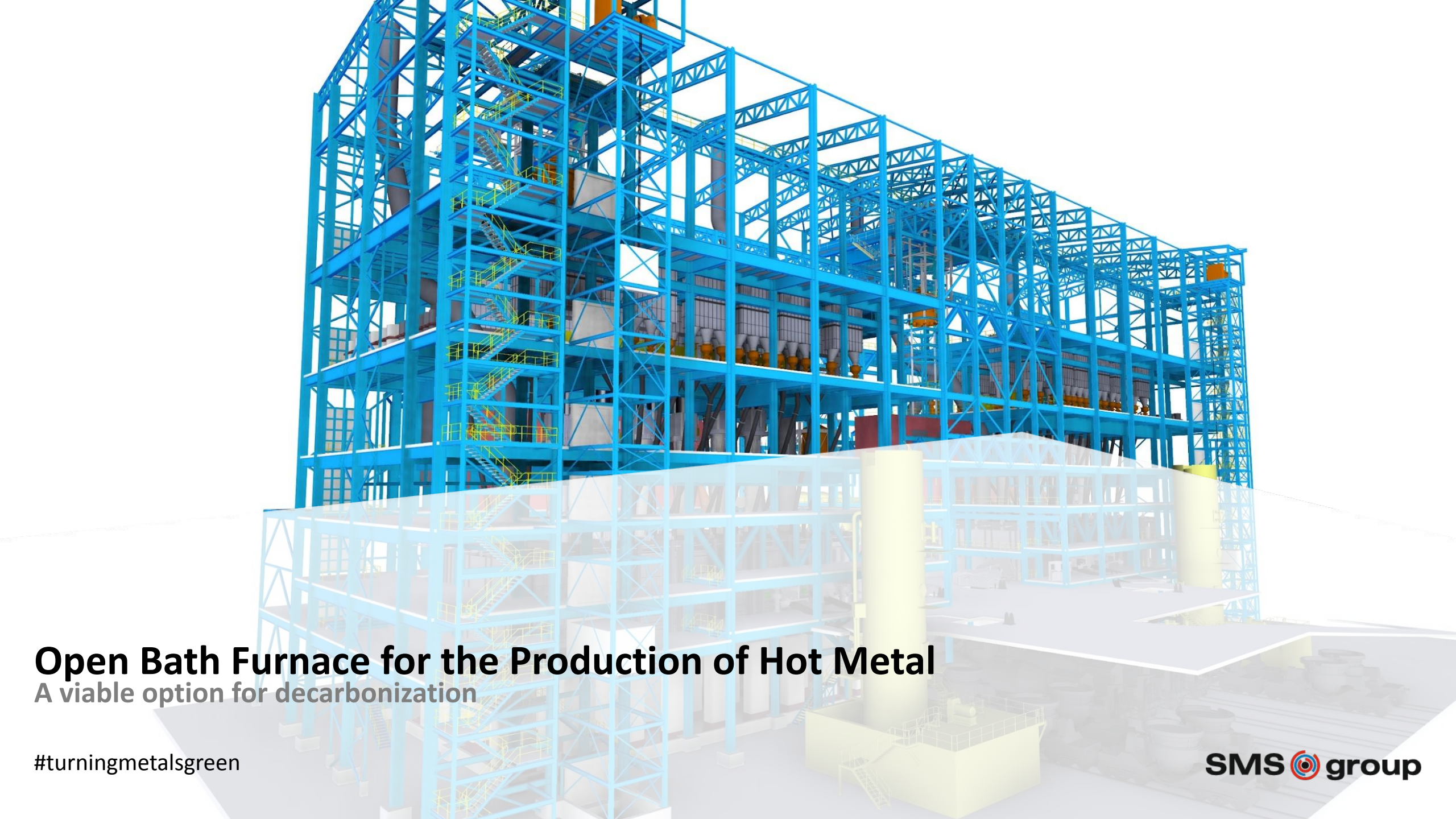


Open Bath Furnace for the Production of Hot Metal

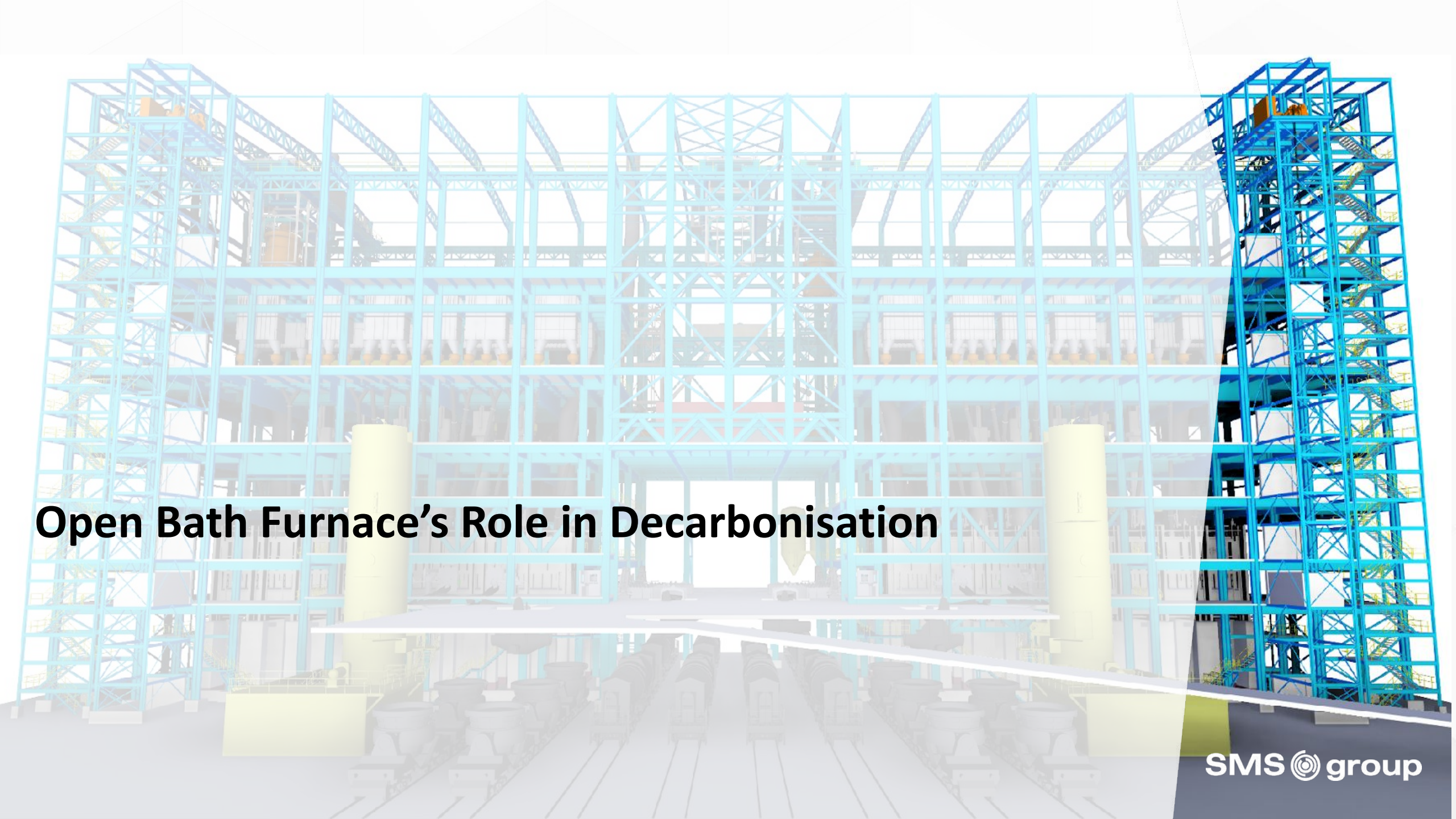
A viable option for decarbonization

#turningmetalsgreen

SMS group

Agenda

1	Role of the open bath furnace in decarbonization
2	OBF types – circular & rectangular
3	OBF vs. EAF



Open Bath Furnace’s Role in Decarbonisation

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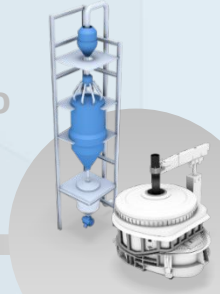
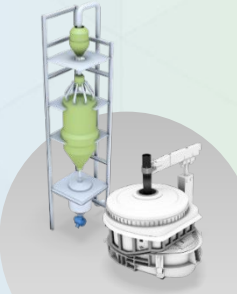
Decarbonisation pathways for integrated steel plants

