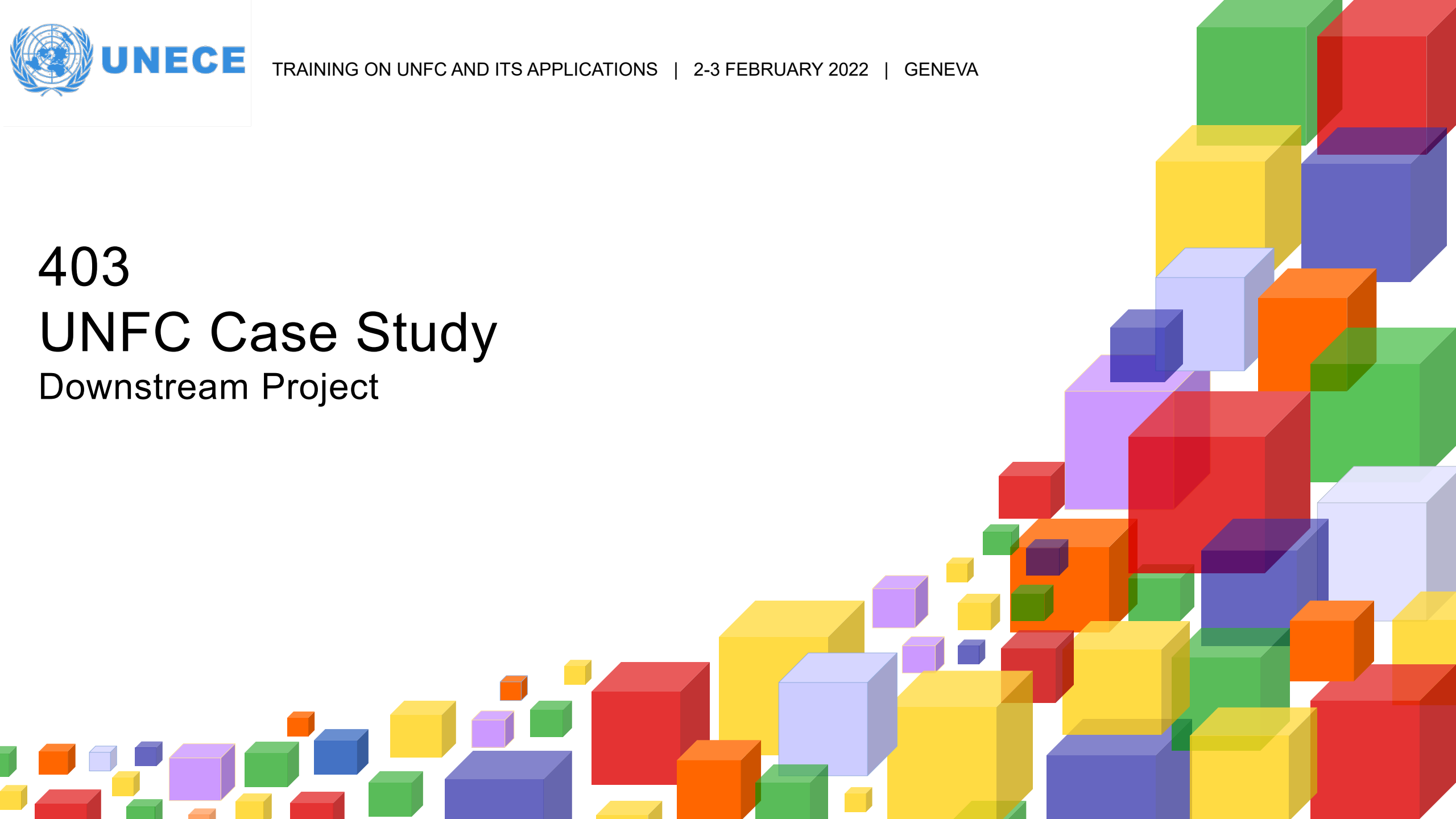


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# UNFC Case Study

## Downstream Project

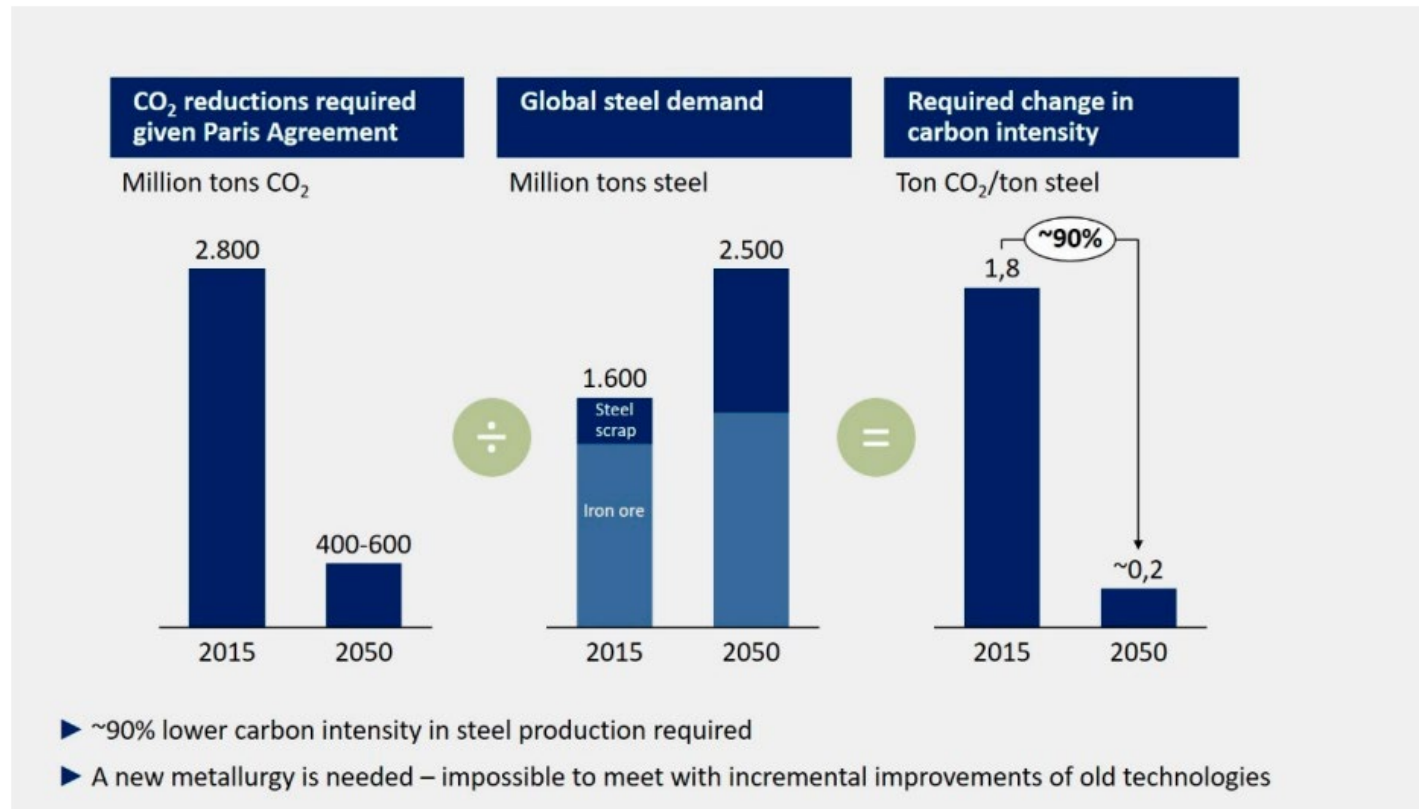


# Objectives

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- Classification of an innovative project
- E, F and G aspects
- UNFC classes / sub-classes applicable

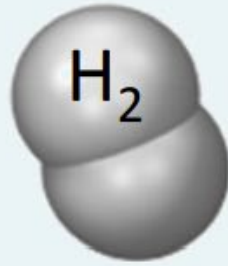
# Global steel demand and required decrease of CO<sub>2</sub>





