Hy4Smelt – Demonstration Plant

06/05/2025

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aws austria wirtschaftsservice
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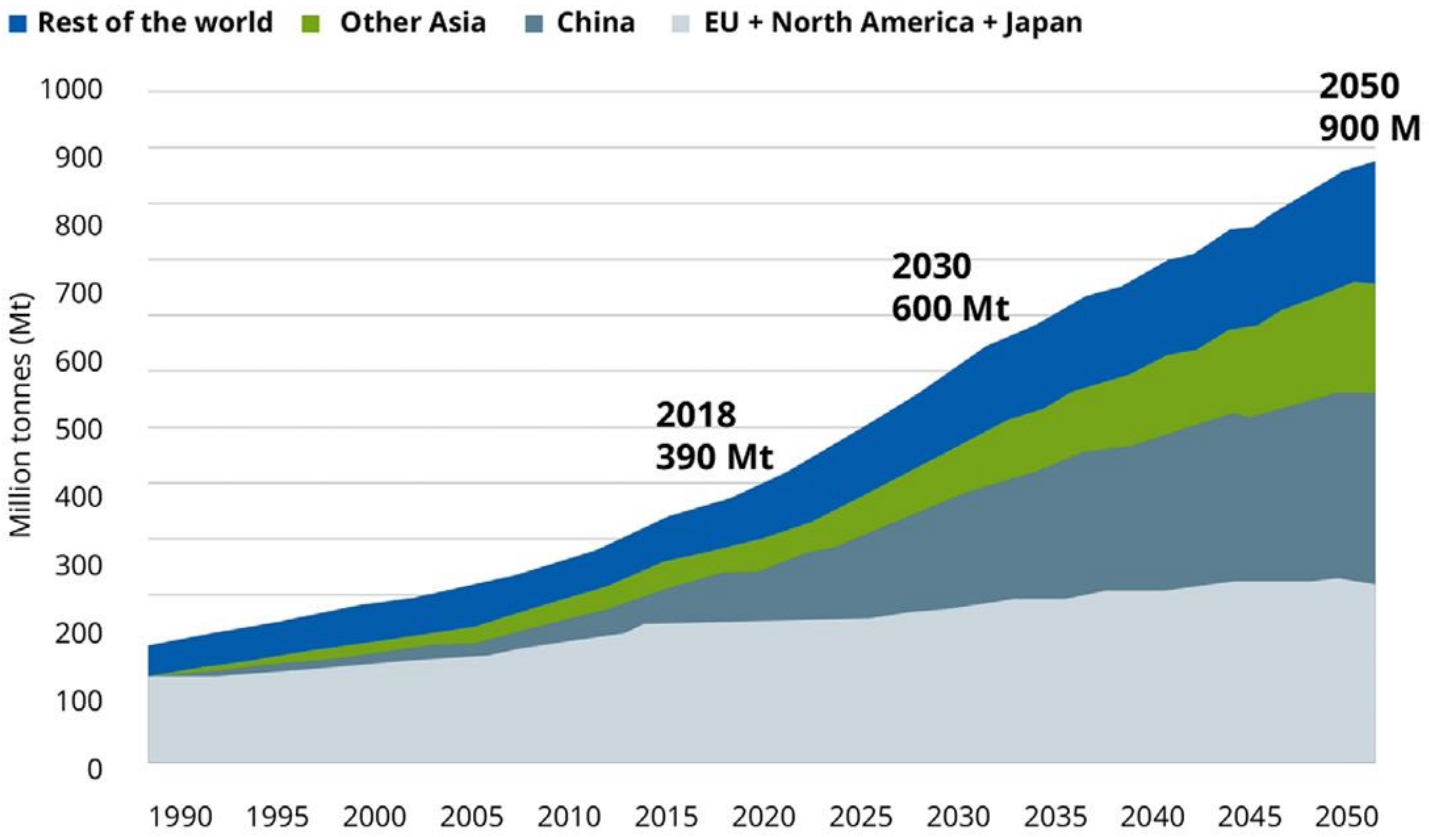
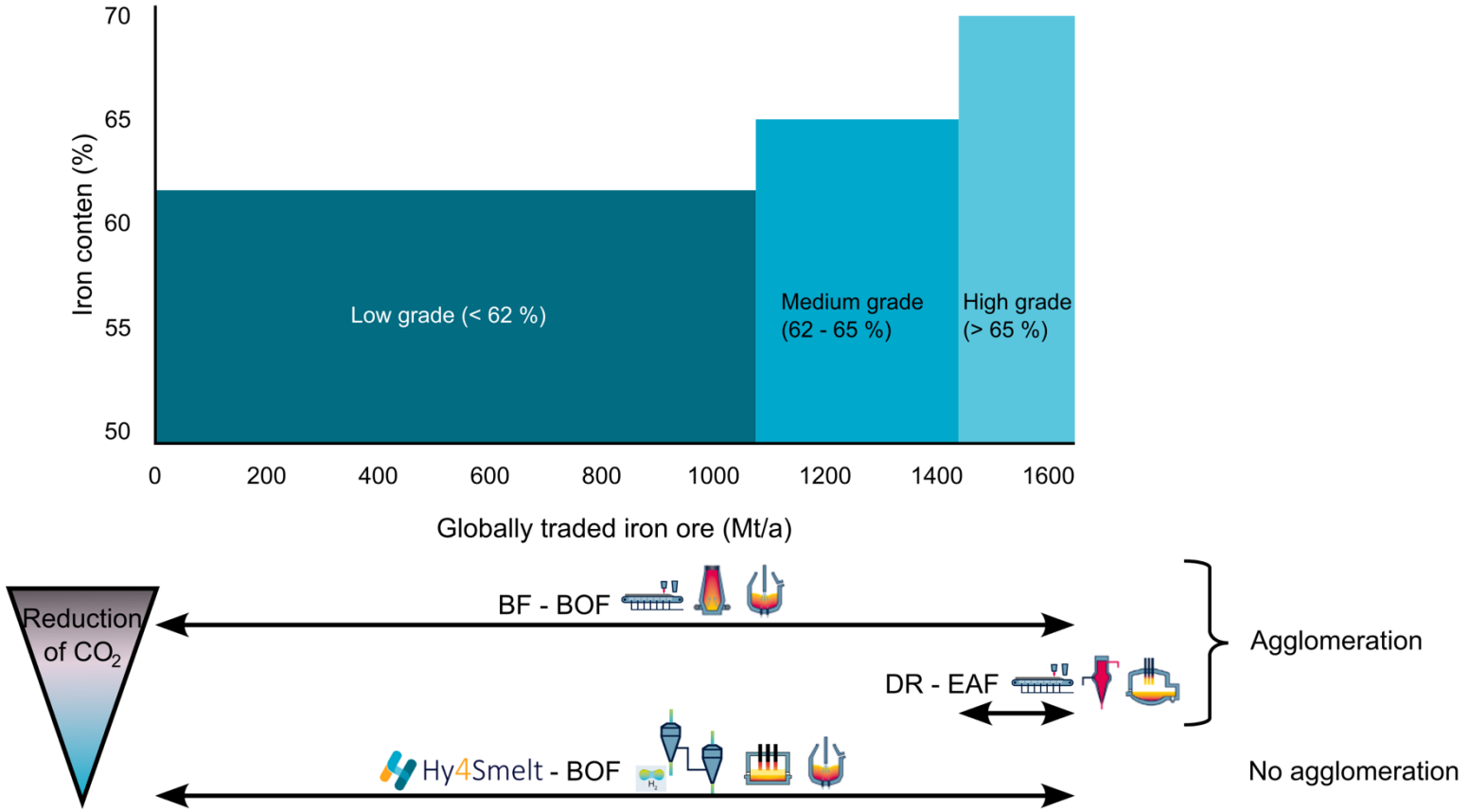
Global Trends for Scrap Availability