Scope 1 and 2

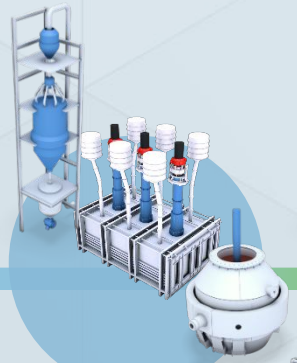


Direct Reduction into
Electric Arc Furnace

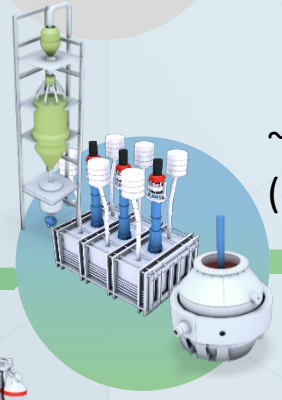


~10-40 kg C / t_{LS}*
(NG + injection coke)

+ biomass/-gas



**Direct Reduction into
Open Bath Furnace**



~100 kg C / t_{LS}*
(coke + NG)

+ CCUS and/or biomass/-gas

Conventional
Blast Furnace

Blue Blast Furnace

Hot H2
Syngas

~140 kg C / t_{LS}*
(coke + NG)

+ CCUS and/or biomass/-gas

100% **75%** **50%** **25%** **Climate neutral**

OECD EU-28 emission factor of 80kg CO2/MWh (target 2050)

* corresponds to scope 1 direct carbon input

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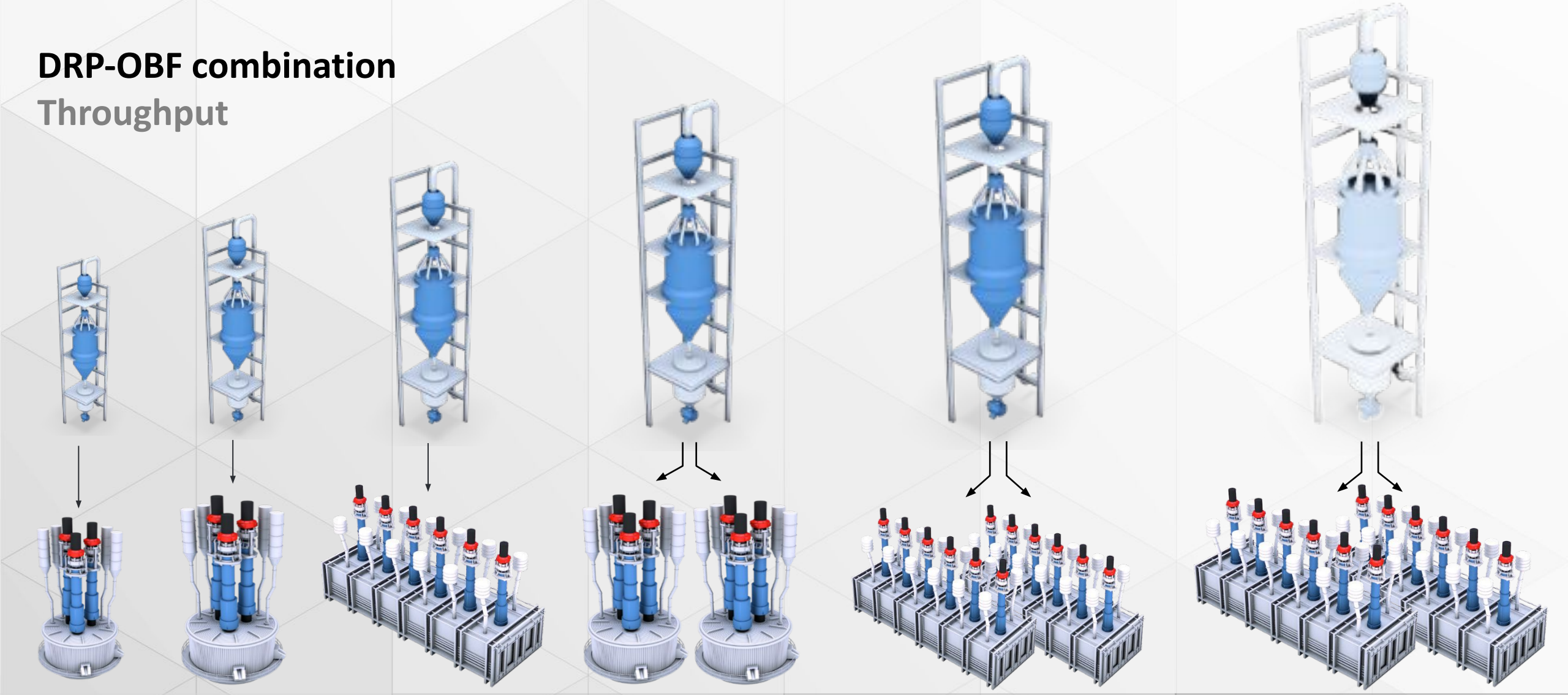
DRP-OBF combination

