Practice of HBIS HYMEX demonstration project

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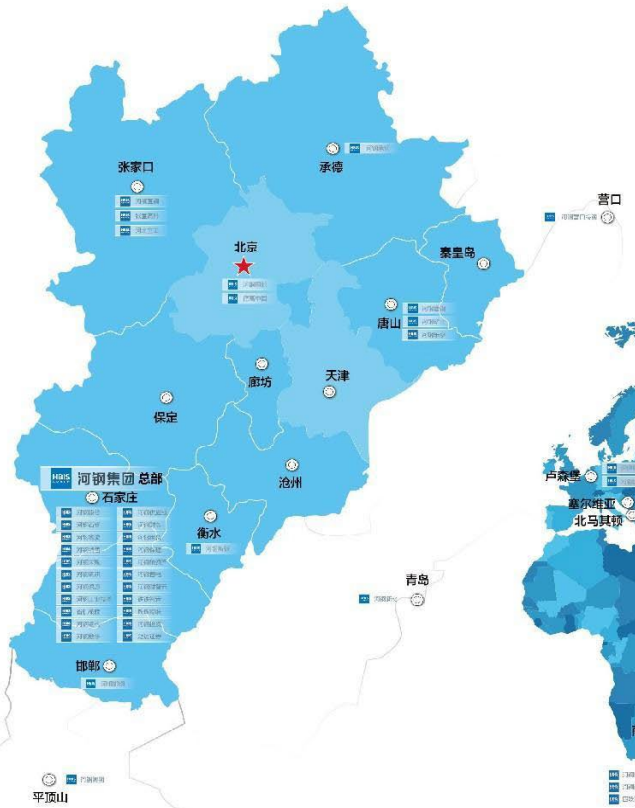
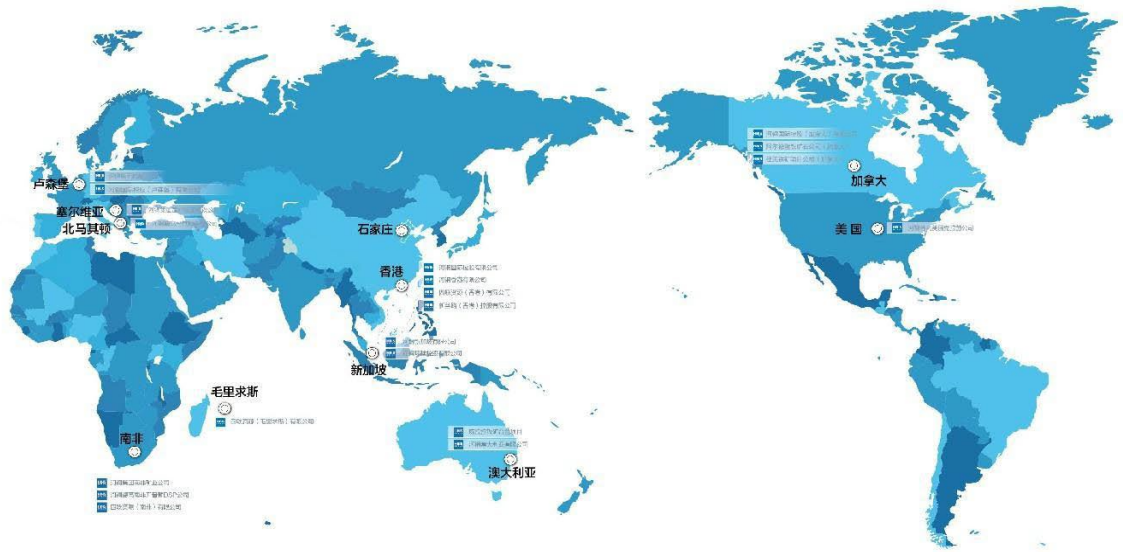
01 Low-carbon strategy of HBIS Group

HBIS Group: Being the most competitive steel enterprise

Crude steel	Total asset	Revenue	Social contribution	Employees	Brand value
41 Mt	539.6 bn¥	400.7 bn¥	49.5 bn¥	100000+	143.6 bn¥

- China's largest manufacturer of home appliances steel and second largest of automotive steel
- The world's second largest manufacturer of vanadium and titanium materials
- Leading enterprise in steel for ocean engineering and construction