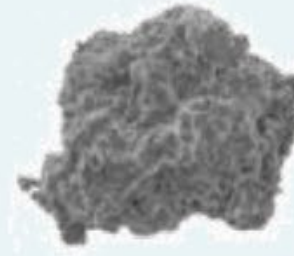
Iron ore pellets

+



Hydrogen

=



Sponge iron

+



Water

# SSAB HYBRIT Project, Sweden

- HYBRIT, acronym for Hydrogen Breakthrough Ironmaking Technology, is a development project with the aim of implementing fossil-free steelmaking in all stages of production; from iron-ore extraction, through pelletisation and reduction (iron-making), to the final steelmaking (in electric arc furnaces).
- Fossil free electricity production for hydrogen production for
  - parts of the mining and processing of iron ore (pelletisation).
  - direct reduction of iron ore
  - electric arc furnaces (for melting of sponge iron and adding materials, most notably carbon, to make steel)

# SSAB HYBRIT project, Sweden

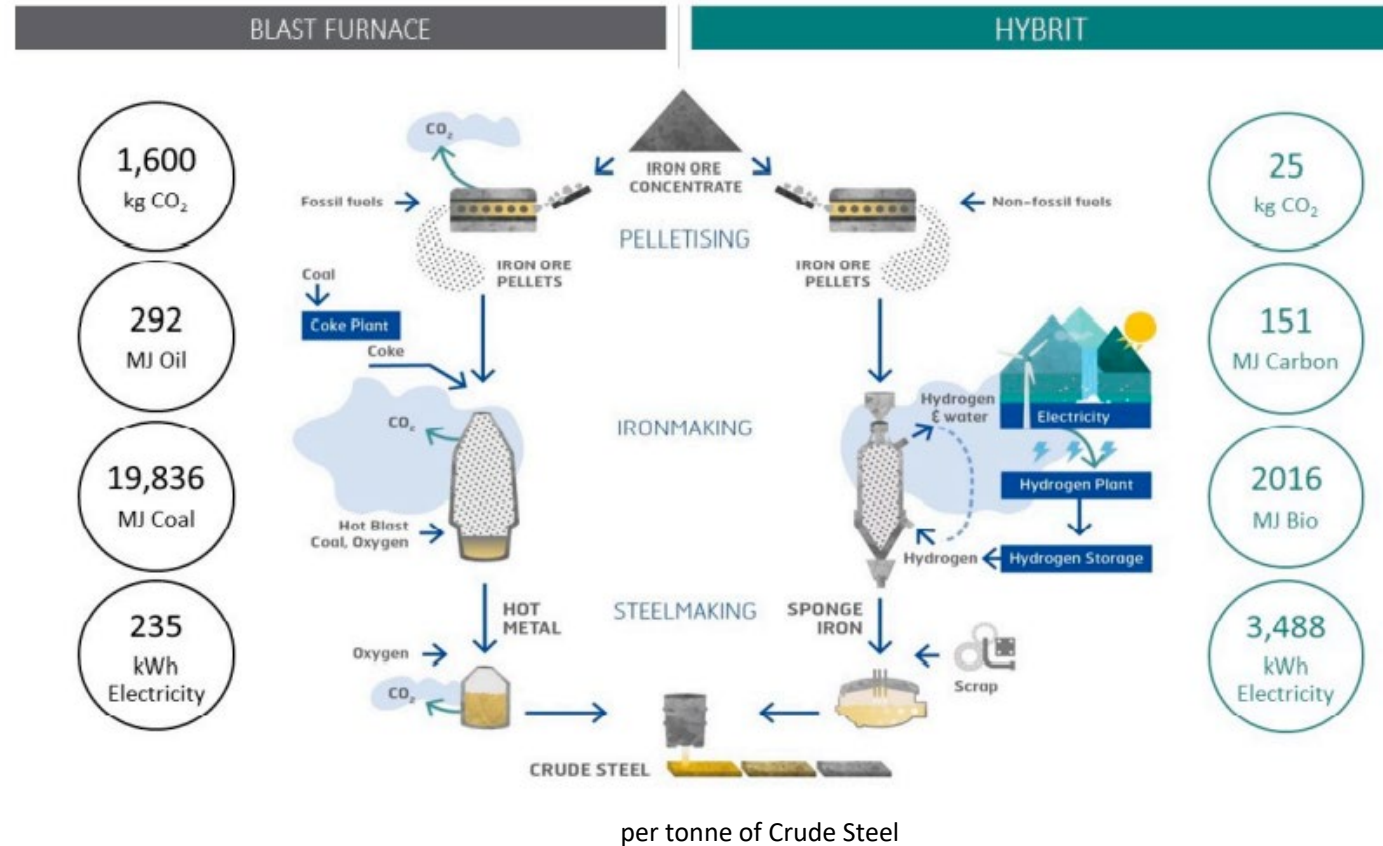
- Steel: Encompassing mining and energy for hydrogen production