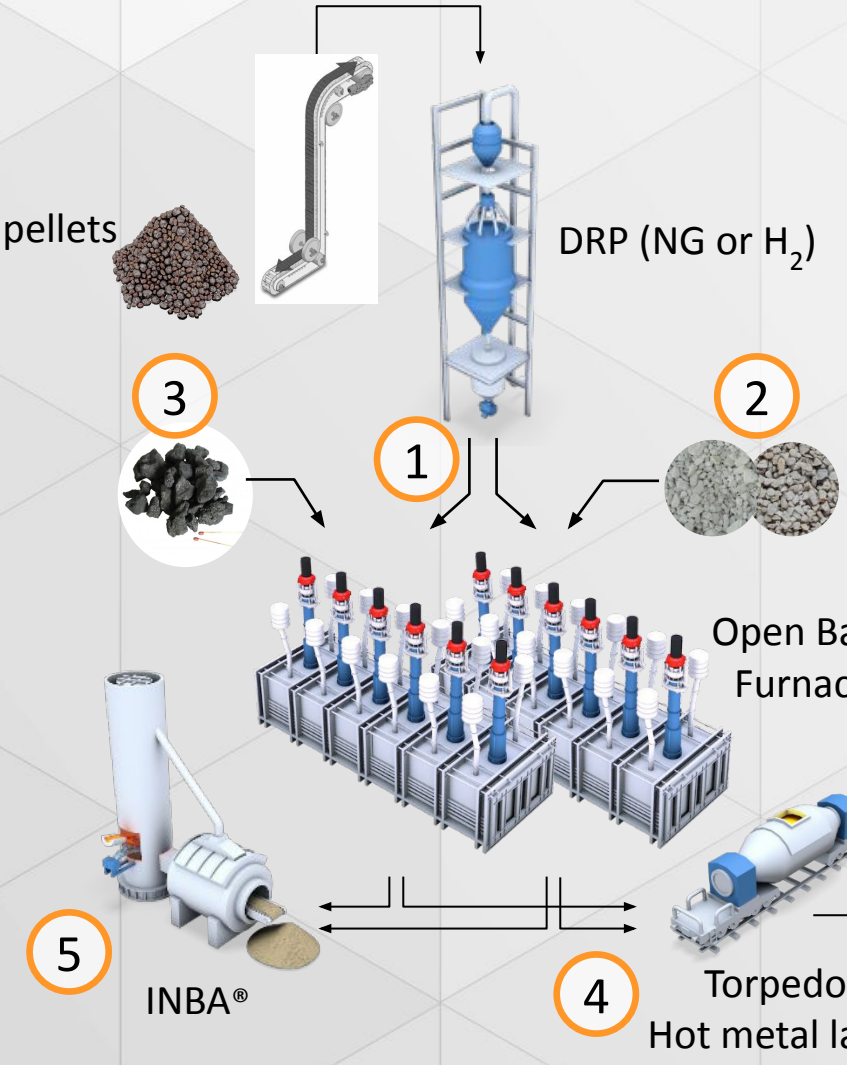
Throughput



DRP-OBF combination

Simplified flow sheet

Patent pending



0 BF Grade iron ore pellet can be utilized

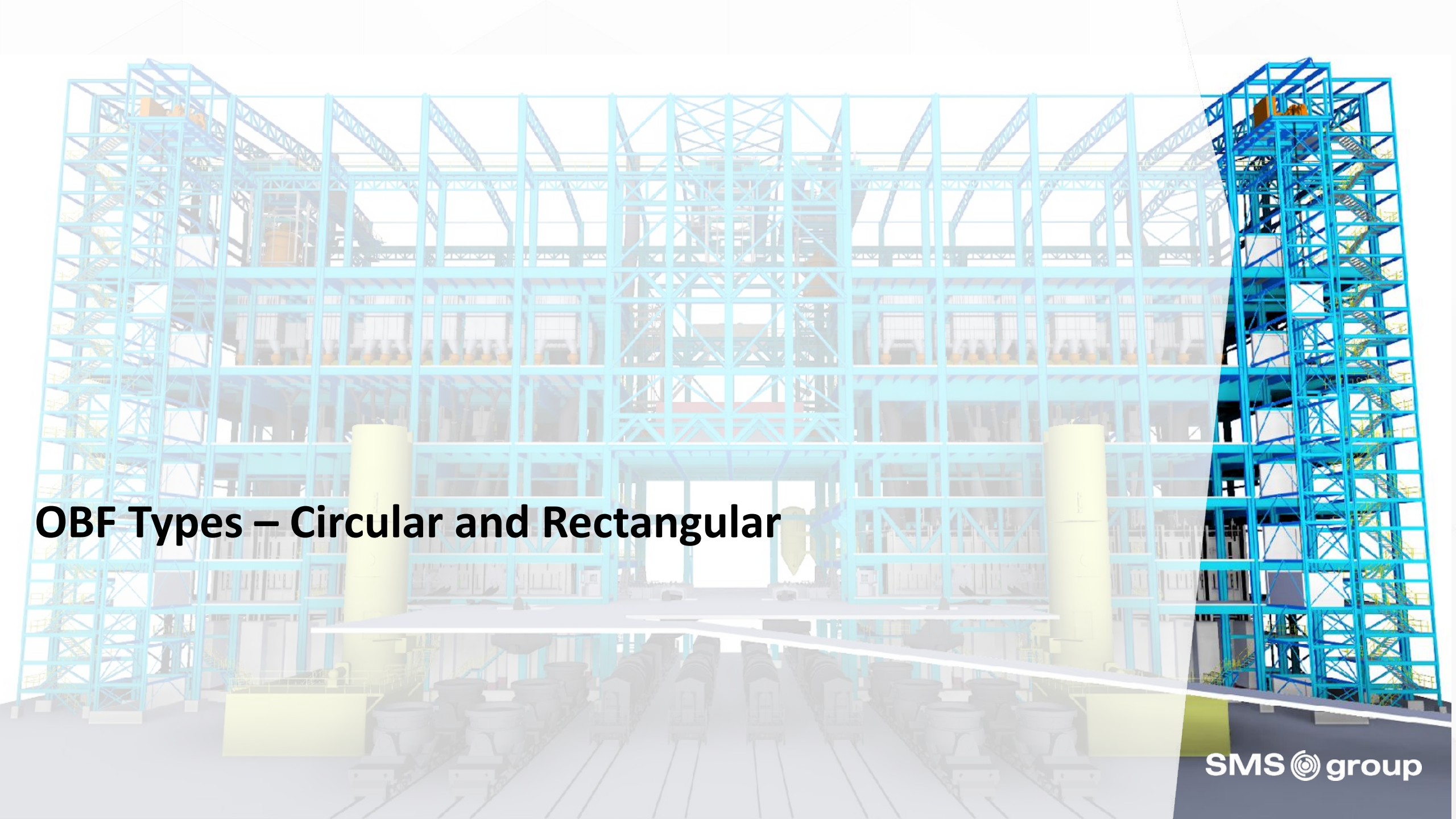
1 DRP may start with NG and switch in the future to H_2
HDRI is charged to OBF feed bins and then melted in the OBF

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



OBF Types – Circular and Rectangular

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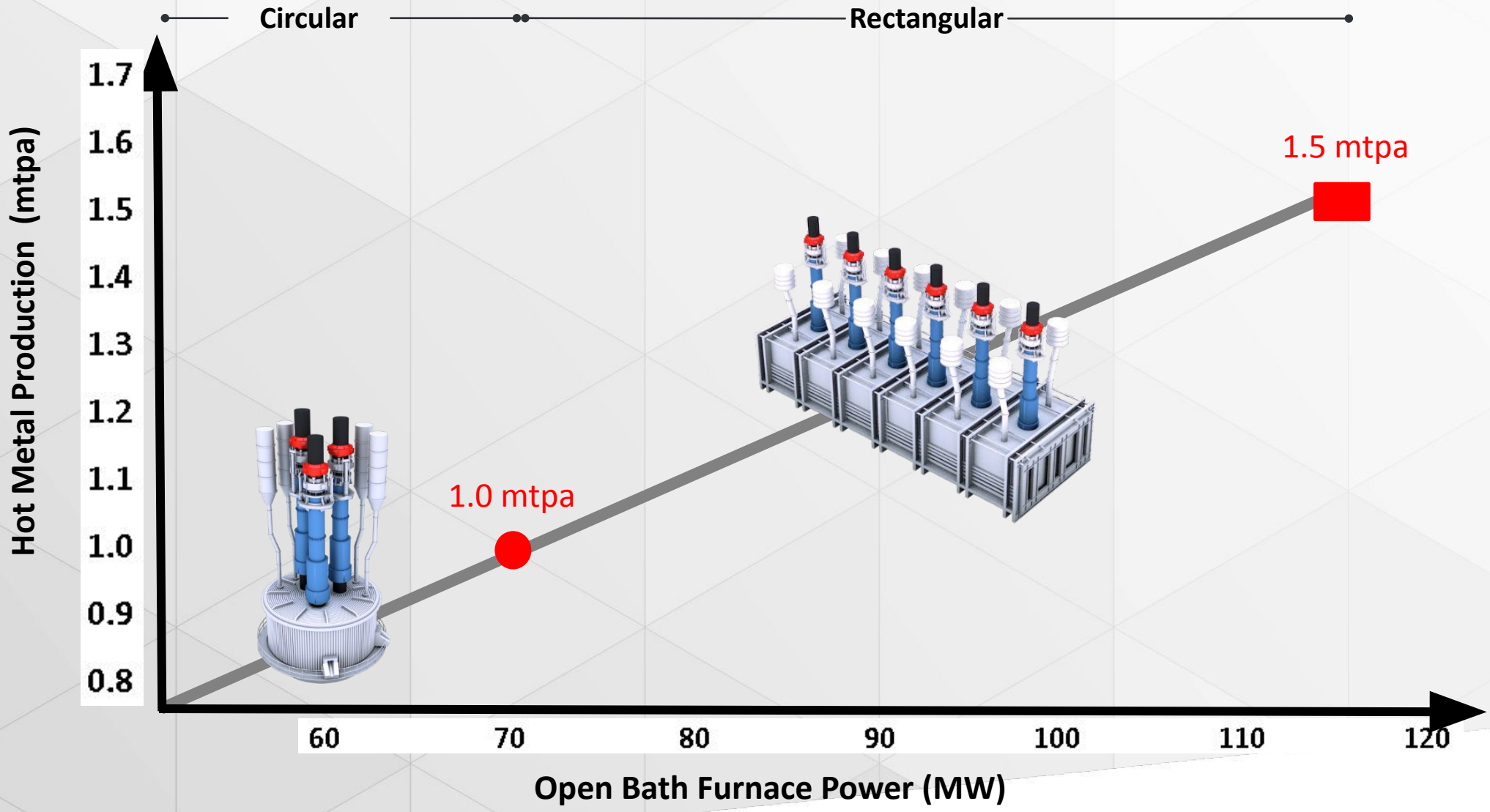
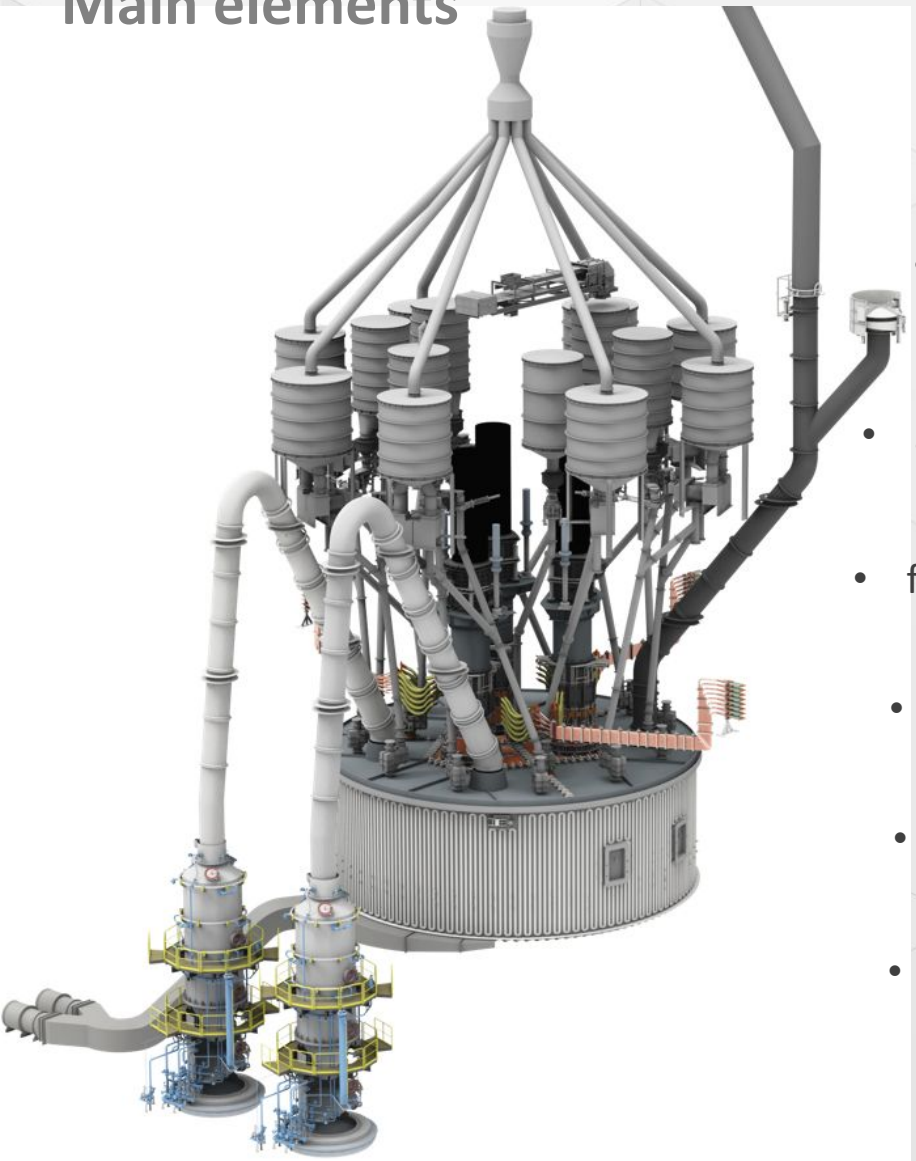
Circular & rectangular OBF technologies

