

# Climate Friendly Materials Platform

## Hydrogene as alternative for steelmaking

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ArcelorMittal Eisenhüttenstadt GmbH

## Steel as green material....





### Applications of steel:

- *Automotive-* light constructions by ultra high strength steels
- *Railway:* Locomotives, wheels, wagons, rails...
- *Civil engineering:* Steel based constructions (Steligence®)
- *Solar:* Frames and supports
- *Wind energy:* Tower construction and generators
- *Longer life time* of buildings, vehicles and devices by innovative coatings
- Steel is endless recyclable without losing its properties and extremely flexible concerning new applications

Table 1

Material group	Recyclability*	Made from end-of-life material
 1 Plastics and synthetic fabrics		5-10%
 2 Cement <sup>3</sup>		0%
 3 Aluminium		21%
 4 Steel		22%
 5 Paper and cardboard		50-60%

\*Ability to make same material again at end of life

-  Fully recyclable, low risk of downcycling
-  Highly recyclable, risk of downcycling
-  Partially recyclable, risk of downcycling
-  Little or no recyclability

...but: 7% of CO<sub>2</sub>-emissions are generated by steel making

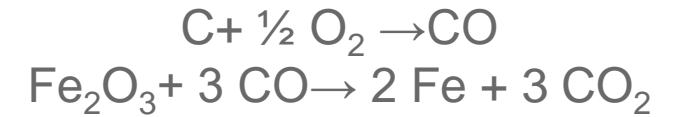
# From Ore to Steel: Blast Furnace- Converter (BOF) Route, Example ArcelorMittal Eisenhüttenstadt



BOF Plant: Adjusting Steel composition



Blast furnace: Reduction of Fe-Oxid by C



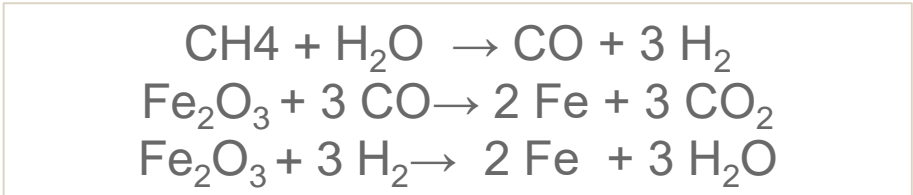
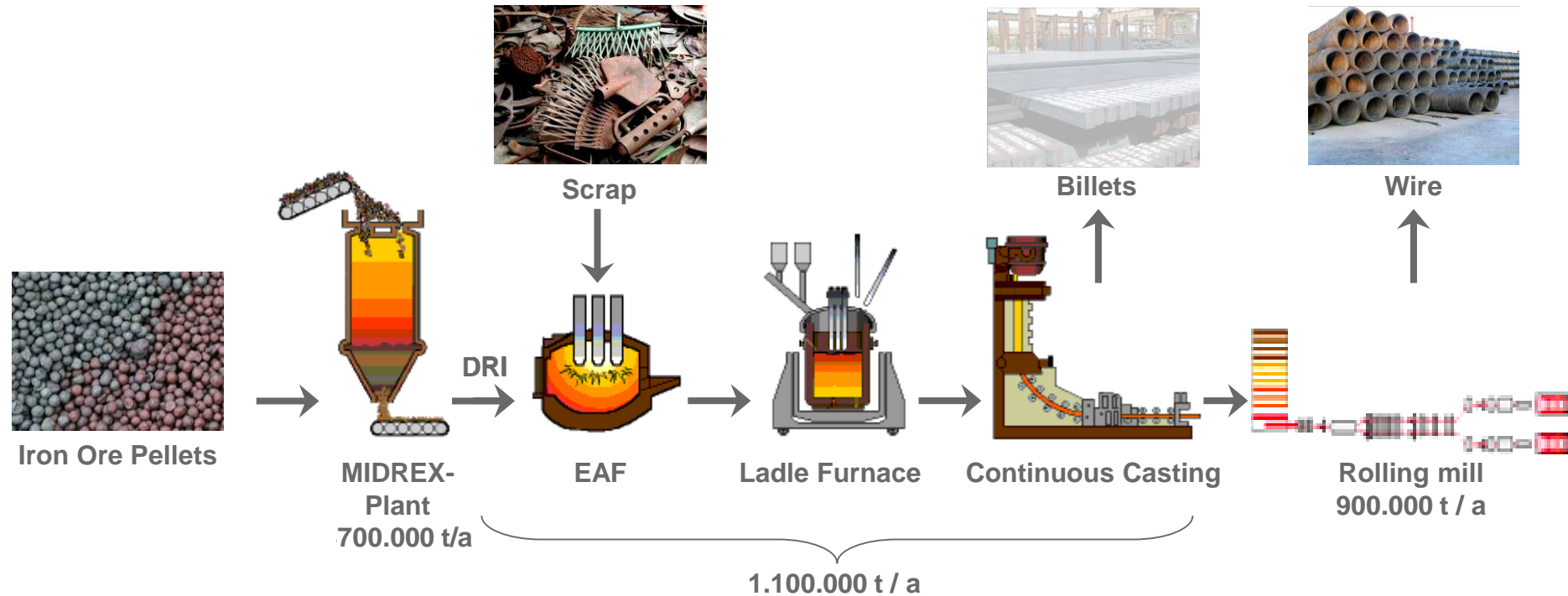
Hot Strip Mill



