

# DEMONSTRATION PLANT HY4SMELT

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Vienna, 01/17/2024

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# CLIMATE NEUTRAL STEELMAKING

## FROM CARBON TO HYDROGEN

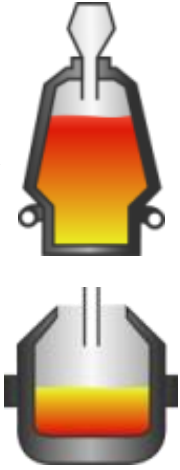
2020



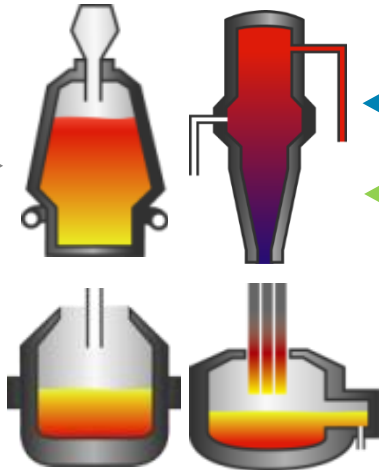
2035

2050

C →



C →



CH<sub>4</sub>  
H<sub>2</sub>

H<sub>2</sub>

CO<sub>2</sub> 100 %

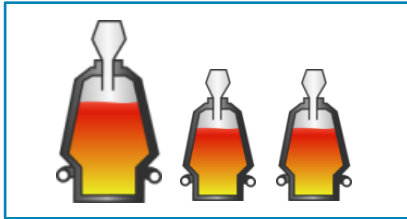
< 70 % + CCU/S

neutral + CCU/S  
voestalpine

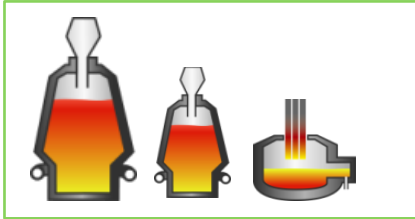
FIRST STEP HYBRID PROCESS CONCEPT

voestalpine Linz site

Status Quo

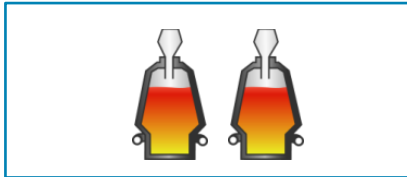


2027

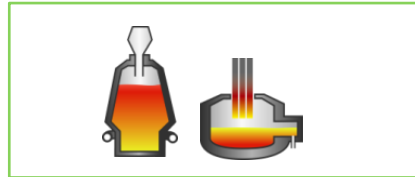


voestalpine Donawitz site

Status Quo

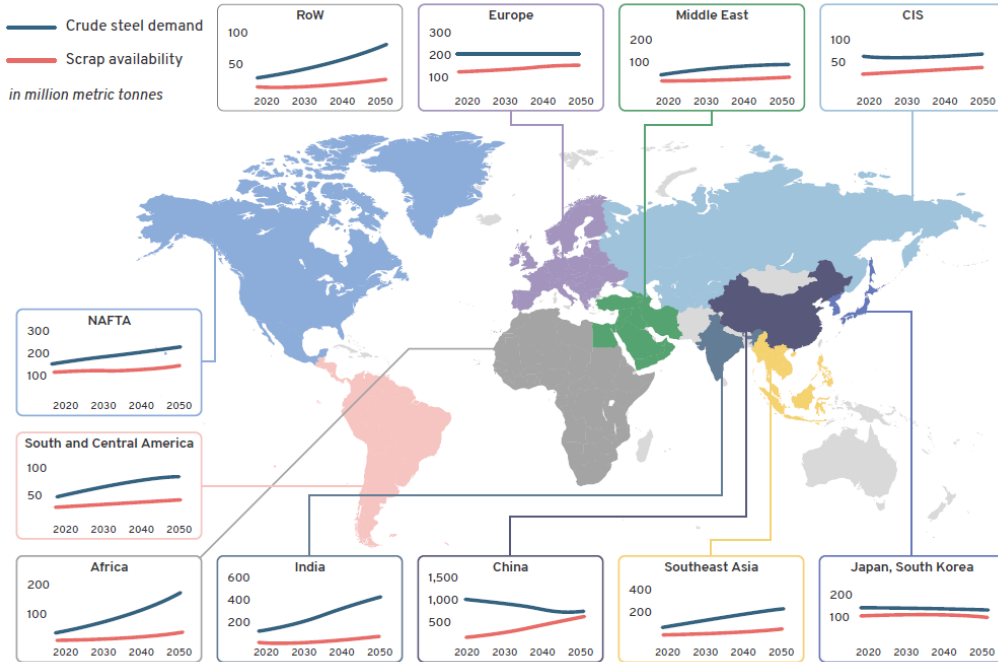


2027



- Hybrid technology with EAF process additional to BF/DR/BOF until 2030