FORTUNE 500 — Rank 229

WBL — Rank 2 among Chinese Steel Industry

Systematic green and low-carbon development strategy

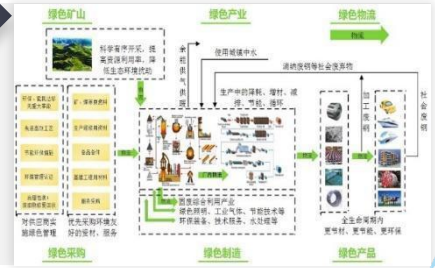
- From comprehensive environmental governance of factory areas and creation of the world's cleanest factory, to adjustment of plants location,
- from ultra-low emission transformation and the first release of low-carbon development action plans, to the formation of the "6+2" low-carbon development technology roadmap,
- from the completion of the HYMEX project to the release of the "6+6+5" low-carbon emission product development plan,
- a systematic green and low-carbon strategy of energy conservation, pollution abatement, carbon reduction, circulation, and coordination has been formed

Phase I： 2008 – 2015

The path of clean production

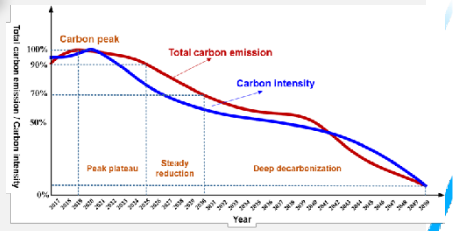
Phase II： 2016 – 2020

The path of green development



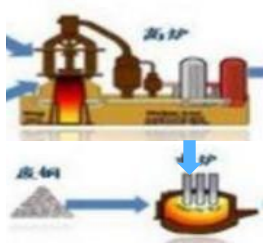
Phase III： 2021 - present

The path of low-carbon development



Focus on three major innovations, implement the "6+2" low-carbon roadmap

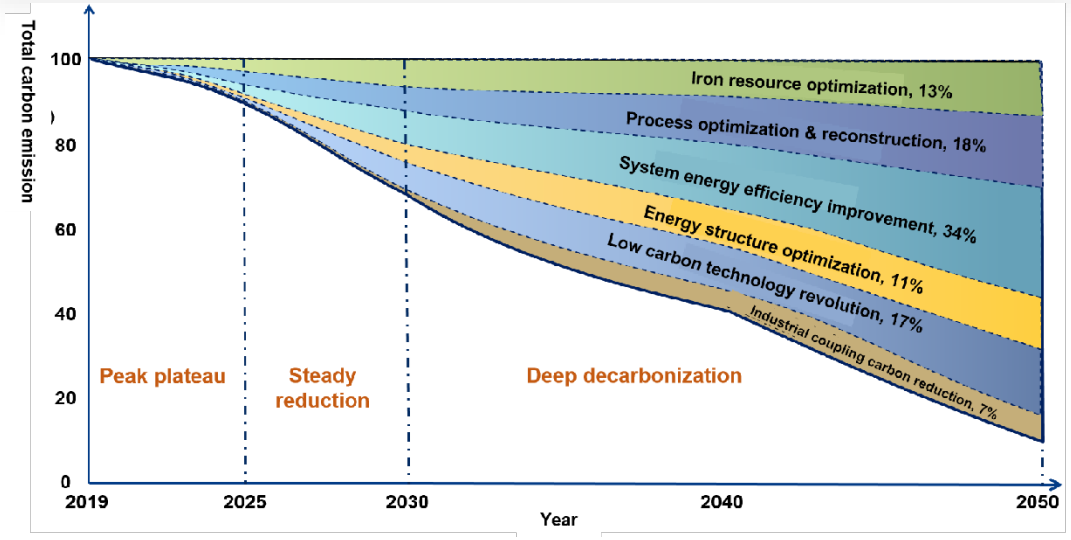
Process structure



Energy structure

Material technology

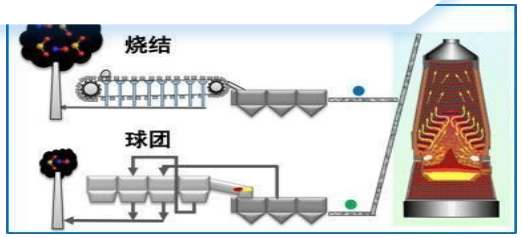
Three major innovations	Focus on process structure, energy structure and material technology.
Implementation approach	Implementing six technical paths and building two carbon platforms
Development goals	Achieve a 10% reduction in carbon emissions from peaking year in 2025, a 30% reduction in 2030, and strive to achieve carbon neutrality by 2050