Cold Rollig Mill

Customer

# From Ore to Steel: DRI-Electric Arc Furnace (EAF) route, Example ArcelorMittal Hamburg

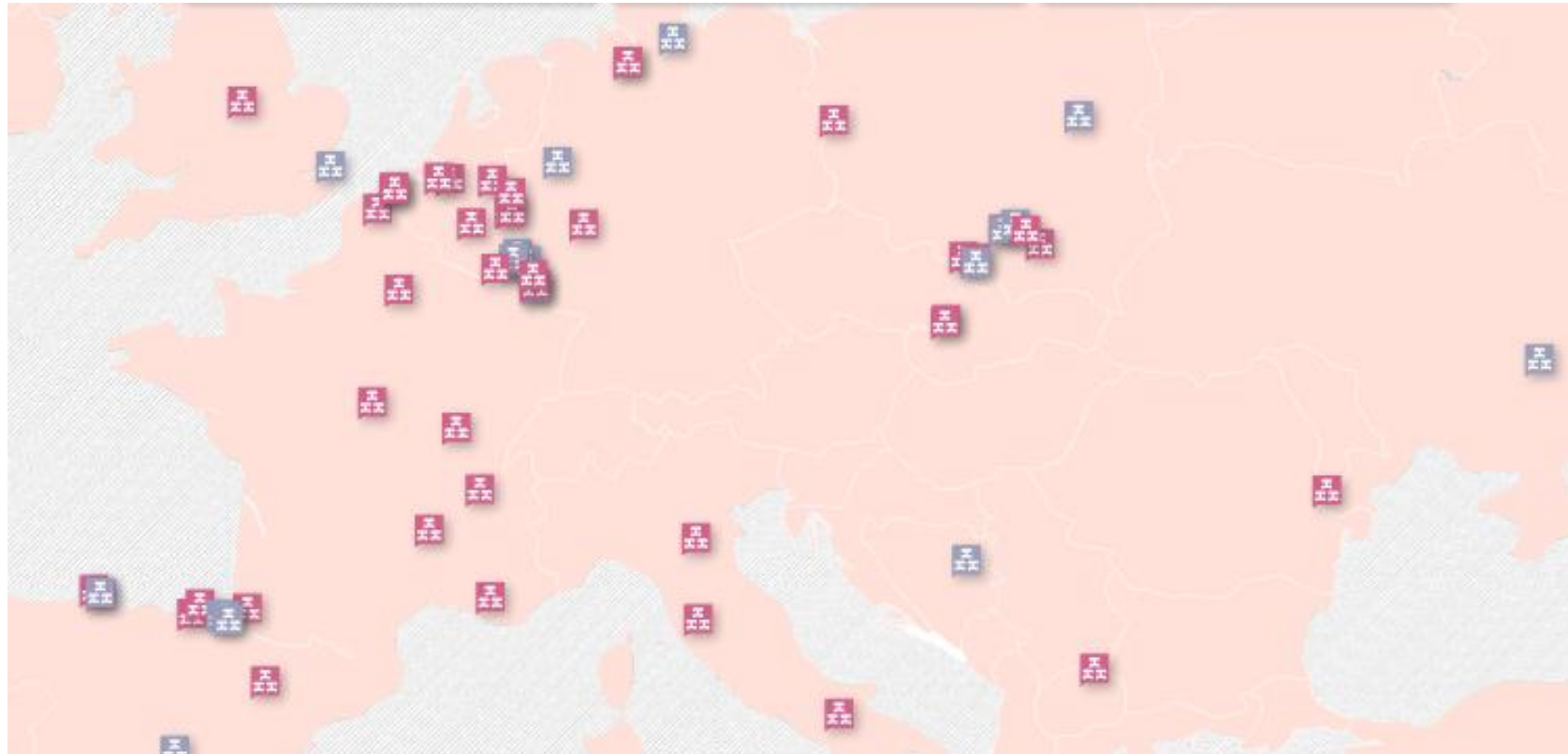


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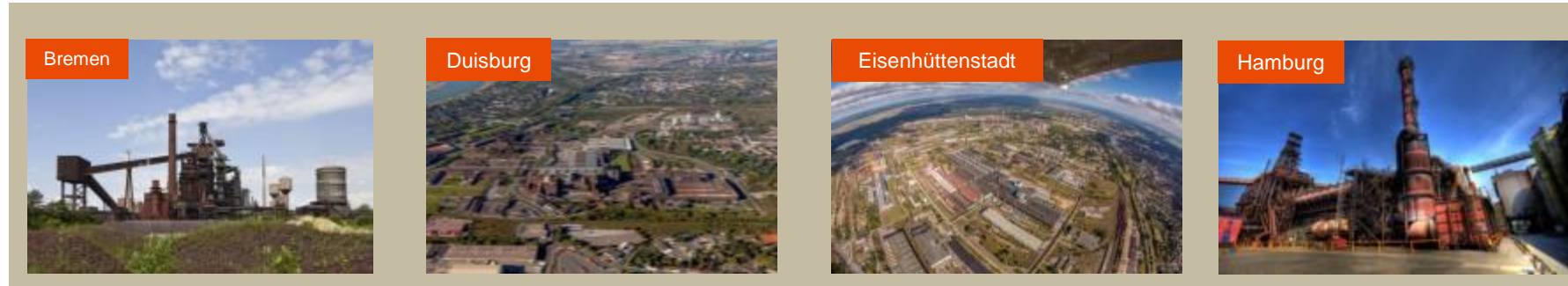


## ArcelorMittal- The world's biggest steel maker

With shipments of 84,5 Mio. tpa steel, more than 190,000 employees and manufacturing in 18 countries ArcelorMittal is the leading steel- and mining company.



# ArcelorMittal in Germany



- 4 Sites
- Flat steel: Bremen and Eisenhüttenstadt
- Long Products: Hamburg and Duisburg
- 20 Trading and Steel Service Centers