Throughput vs. power

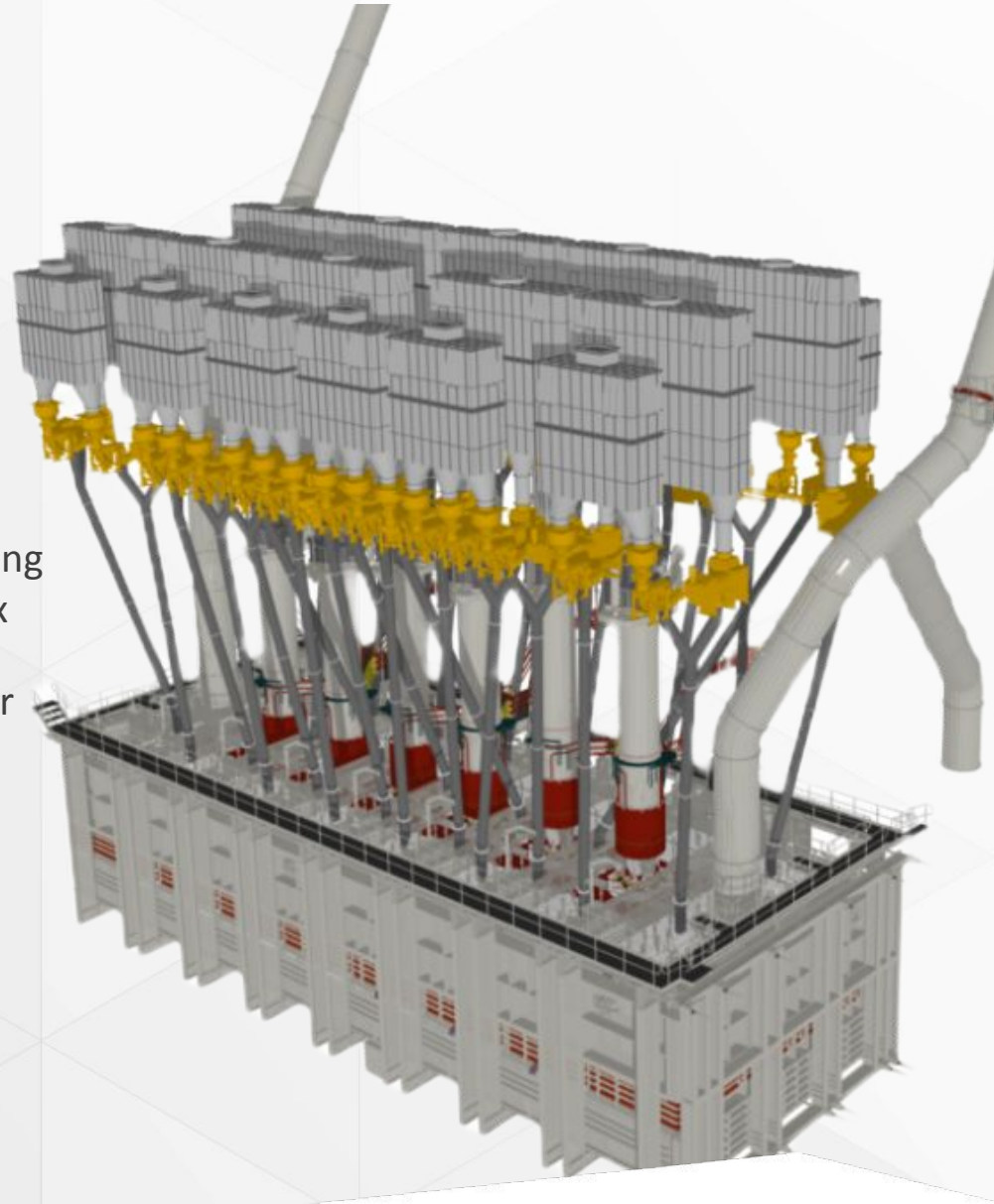


Circular & rectangular OBF technologies

Main elements

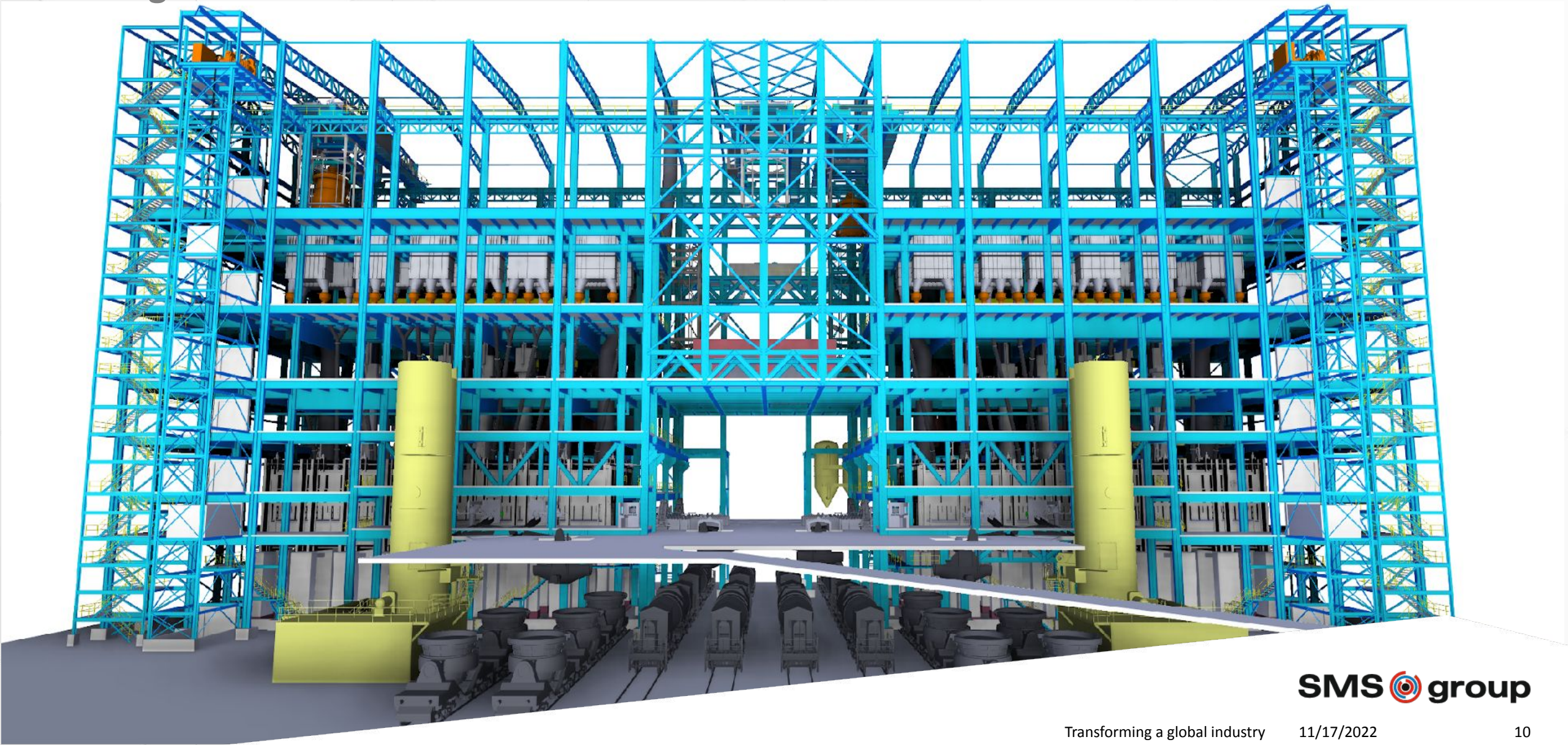


- furnace feed bins and chutes
- precision material dosing
- set of high current conductors delivering power from transformer
- Söderberg electrode columns delivering electrical power to the material mix
- furnace roof to seal furnace against air ingress and gas egress
- closed circuit, water cooled shell supported by copper cooling
- multiple tap holes for metal and slag at different elevations
- forced air cooling of bottom shell
- off gas handling and cleaning