https://worldsteel.org/

- **Crude steel** demand will be **30 % higher in 2050** than it is today
- Much of this **growth** will be **in emerging economies** with declining demand in China, Europe, Japan, and South Korea
- **Contribution of scrap** in the total steel charge will likely grow to **40 % in 2050** from 30 % than today
- Process technologies for **OBM (ore based metallics)** will have an **important role** in future CO_2 neutral steelmaking

Iron Ore Grades and Process Routes



- **Majority of iron ores** for steel production are fine ores with **Fe < 65 %**
- **EAF** process is **not suitable for** melting DRI/HBI with **high slag quantities** of up to 300 kg/t
- **Iron ores with Fe > 65 %** will not be able to replace low/medium grade ores in the future
- **Smelter in combination with direct reduction** enables slag separation for **BOF and EAF** similar to BF process

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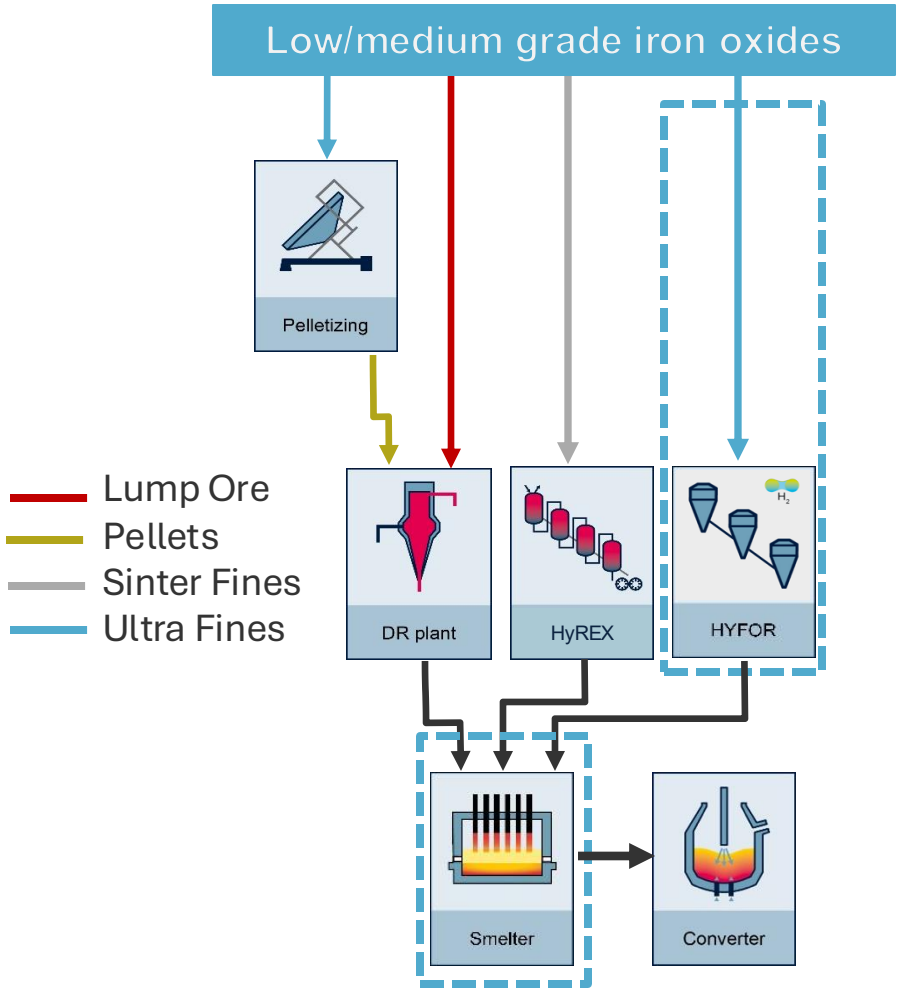
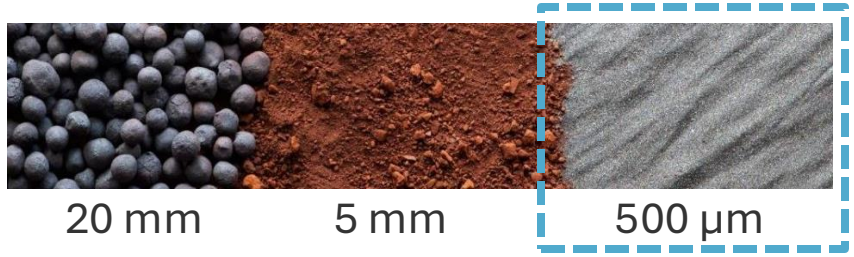
Process Routes for Green Hot Metal