	2018
Safety (LTIFR*)	0,66
Crude Steel	7,6 Mio. Tons
Turn over	7,4 Mrd. Euro
Employess (Headcount)	9013
Apprentices	552

\* LTIFR = Lost Time Injury Frequency Rate

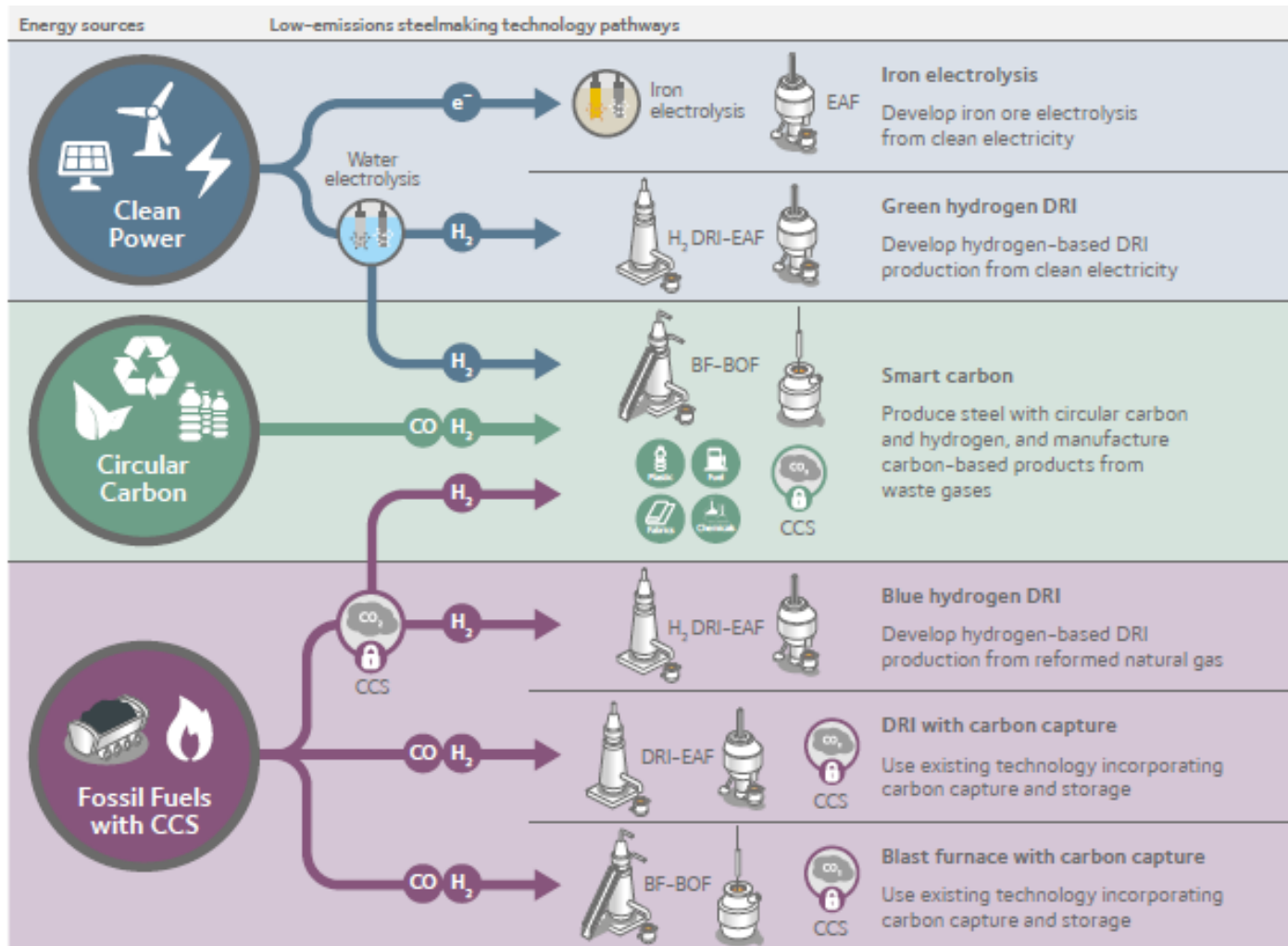


## ARCELORMITTAL: Target is CO<sub>2</sub>-neutrality in Europe by 2050

- ArcelorMittal will substantially reduce **CO<sub>2</sub>-Emissions by 2050** according Paris Climate Agreement
- In Europe ArcelorMittal will take the lead and will produce steel CO<sub>2</sub>-neutral by 2050
- Extensive research- and pilot programs to achieve CO<sub>2</sub>-reduction and compensation
- Reduction of CO<sub>2</sub> -emissions by 2030 by 30%



# ArcelorMittal: Ways towards CO<sub>2</sub>-Neutrality



Direct ore-electrolysis: In laboratory phase

Investment planned at ArcelorMittal Hamburg

Transformation of BF-BOF Route to CO<sub>2</sub>-Neutrality by:

- Use of natural gas and hydrogen in blast furnace
- Utilization of CO<sub>2</sub> (Bio-Ethanol)
- Use of bio masses

CCS-technology: projects in Belgium and France, but not allowed in Germany



# Ways to reduction of CO<sub>2</sub>-emissions at ArcelorMittal Eisenhüttenstadt

## A) Keeping Blast-Furnace- Converter-Route

- Increase of scrap share at steel production
  - Pre-heating and/or pre-melting of scrap
- Use of hydrogen or natural gas (CH<sub>4</sub>) as reduction agent:
  - Injection of hydrogen or natural gas/hydrogen mix in blast furnace
- Use of bio coal in blast furnace (under investigation, limited availability)