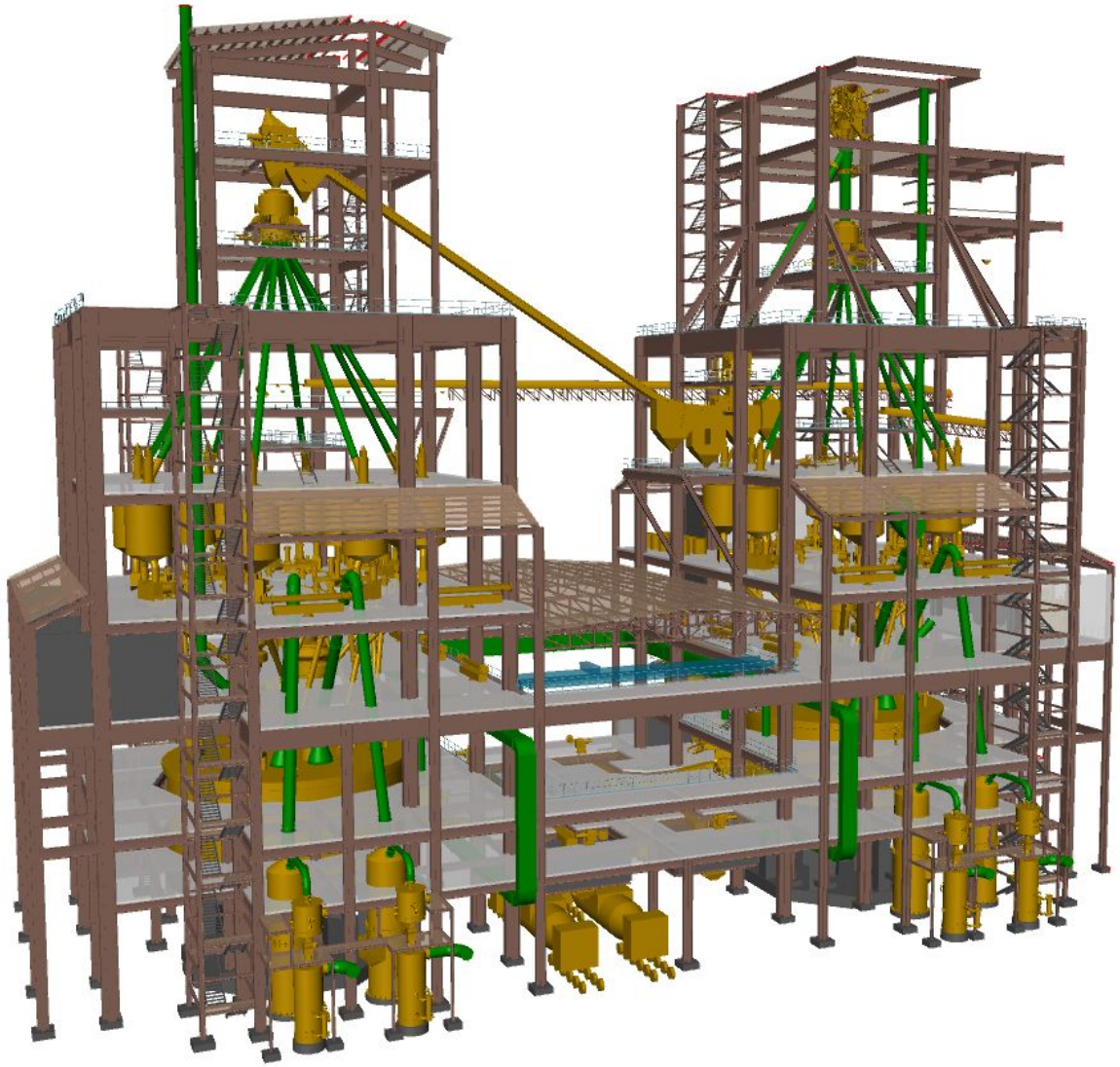
Plant layouts

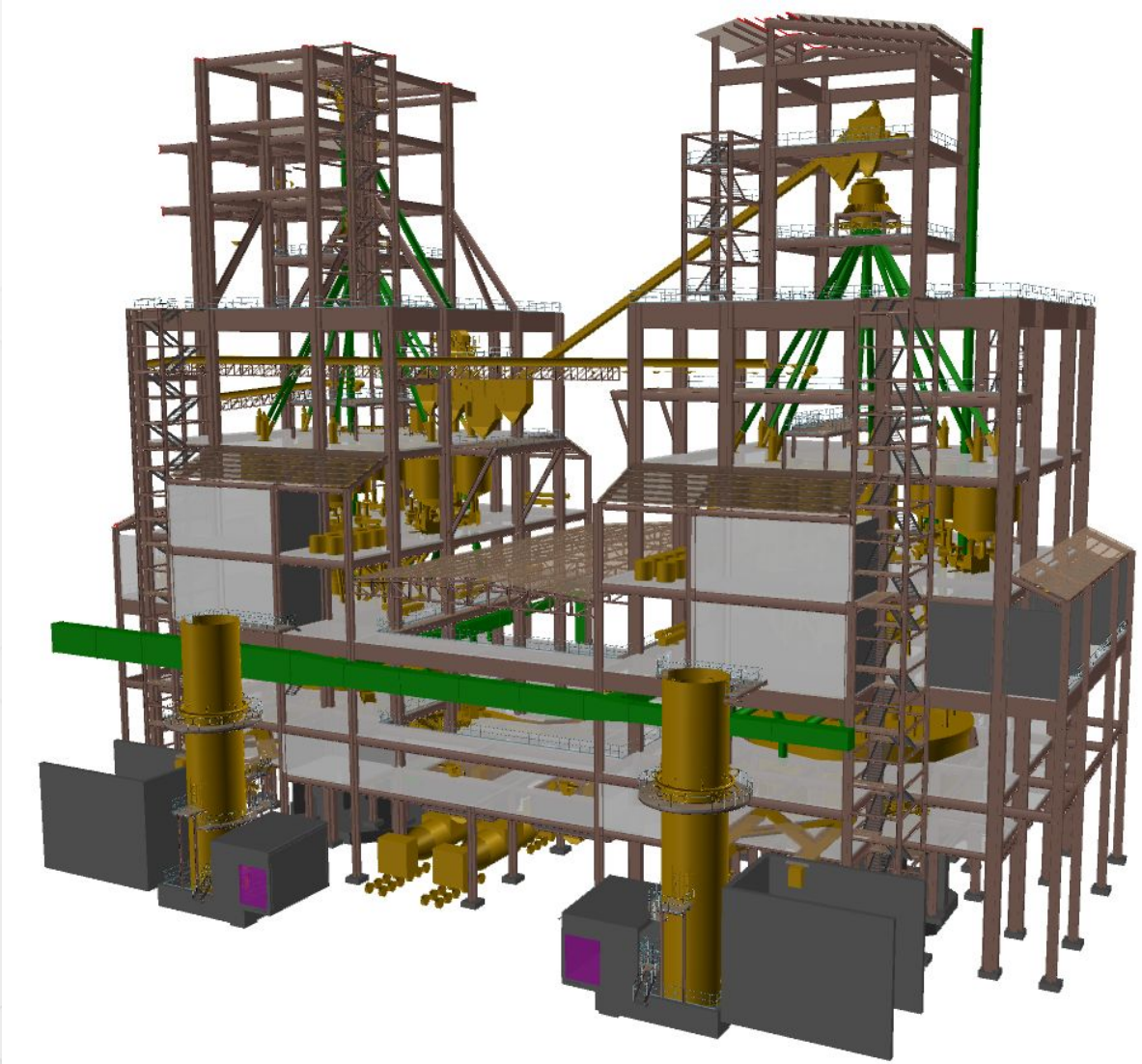
Rectangular OBF



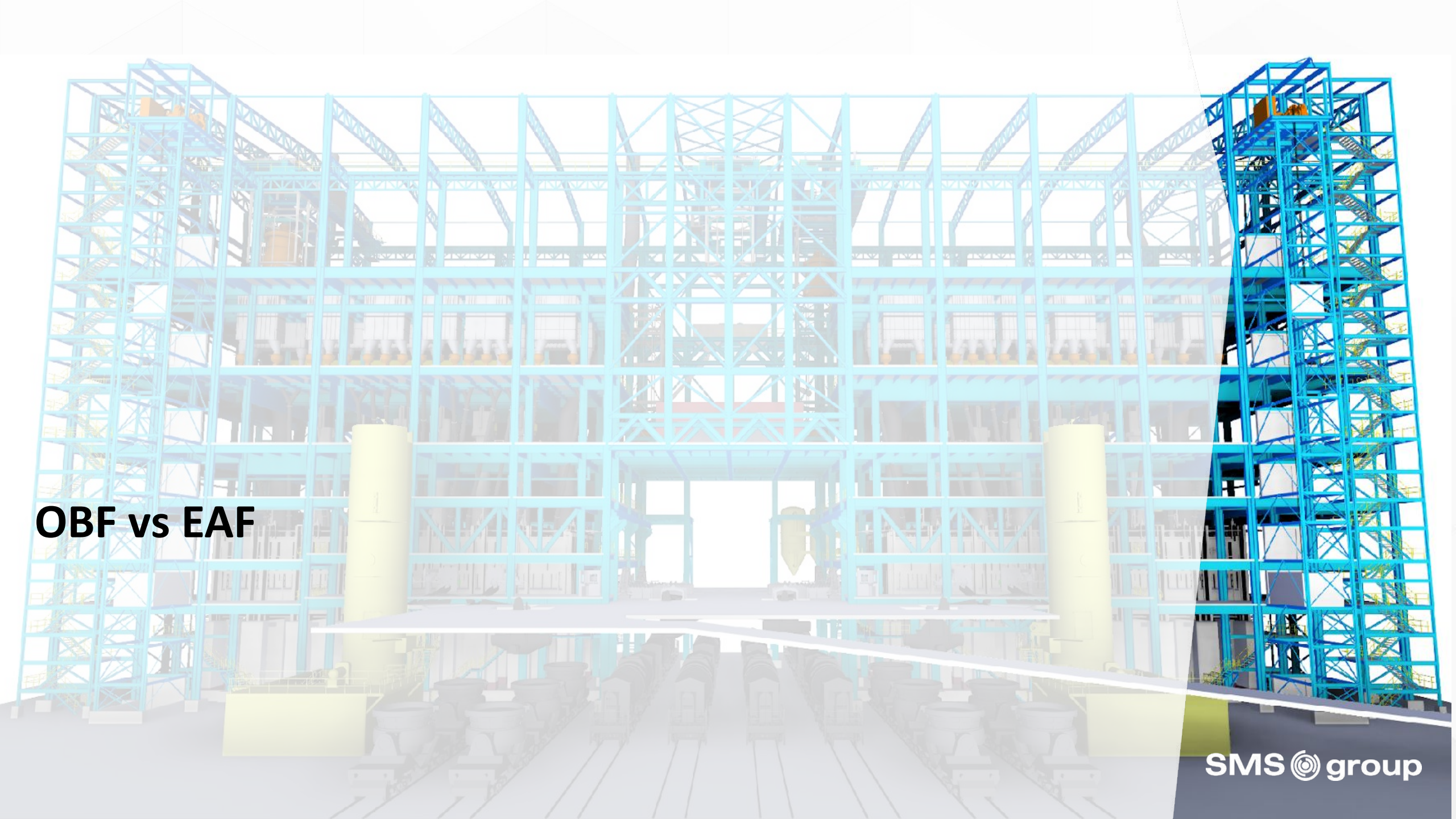
Plant layouts

Circular OBF





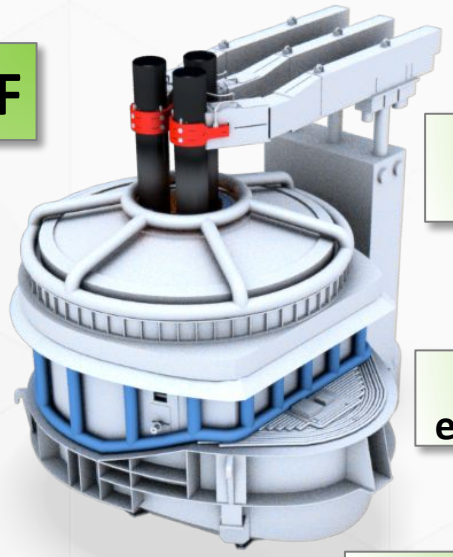
OBF vs EAF



OBF vs. EAF

Major distinguishing features

EAF



batch production

oxidizing environment

tapping steel

- open to atmosphere □ oxidizing environment
- smaller bath surface area □ higher power density
- short term vessel and lining philosophy
- concentrated batch feed of materials