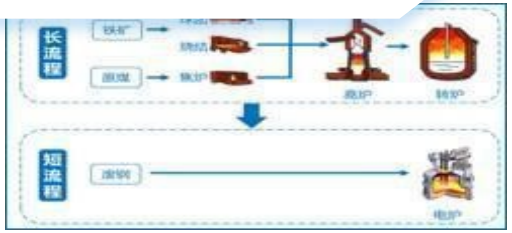
The "6+2" low-carbon technical roadmap

Six technical paths

Optimization of iron resources



Process optimization and reconstruction

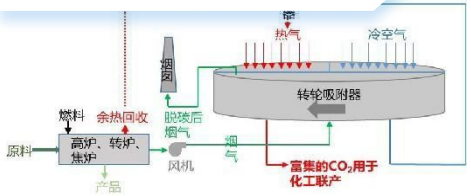


System energy efficiency improvement

Energy structure optimization

Low-carbon breakthrough technologies

Industrial collaborative carbon reduction



Two carbon platforms

Product LCA platform

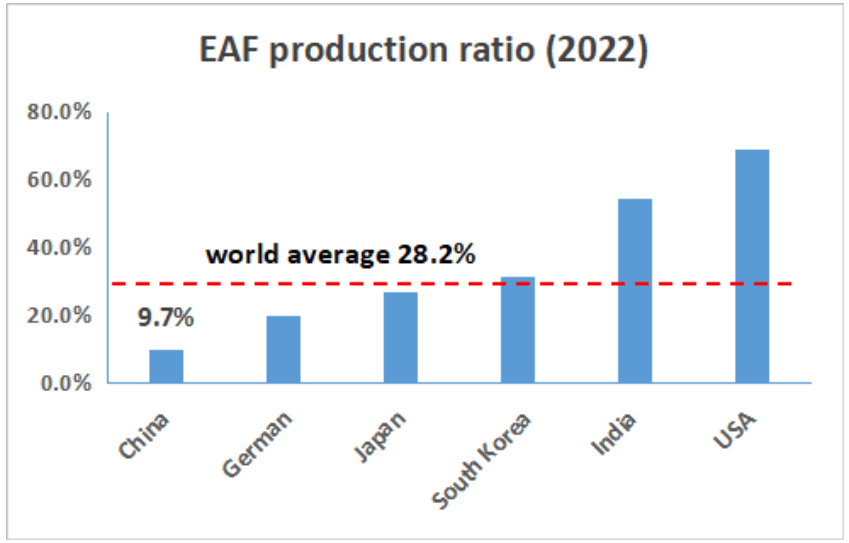
Carbon data management platform

02 The HYMEX project of HBIS

- COG zero-reforming based DRI-EAF

Challenges for China steel industry to develop DRI - EAF processes

- Currently, about 90% of the steel in China is produced by BF-BOF processes.
- Lack of scrap steel resources in China.
- The DRI - EAF process is an optional path, but the lack of gas resources (natural gas) and higher cost are limiting factors in China.
- However, nearly 190 billion cubic meters of coke oven gas (COG) are produced each year.
- COG contains over 60% H_2, which makes it a good choice for being used as reducing gas.