- Stepwise decrease of BF/BOF capacity at integrated sites
- Up to 30 % CO<sub>2</sub> reduction independent from green hydrogen
- High potential for further CO<sub>2</sub> decrease as soon as green hydrogen is economical available
- Concept ready for integration of breakthrough technologies 2035+

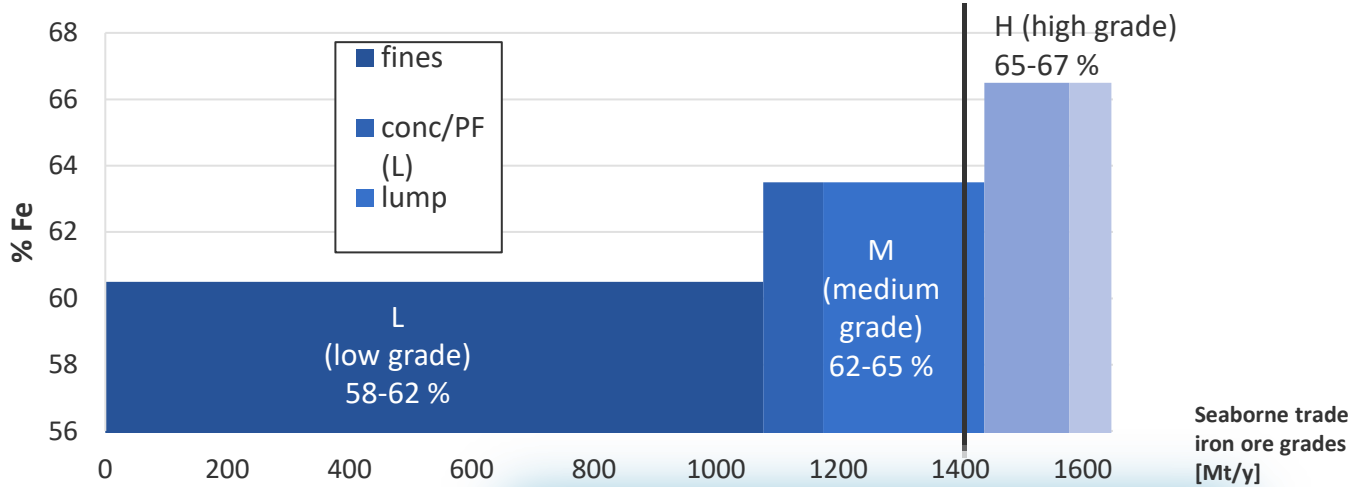
GLOBAL TRENDS FOR SCRAP AVAILABILITY



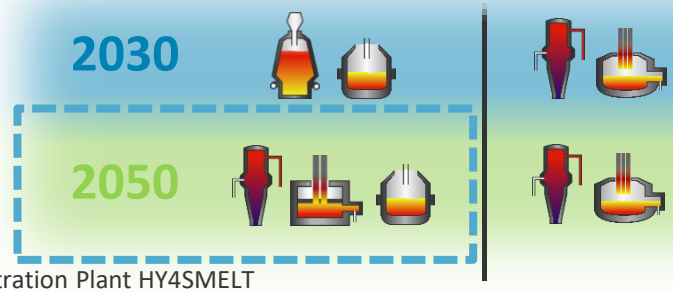
- Crude steel demand will be 30 % higher in 2050 than today
- Much of this growth will be in emerging economies with declining demand in China, Europe, Japan, and South Korea
- Contribution of scrap in the total steel charge will likely grow up to 50 % in 2050 from 30 % than today
- Process technologies for OBM will have an important role in future CO<sub>2</sub> neutral steelmaking