- electrodes and electrode arms

OBF

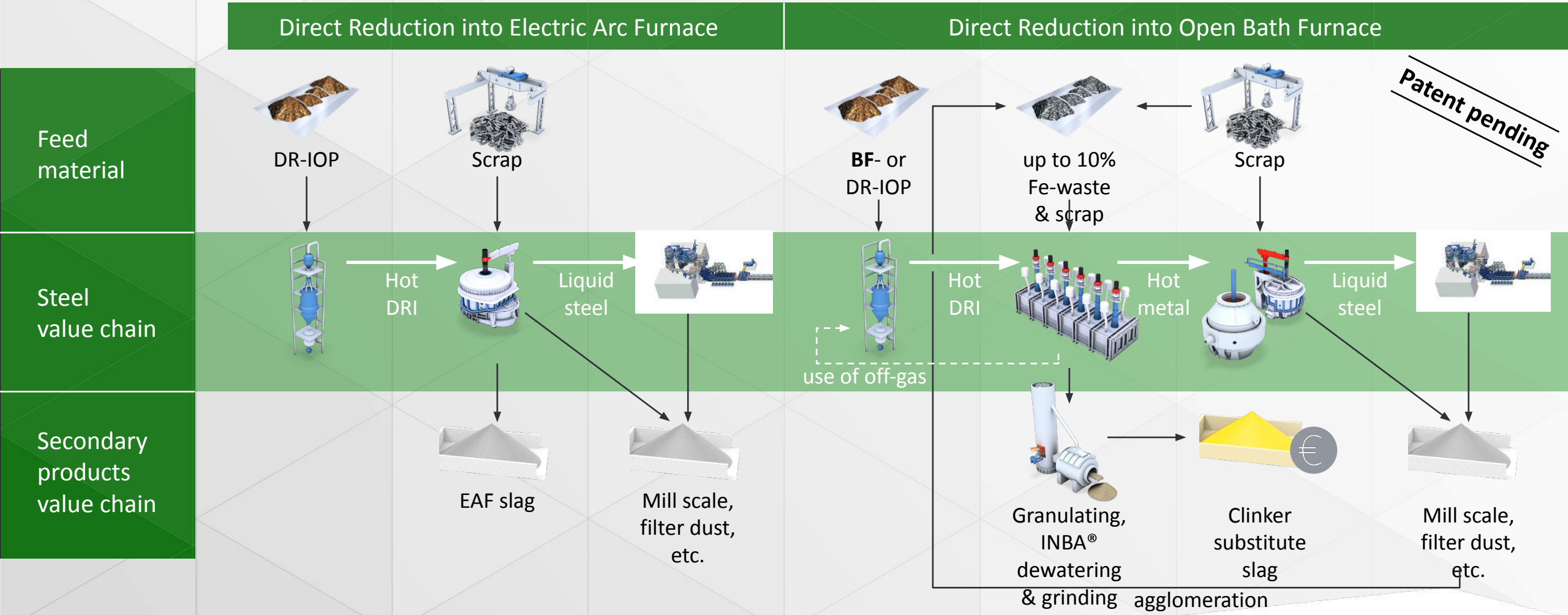
continuous production

reducing environment

tapping hot metal

- process sealed from surrounding atmosphere □ reducing environment
- large bath surface area □ lower power density
- long term vessel and lining philosophy
- distributed and continuous material feed
- suspended Söderberg electrode
- continuous “power on”

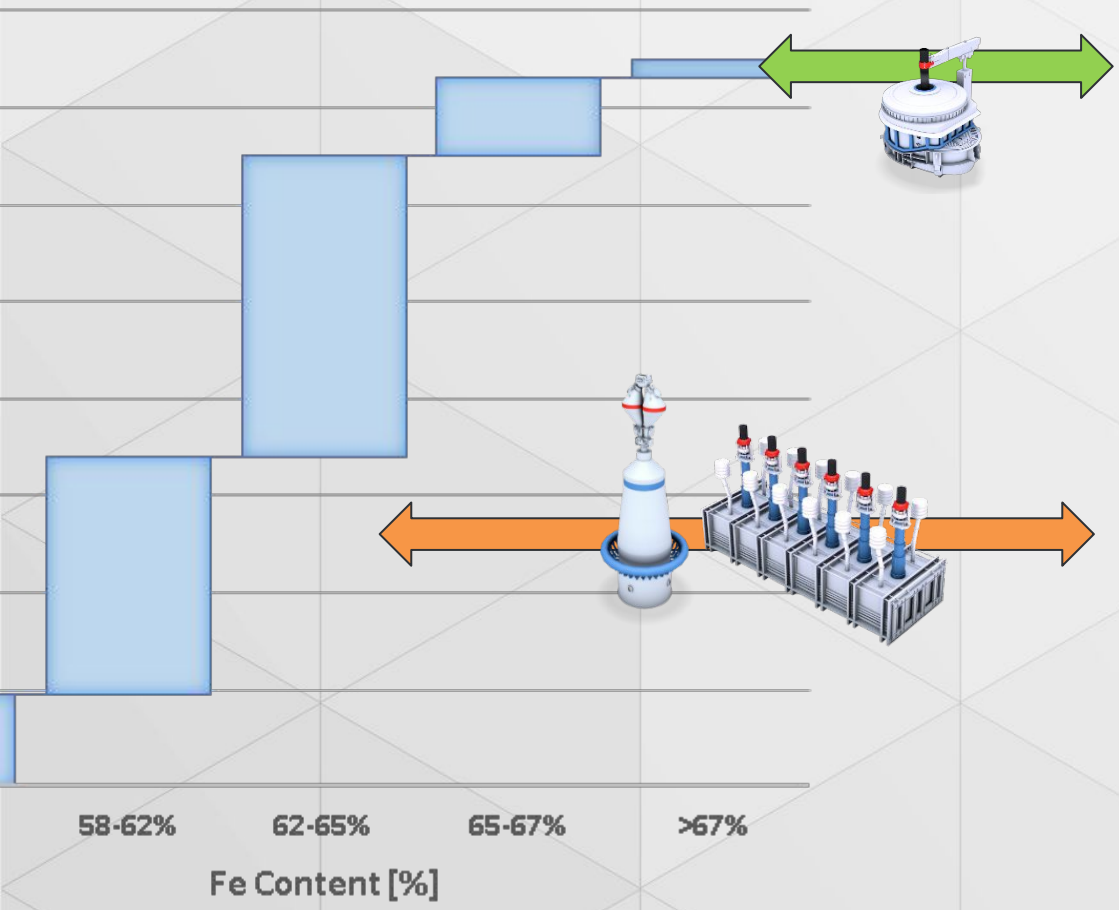
Direct reduction application to integrated quality steelmaking