***Problem: CO<sub>2</sub>-Reduction targets difficult to achieve without application of CCS***

## B) Shift towards DRI-EAF route

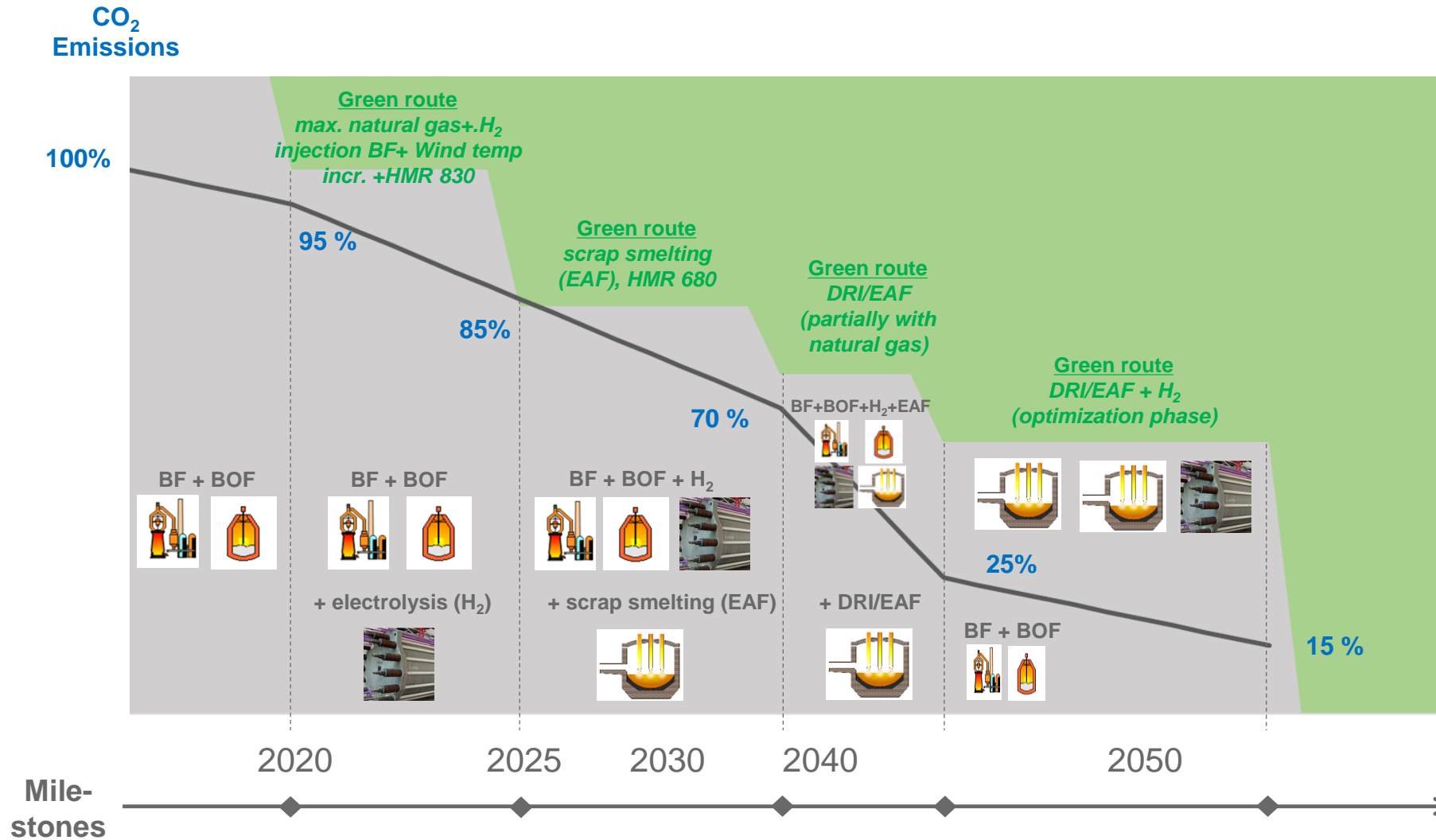
Step 1: Use of natural gas as reduction agent

Step 2: Use of green hydrogen as reduction agent

### ***Problems:***

- ***Investments costs***
- ***Availability of green hydrogen and green electricity***

# Plan of Arcelormittal Eisenhüttenstadt for stepwise reduction of CO<sub>2</sub> emissions



## Differences in conditions for CO<sub>2</sub>-reduction activities in steel industry within EU

- Different national funding programmes
- Different legal approaches (e.g. CCS is not allowed in Germany)

## Requests of steel industry on politics concerning restructuring towards CO<sub>2</sub>-neutrality

Creation of legal framework for:

- Fair trade conditions by CO<sub>2</sub>- price considerations for steel imports
- Support for cost intensive transition towards carbon neutrality by funding programs
- Creation of frame work for availability of green electricity and green hydrogen