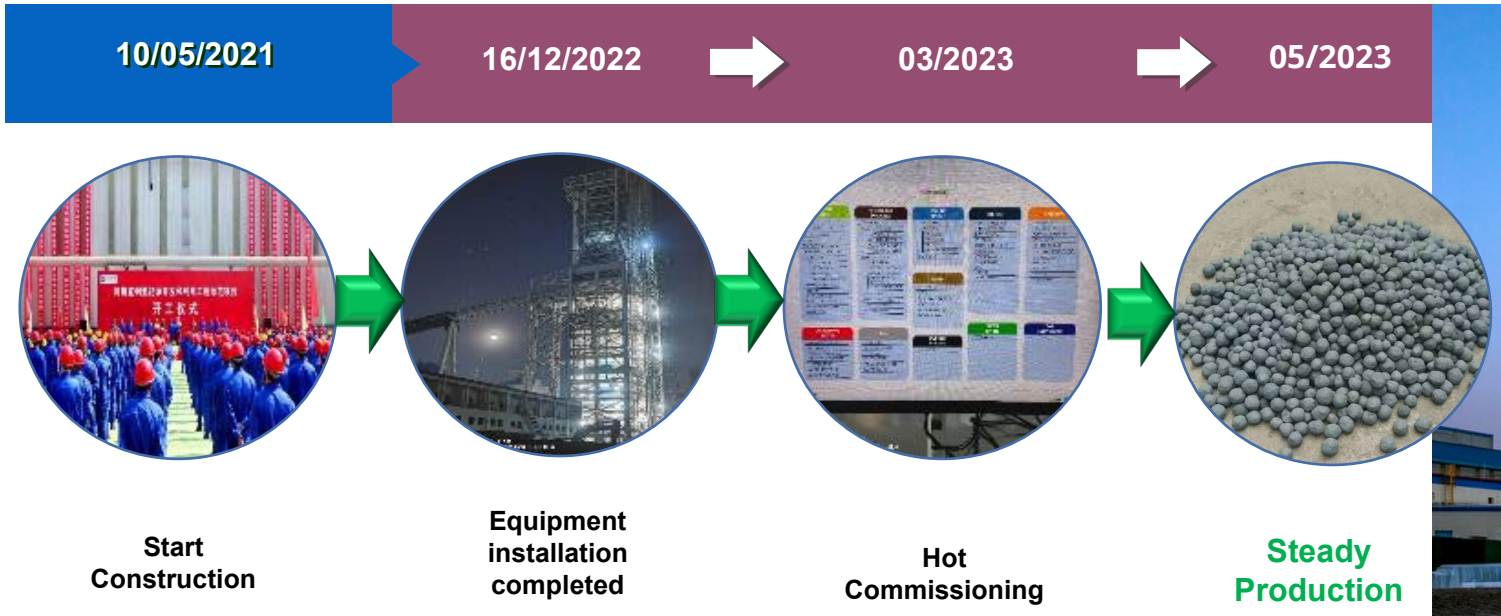


Typical composition of COG

H_2	CO	CO_2	CH_4	N_2	C_2H_4+C_2H_6	rest
~62%	~7%	~2%	~20%	~5%	~2.5%	trace

Construction of the HYMEX project

- Making full use of the rich COG resources of China steel industry, HBIS built the world's first COG zero-reforming technology based DRI project, located in Xuanhua, Hebei, China.
- A CONSTEEL EAF steelmaking line has been constructed simultaneously.