- **HYFOR** is an alternative **direct reduction process** for **ultrafine iron ores** that will not require any agglomeration steps
- A combination with **Smelter technology** is used for melting and final reduction of direct reduced iron (DRI) based on low and medium grade iron ores with Fe < 65 %
- In that way **green hot metal** is produced with **hydrogen** for BOF or EAF steelmaking



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Pilot Plant HYFOR

- Test the performance of **HYFOR reactor** and **preheating/oxidation cyclone** under real operating conditions
- Direct reduction of **magnetite/hematite iron ore fines with H_2** in fluidized bed reactor at **700 °C** up to a **metallization degree of 97 %**
- Typical grain size: **100 % < 150 µm**
  Max. grain size: < 500 µm (up to 1 mm possible)
- **Batch operation** with 800 kg ultrafine iron ore is equal to **200 kg DRI per hour**
- **Pilot plant at voestalpine Donawitz site** as technical basis for next development phase

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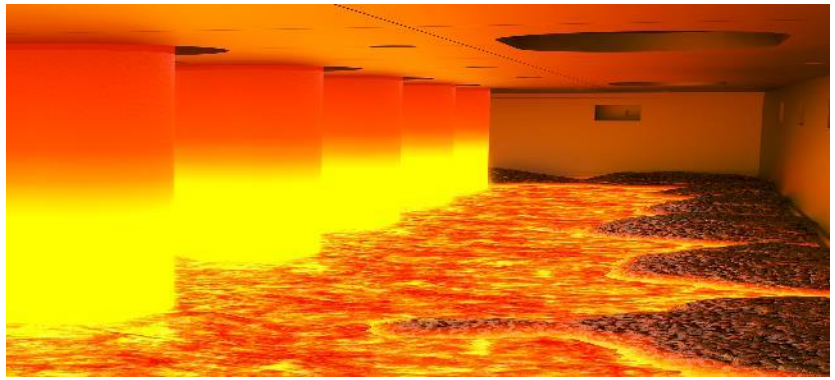
Smelter Process

- **DRI is molten, final reduction takes place** and an adjustment of the iron (carbon level) and slag (basicity, MgO-level)
  - Iron from the Smelter go the steel plant
  - Slag is granulated and used in cement industry
  - High calorific off-gas as substitute for natural gas
- Due to the **reducing atmosphere inside the Smelter**, the Smelter is well designed to **process other iron oxide containing materials from steel production** such as dusts, mill scale or slags to improve the **circularity of the production process**
- For the **Smelter** in large scale ironmaking **no reference plants exists yet**; however, principles were tested and verified by simulations, in the laboratory and on a modified furnace in the hundred kg scale