<https://missionpossiblepartnership.org/>

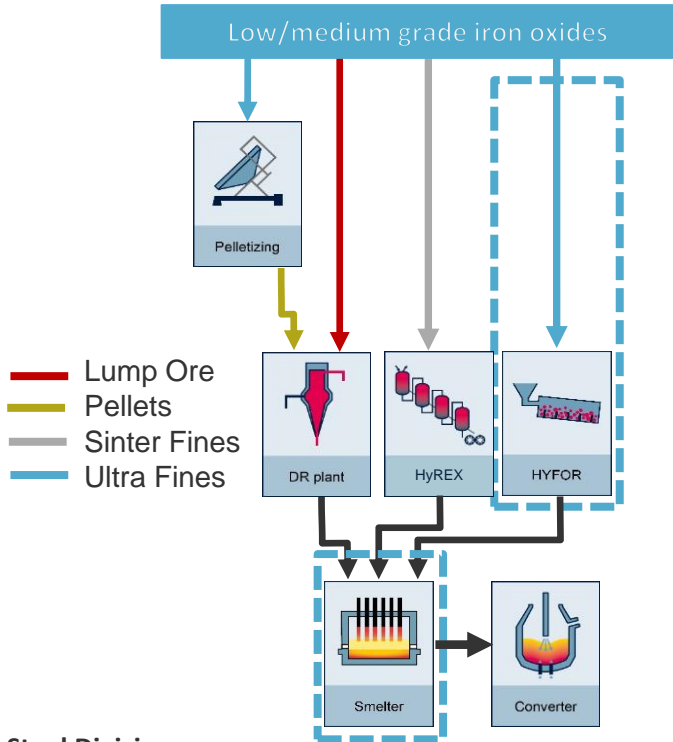
IRON ORE GRADES AND PROCESS ROUTES



- World iron ore market is dominated by low and medium grade iron ores
- Replacement BF/BOF by DR/EAF process route requires an adapted concept for steelmaking from low and medium grades iron ores



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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ONE STEP AHEAD.

# DIRECT REDUCTION TECHNOLOGY

## PROCESS DEVELOPMENT HYFOR

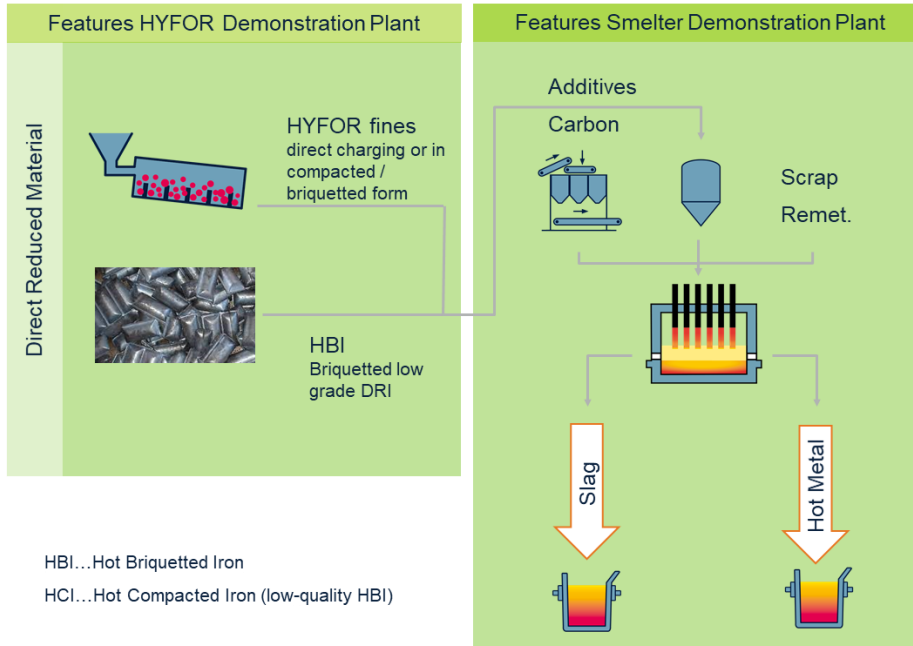


- Test the performance of **HYFOR reactor** and **preheating/oxidation cyclone** under real operating conditions
- Direct reduction of **magnetite/hematite iron ore fines with H<sub>2</sub>** in fluidized bed reactor at **700 °C** up to a **metallization degree of 97 %**
- Typical grain size: **100 % < 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