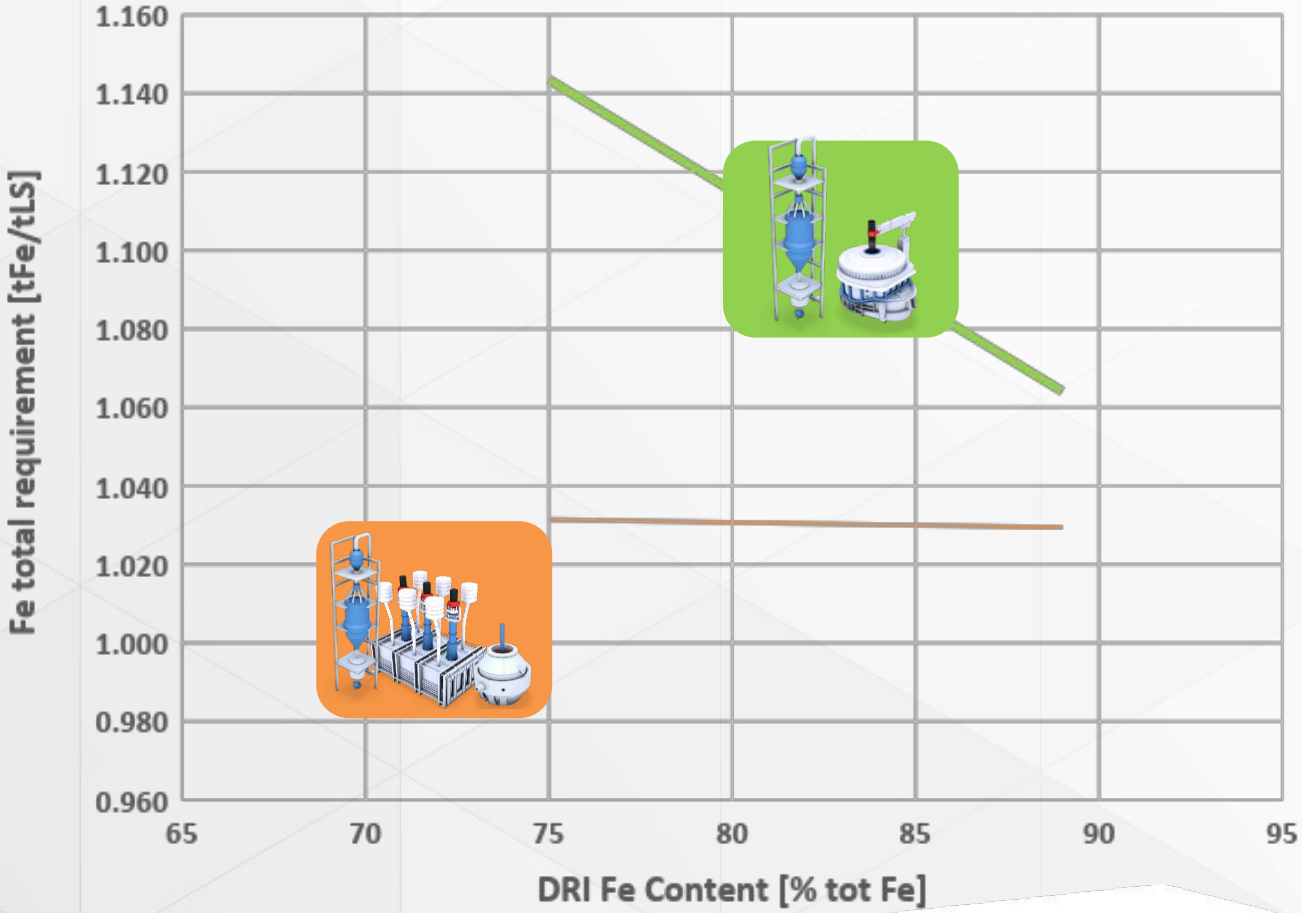


DR-IOP: Direct Reduction grade Iron Ore Pellets
BF-IOP: Blast Furnace grade Iron Ore Pellets

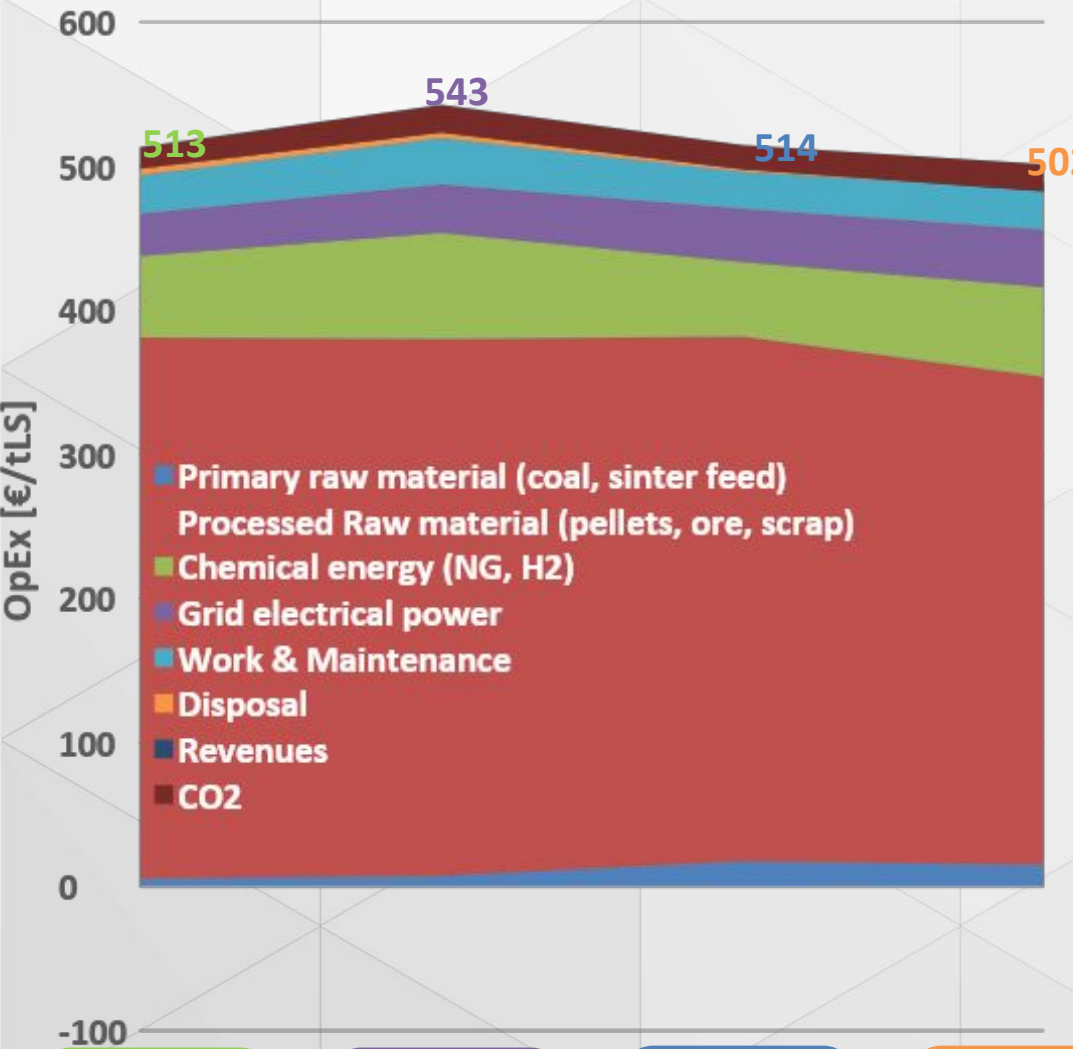
The impact of iron ore availability and DRI quality on EAF and OBF routes