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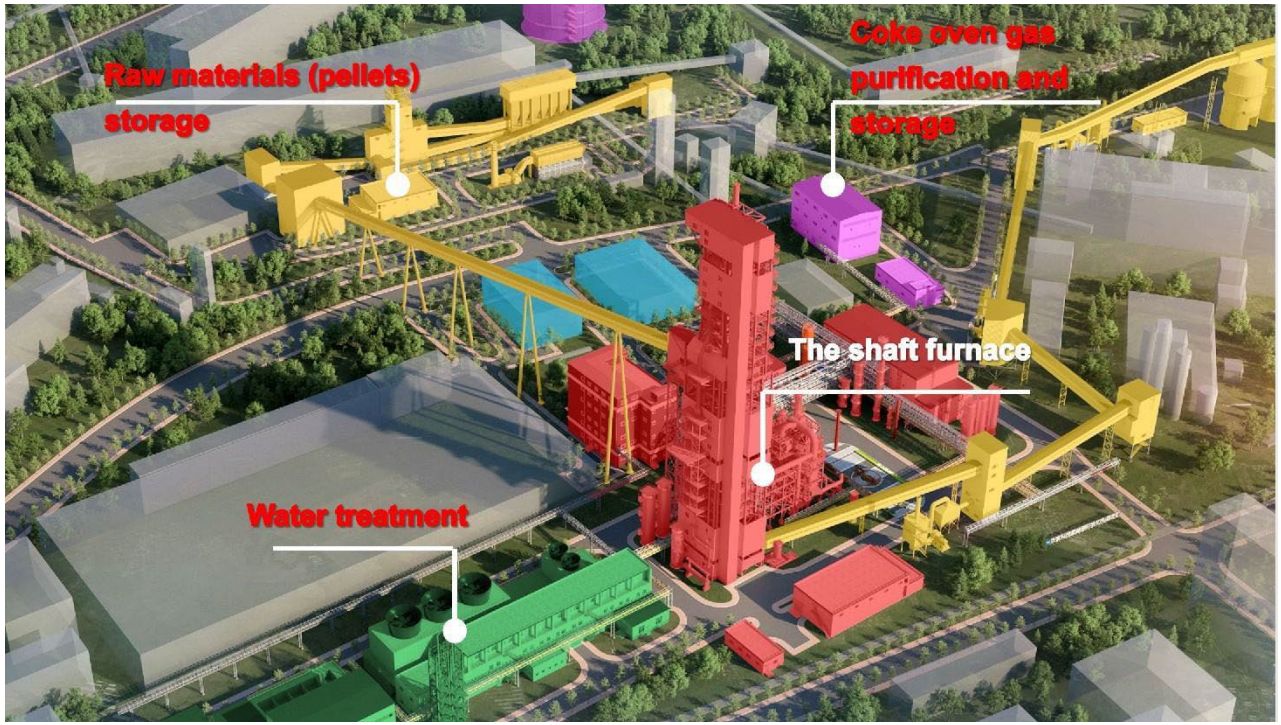
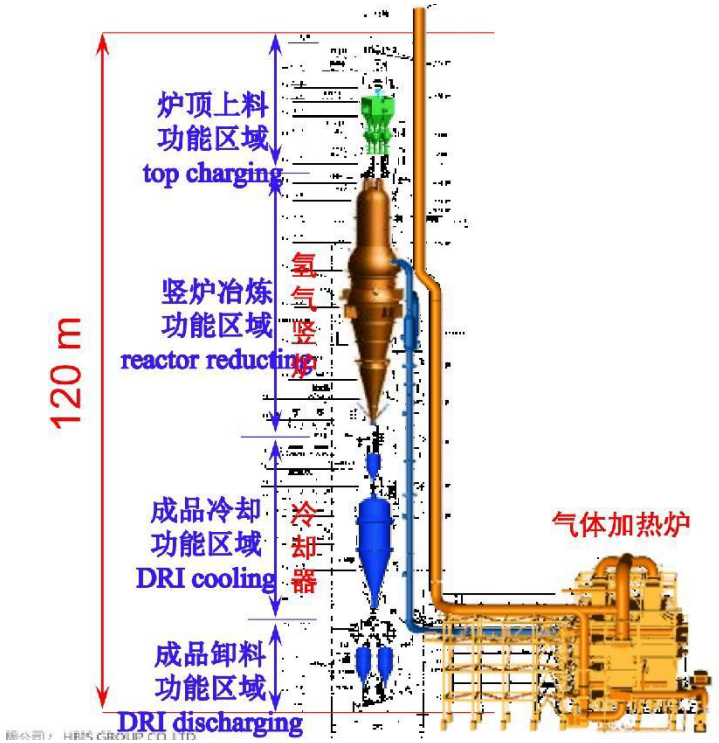
Hydrogen Metallurgy - EAF, Xuanhua

Main facilities

- DR shaft furnace ironmaking facilities
- Gas process facilities
- Auxiliary facilities