- HYBRIT Development AB, a joint venture by SSAB, LKAB, and Vattenfall.
- HYBRIT Development AB is the 'project leader' and the actor responsible for the H-DR pilot.
- SSAB and Vattenfall have been the two parties mainly responsible for communication and public relations.
- LKAB is responsible for the pelletisation trials.
- Vattenfall is responsible for the hydrogen production and building new capacity for electricity generation and distribution.
- The Swedish Energy Agency is the main funding body. The research programme which is part of the initiative involves several actors: Swerim/Mefos, Sandvik, SEI, RISE, Luleå technical university, KTH and Lund University.



# SSAB HYBRIT project, Sweden



2016 - 2017

## Pre-feasibility study

2016

- Pre-feasibility study with support from Swedish Energy Agency
- 4-year R&D project with support from Swedish Energy

2017

A joint venture company between SSAB, LKAB and Vattenfall

2018 - 2024

## Feasibility study pilot plant trials

Feb 2018

Decision for pilot phase

2019 - 2021

Fossil-free pellets trial

2020-2024

Hydrogen-based reduction and smelting trials

2021/22 - 2024

Hydrogen storage

2025 - 2045

## Commercial volume plant trials and transformation

2025

- Transformation - BF\* to EAF\*\* at SSAB Oxelösund
- HYBRIT demo plant

2026

SSAB fossil-free steel on market

2030 - 2040

Transformation - BFs to EAFs at SSAB Raahe & SSAB Luleå

2045

SSAB fossil-free

# The project

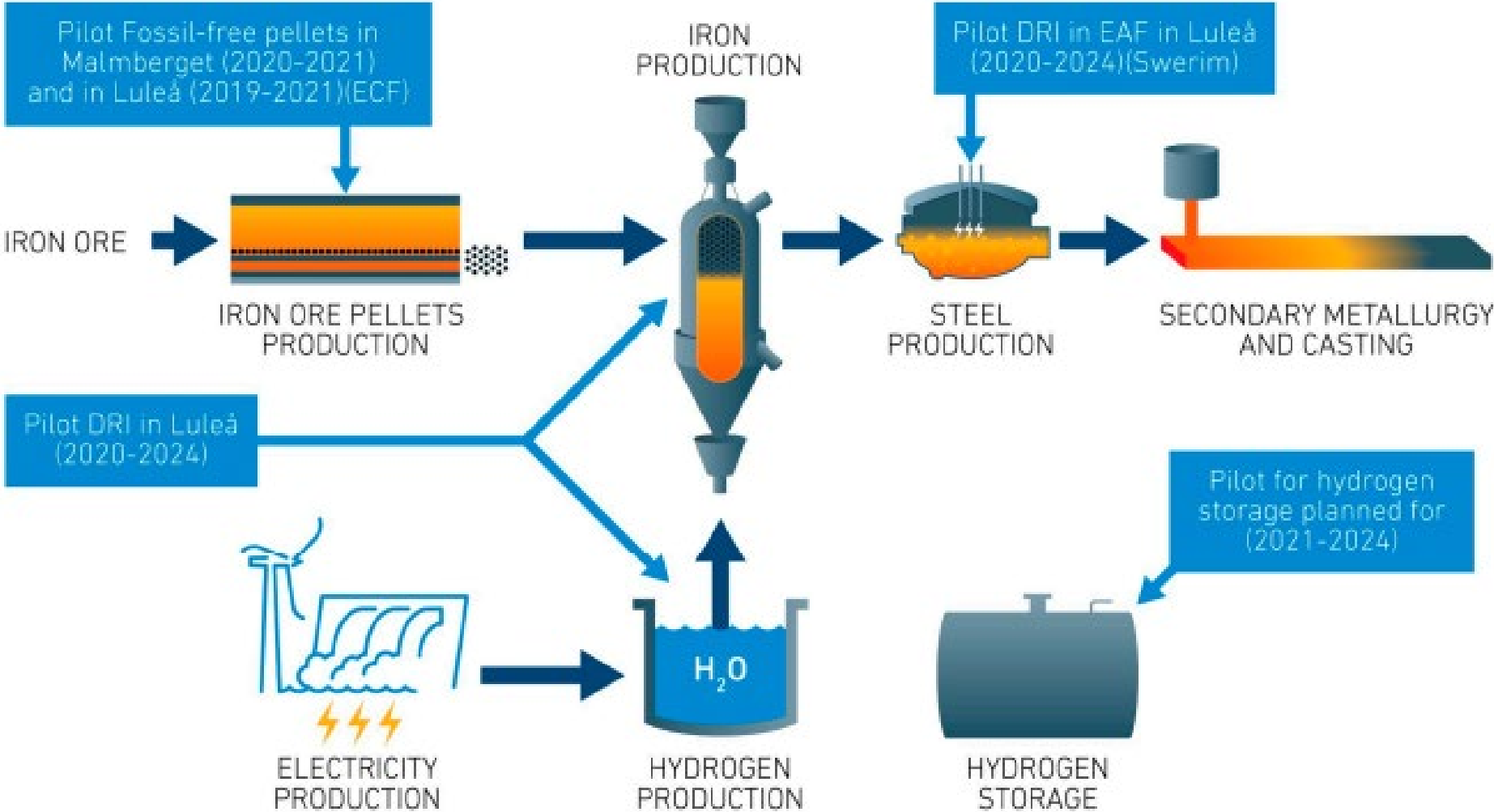
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- Pilot projects