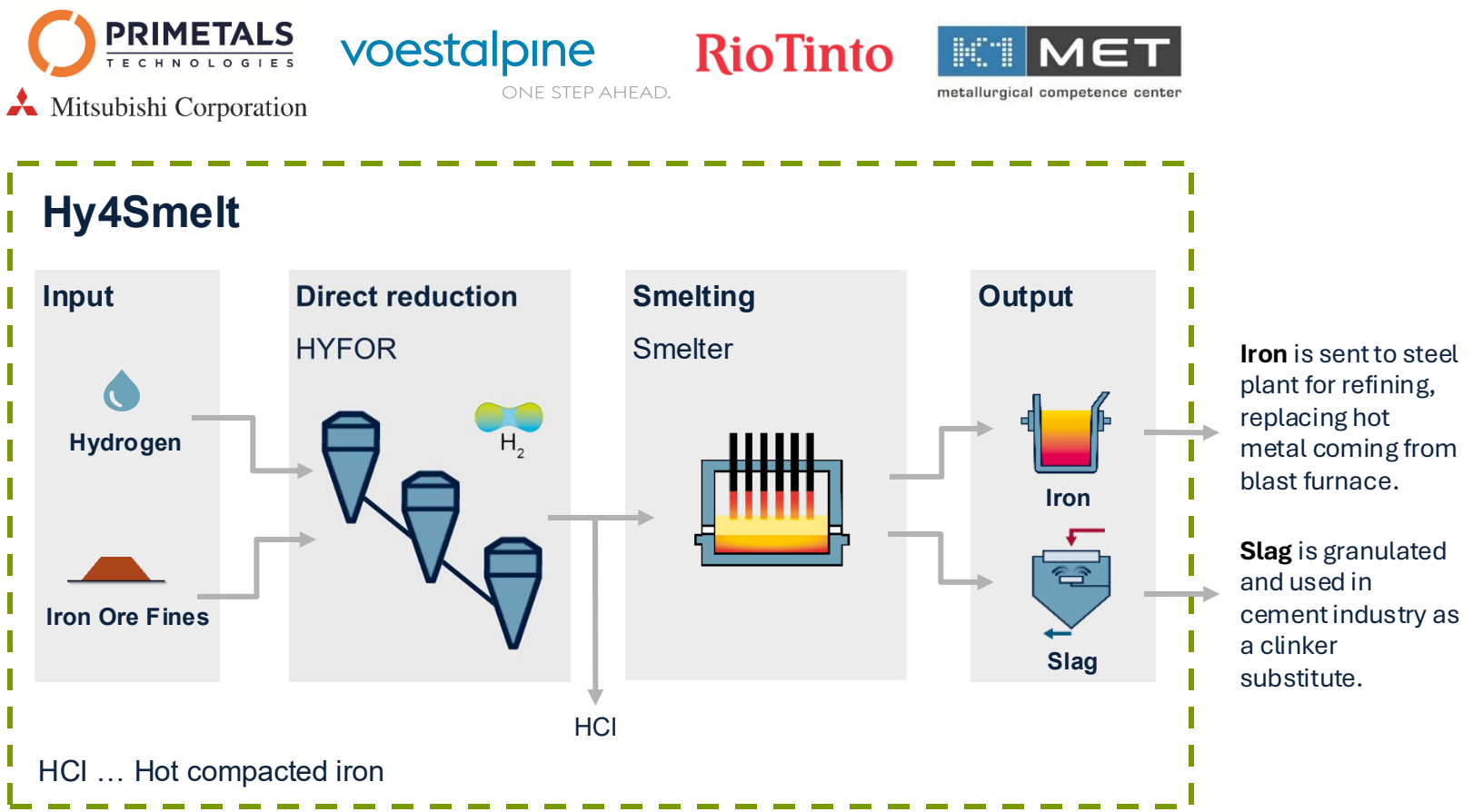
Cross section of a Smelter



Inside a Smelter

Smelter Process

- Hy4Smelt is a **groundbreaking new process** combining direct reduction (HYFOR) and electrified smelting under reducing conditions (Smelter)
  - In the **direct reduction step** the iron oxide in the fine iron ore is reduced to metallic iron using only green hydrogen
  - In the **smelting step** the direct reduced iron is smelted using green electricity, the melt is adjusted, hot metal (HM) and slag are tapped separately from the furnace
- The Hy4Smelt plant is capable to process a **wide range of iron ore fines** coming from different mines worldwide
- Green energy and bio-carbon in Hy4Smelt allows for **carbon neutral iron production**



Basic Design Demonstration Plant

Iron ore	2 – 3 t/h
Hydrogen	1.500 m^3/h
Hot metal	2 – 3 t/h
Slag	< 1 t/h
TRL	8
Location	voestalpine Linz site
CAPEX	MEUR 130
OPEX	MEUR 50
FID	04/2025
SOP	07/2027