# DEMONSTRATION PLANT

## BUILDING BLOCKS FOR GREEN HOT METAL

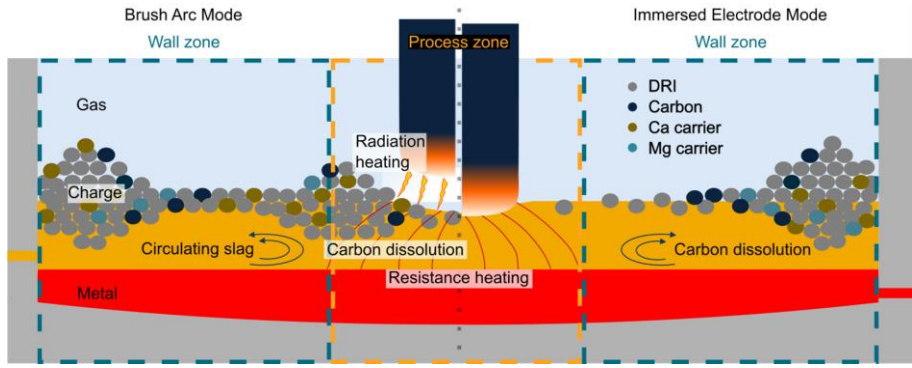
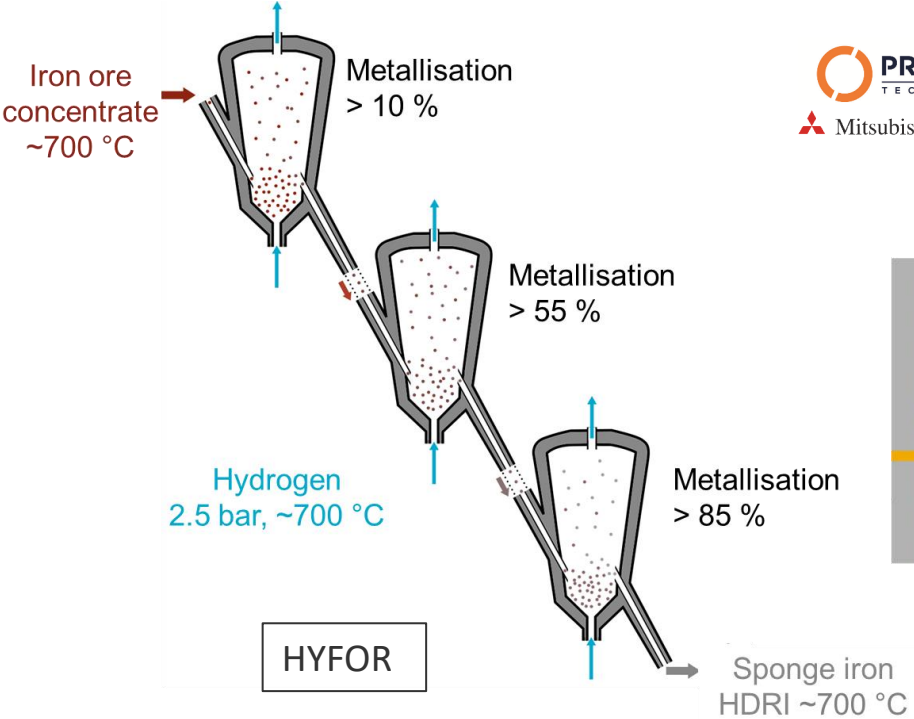