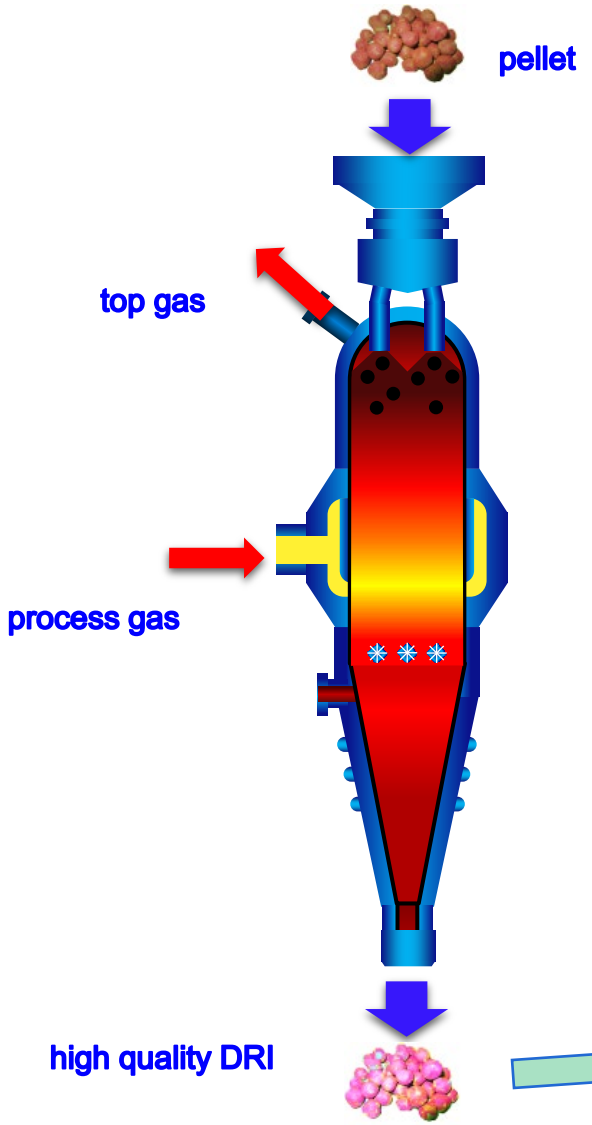


- Charging
- Reactor
- Cooling
- Discharging



Technical principles

- COG contains over 60% H_2, after self-reforming, the H_2: CO can reach 8:1.
- The DR process using COG as the gas source mainly includes two routes, i.e. solid flow and gas flow, namely the pellet-DRI transportation and processing system, and the COG supply-tail gas recovery processing system.



$CH_4(g)+H_2O(g)\rightarrow CO(g)+3H_2(g)$

$CH_4(g)+CO_2(g)\rightarrow 2CO(g)+2H_2(g)$

$Fe_2O_3(s)+3H_2(g)\rightarrow 2Fe(s)+3H_2O(g)$

$Fe_2O_3(s)+3CO(g)\rightarrow 2Fe(s)+3CO_2(g)$

$3Fe(s)+CH_4(g)\rightarrow Fe_3C(s)+2H_2(g)$

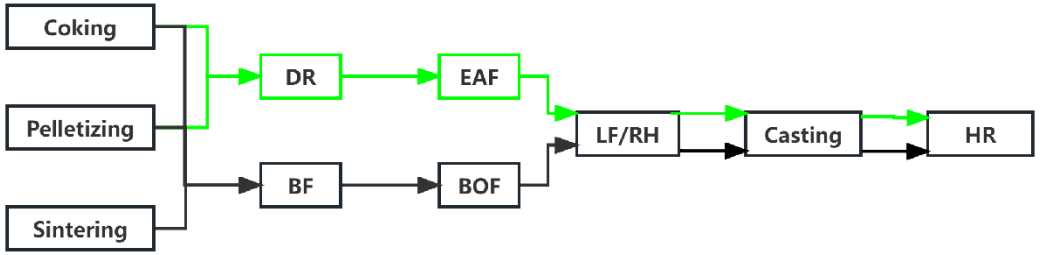
Indicator	Typical value
TFe	~90%
MFe	~85%
Metallization ratio	≥94%
C	2.5-4.5%
S	≤0.004%
Volume density	1600 ~ 1900kg/m^3
Apparent density	3.4 ~ 3.6g/cm^3

Use of DRI in the EAF

- CH_4 reacts with the reduced metal iron in the shaft furnace to form cementite, achieving carburization of DRI and generating H_2. Carbon-containing DRI is also beneficial for EAF smelting.
- Good for the slag forming in the early stage of EAF smelting, to promote De-P.
- DRI is pure, suitable for high quality steel production

Carbon emission reduction

- Organizational Level Carbon Emission Analysis
- worldsteel CO_2 Data Collection Methodology
- the carbon emission intensity per ton of crude steel was reduced by 65% to 70%.