Suitability for OBF and EAF operation

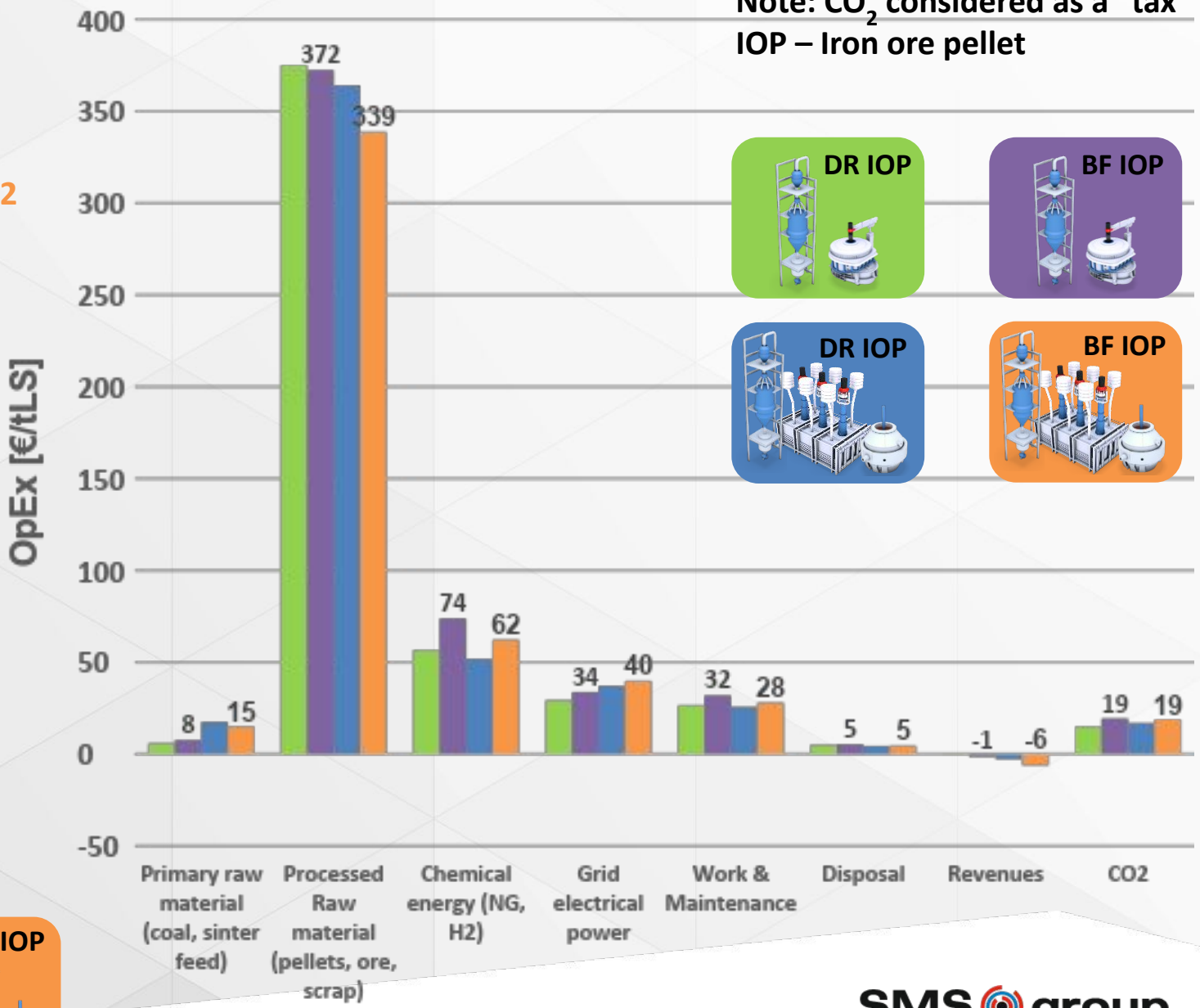




Opex comparison OBF vs. EAF

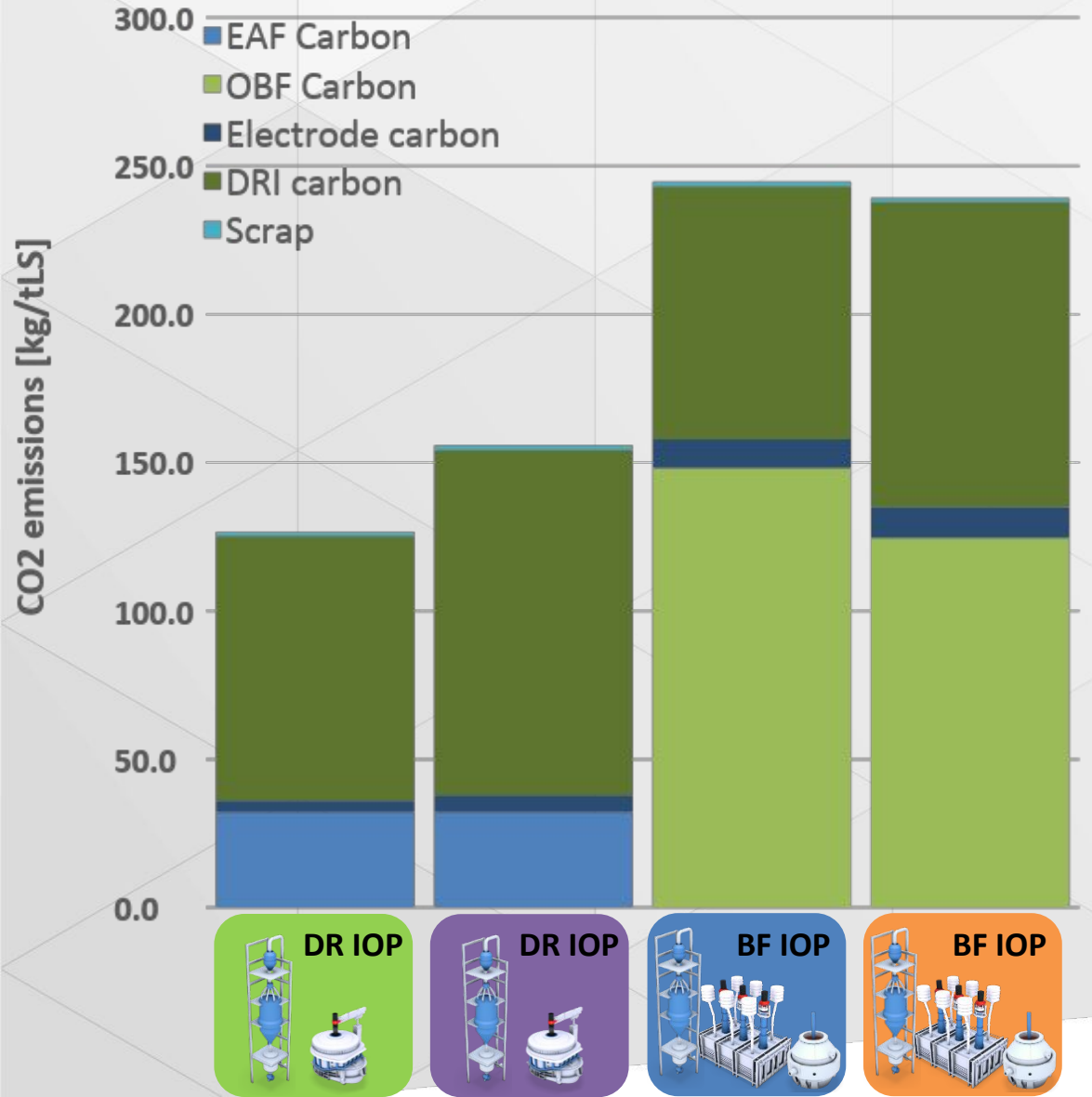


Note: CO_2 considered as a "tax"
IOP – Iron ore pellet



Specific usage & CO_2 footprint OBF vs. EAF

Scope 1



		DR IOP		BF IOP		DR IOP		BF IOP	
Specific usage	CO_2 Footprint	kg /tLS	kg CO_2 / tLS	kg /tLS	kg CO_2 / tLS	Kg /tLS	kg CO_2 / tLS	kg /tLS	kg CO_2 / tLS
DRI		973	89	1270	116	932	85	1123	103
EAF/OBF carbon		10	32	10	32	49,4	148	42	125
Scrap		210	1.5	210	1.5	210	1.5	210	1.5
Electrode		1	3.9	1,4	5.8	2,4	9.6	2,6	10
Scope 1			**126.4**		**155.3**		**244.1**		**239.5**
Elec power (kWh/tLS)		406	-	380	-	540	-	582	-


MOVING
METALLURGY
FORWARD
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