  - Fossil-free heating technologies for the pelletisation of iron ore.
  - Direct reduction using hydrogen with steelmaking in an electric arc furnace
  - Steel production
  - Hydrogen storage
- A research project is studying the potential side-effects and possibilities of implementing fossil-free steelmaking and specific technological solutions (such as hydrogen storage or the handling of vanadium contamination in the electric arc furnaces).





# Pilot Plants



# G Axis

- 3 plants to be converted to HYBRIT process by 2045
- EAC at SASB Oxelösund and Demo of HYBRIT at Oxelösund by 2025 – 1 million tonnes/a (G2)
- SSAB Raabe conversion to HYBRIT by 2045– 4.9 million tonnes/a (G3)
- SSAB Luleå conversion to HYBRIT by 2045 – 3.6 million tonnes/a (G3)



# F axis

- The prefeasibility study results underline that **no major, previously unknown technical obstacles have been identified.**
  - Nevertheless, considerable **future development efforts will be required** to realise and verify the concept, and to handle risks. These include fundamental research projects using models and laboratory scale experiments, as well as trials in pilot and demonstration plants.
  - Considering current cost levels, an iron- and steelmaking value chain based on the HYBRIT concept would result in a **20 to 30 per cent increase in the cost of producing crude steel**
  - Large-scale hydrogen production and storage is also planned to be built and following the pilot plants, 2 demonstration plants are envisioned before commercialisation in 2042.
  - The mining and pelletisation is not envisioned to be fossil free until 2045.
- F 2.1