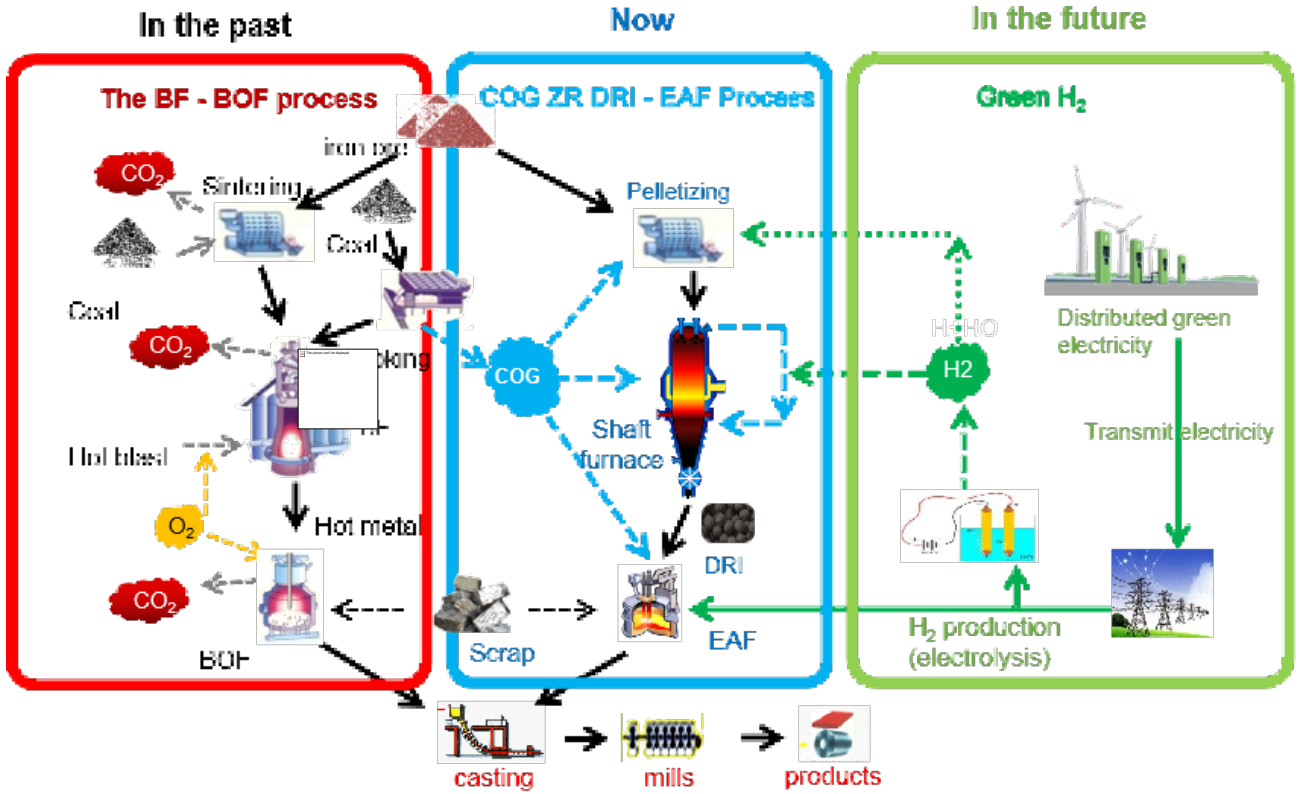
The processes before (in black) and after (in green) transition

- LCA Based Carbon Footprint Assessment
- worldsteel Life Cycle Inventory Methodology
- it was estimated that the carbon footprint of the slab using COG DRI could be between 0.50 tCO_2/t and 0.84 tCO_2/t. When green hydrogen is available, it could be reduced to as low as 0.10 tCO_2/t.

High purity DRI is a good raw material for the production of high-quality steel, e.g. automotive sheet.

Future of HYMEX

- H_2: Grey. Blue. Green.
- DRI-EAF based near zero carbon emission technology and products




2023
Excellence in
low-carbon
steel production

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Thanks!

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