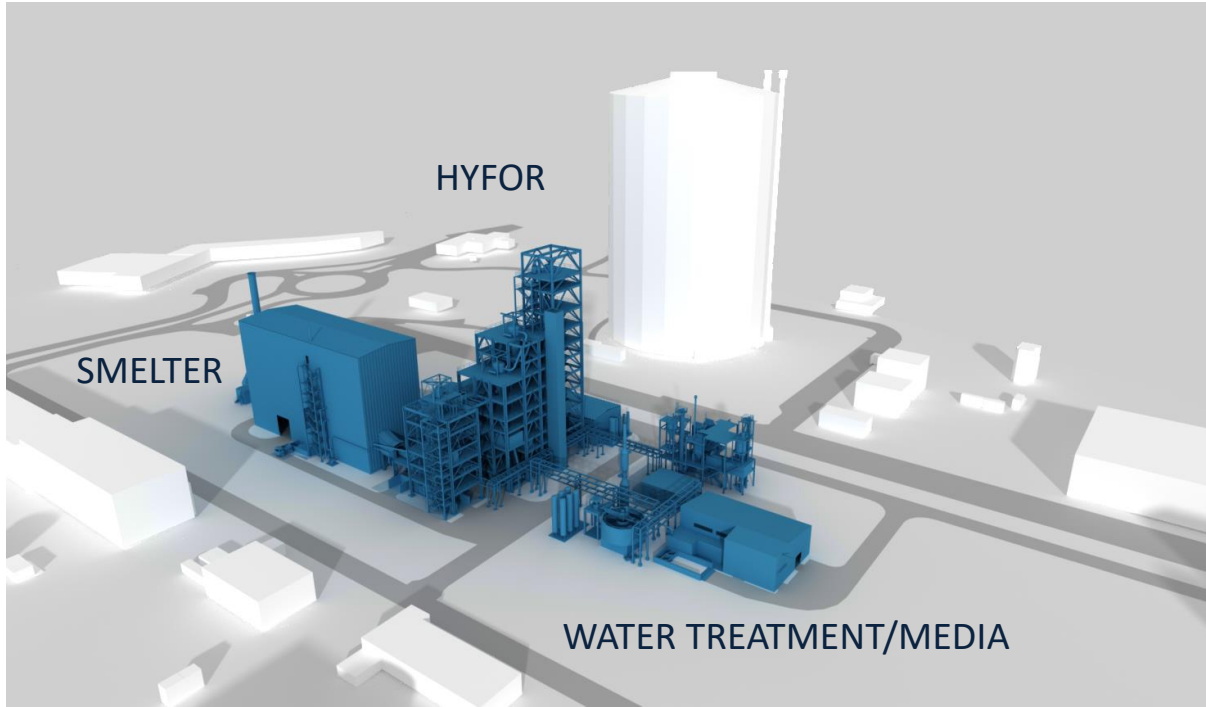
- Continuous operation from preheating iron ores to hot metal (HBI) in longer campaigns
- Flexible Ore Basis - Utilization of multiple iron ore qualities (low to high grades)
- Carbon addition – Based on bio-char and other carbon carriers
- Hot link of DRI fines to Smelter (alternatively HCl) and addition of HBI/Scrap
- Addition of slag forming materials → slag shall be utilized in the cement industry (cross-sectorial approach)
- Autonomous operation of Smelter part



# DEMONSTRATION PLANT

## METALLURGICAL TASKS HYFOR/SMELTER





Iron ore 2 – 3 t/h  
Hydrogen 1.500 m<sup>3</sup>/h  
Hot metal 2 – 3 t/h  
Slag < 1 t/h

Location voestalpine  
Linz site

CAPEX: 120 MEUR  
R&D-OPEX: 50 MEUR

# DEMONSTRATION PLANT



## PROJECT CONSORTIUM



Media supply  
Trial operation



Slag treatment for cement- and construction sector



Engineering Hy4Smelt  
Trial operation



Hy4Smelt slag for replacement of granulated BF slag in cement



Scrap preparation for smelter



Raw material/Product handling  
Trial operation



Reduction technology of iron ores



Grinding parameters slag



LCA modelling Hy4Smelt



Trial operation  
Process evaluation



Dissemination





## FUNDING STRATEGY

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- » In view of the high CAPEX intensity, the financial feasibility of the project will depend on the possibility to obtain enough public funding for the realisation of the project.
- » A high funding demand requires suitable tools on national and EU-level with the opportunity of combining diverse funding instruments.
- » The strong commitment of the Austrian Government and their funding agencies (KPC, AWS, FFG) to the industrial transformation has brought the realisation of Hy4Smelt within reach. Together with the funding tools of the European Commission (Clean Steel Partnership, RFCS) the demonstration phase of this green steel production route seems to be possible.
- » The first step has already been achieved: Hy4Smelt demonstration plant fulfills exactly the requirements for the new KPC initiative "Transformation of Industry - Pilot and Demonstration Plants“.

FUNDING STRATEGY

CAPEX Smelter-Part submitted to KPC „Transformation of Industry“



ONE STEP AHEAD.



CAPEX HYFOR-Part submitted to aws „Twin Transition“



Mitsubishi Corporation



R&D-OPEX will be submitted to RFCS/CSP Big tickets for Steel



ONE STEP AHEAD.



ONE STEP AHEAD.

Thank you! Questions?

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ONE STEP AHEAD.