Model of Hy4Smelt at voestalpine Linz site

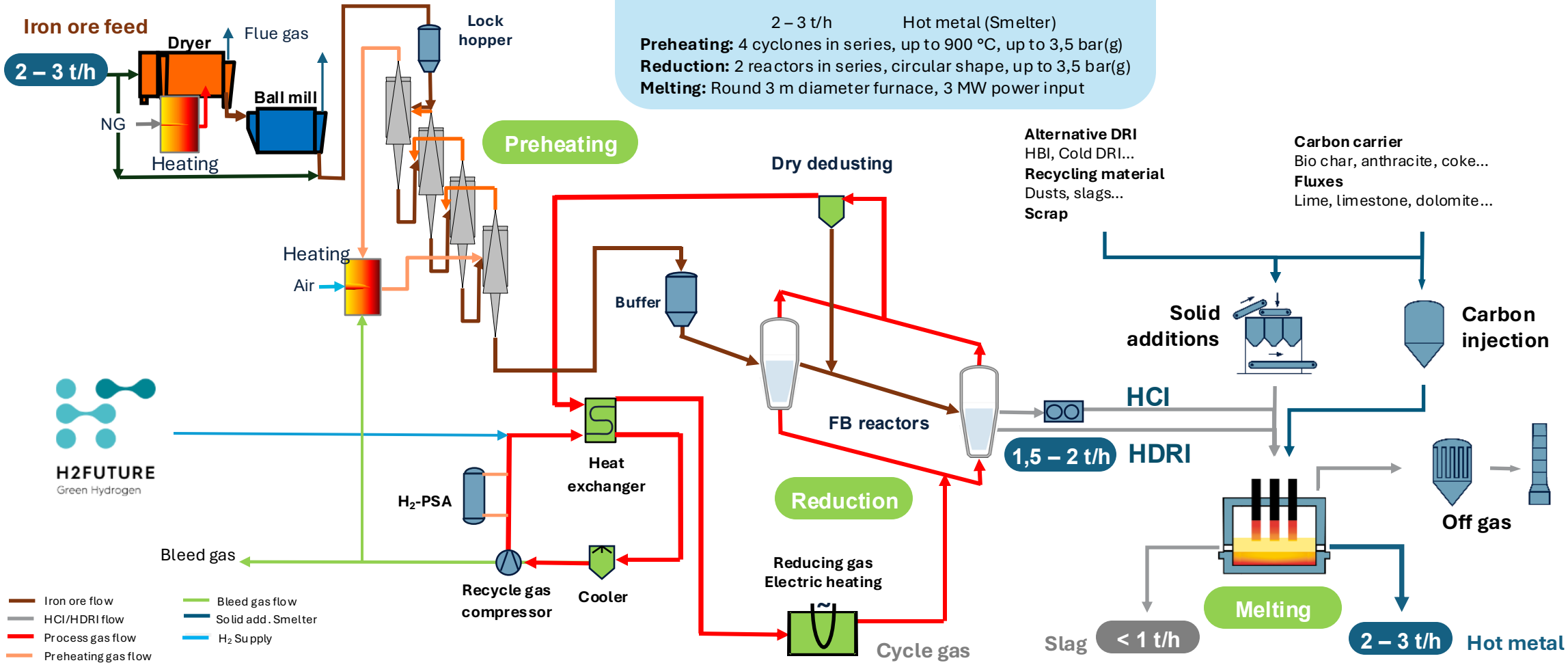
Flow Sheet Demonstration Plant

Hy4Smelt

Main Process data

Productivity:	2 – 3 t/h	Iron ore feed
	1,5 – 2 t/h	DRI (Hyfor)
	2 – 3 t/h	Hot metal (Smelter)

Preheating: 4 cyclones in series, up to 900 °C, up to 3,5 bar(g)
Reduction: 2 reactors in series, circular shape, up to 3,5 bar(g)
Melting: Round 3 m diameter furnace, 3 MW power input



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Funding Strategy

Hy4Smelt

CAPEX HYFOR-Part funded by aws „Twin Transition“

PRIMETALS TECHNOLOGIES
Mitsubishi Corporation

22

austria wirtschafts service aws

Funding in EUR million

CAPEX Smelter-Part funded by KPC „Transformation of Industry“

voestalpine ONE STEP AHEAD.

30

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R&D OPEX funded by RFCS/CSP „Big Tickets for Steel“

PRIMETALS TECHNOLOGIES Mitsubishi Corporation
voestalpine ONE STEP AHEAD.
K1 MET metallurgical competence center

18

Research Fund for Coal & Steel

R&D Deployment funded by EU Clean Hydrogen Partnership „HI2“

K1 MET metallurgical competence center

1,4

HI2 Hydrogen Industrial Inland Valley
Clean Hydrogen Partnership
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R&D OPEX funded by Net Zero Industries „AT/AUS call“ (tbc)

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K1 MET metallurgical competence center
RioTinto

min. 1,5

0,6

klima+ energie fonds

Australian Government
Department of Industry, Science and Resources
Department of Climate Change, Energy, the Environment and Water

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Thank you for your attention ☺