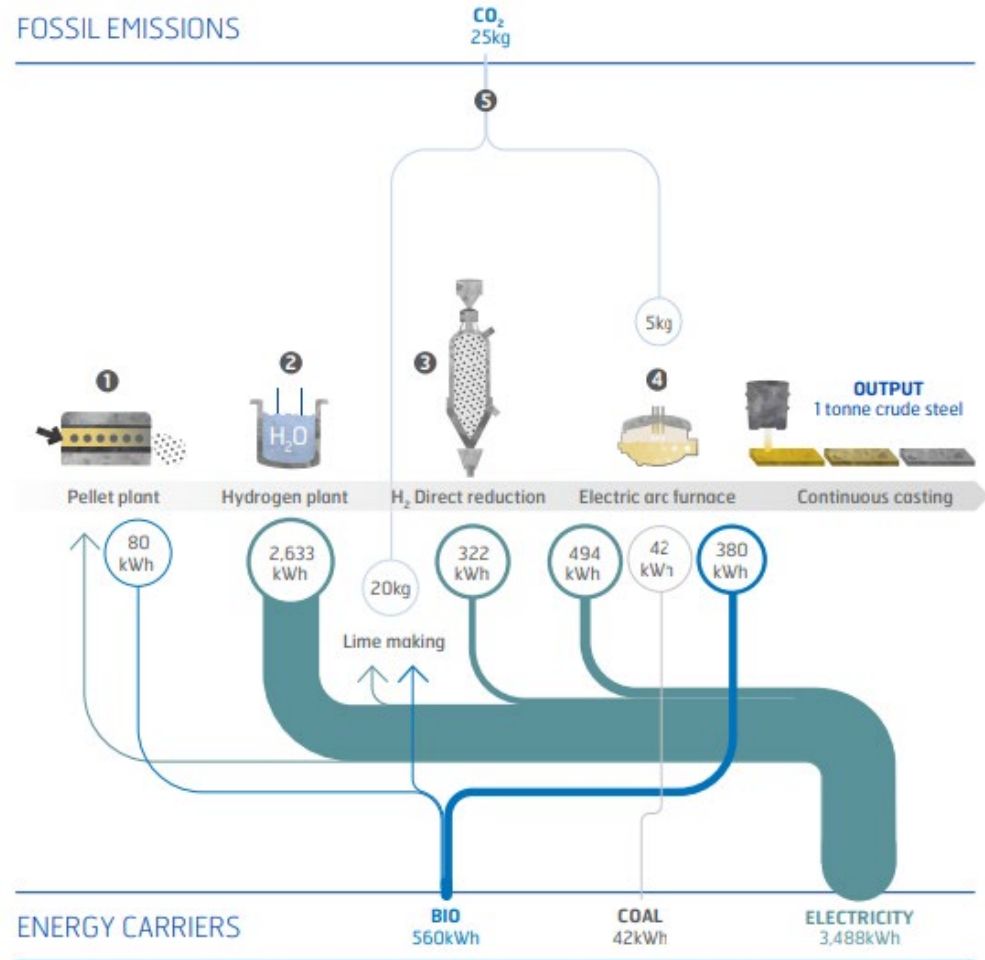


## E axis

- PRODUCTION COSTS SEEM VIABLE Considering current cost levels, an iron- and steelmaking value chain based on the HYBRIT concept would result in a **20 to 30 per cent increase in the cost of producing crude steel.**
- This innovation is **probably only viable under conditions of (global) ambitious climate policies, which require more than 80 % reduction of greenhouse gas emissions before 2050**, since that would require that at least CCS be implemented on all primary steelmaking.
- **No unintended consequences can be identified at this stage.**
- E 2

## HYBRIT

FOSSIL EMISSIONS



All numbers per tonne of crude steel.

## UNFC Classification

Sub-projects	Crude Steel (tonnes / annum capacity)	E	F	G	
SASB Oxelösund	1.0 million	2	2.1	2	
SSAB Raahe	4.6 million	2	2.1	3	
SSAB Luleå	3.6 million tones	2	2.1	3	

- **Potential Viable Project**
- **Development Pending**





# To Summarize

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- Innovative project
- Public-private participation
- E2, F2.1, G2,3: Potentially Viable-  
Development pending

Thank you!

Hari Tulsidas  
Economic Affairs Officer

UNECE

Date 2-3 | 2 | 2022, Geneva

