



SSAB's Transformation to a Fossil Free Steel Company with HYBRIT

Martin Pei

2023-12-06 WSA Breakthrough Technology Conf.

SSAB

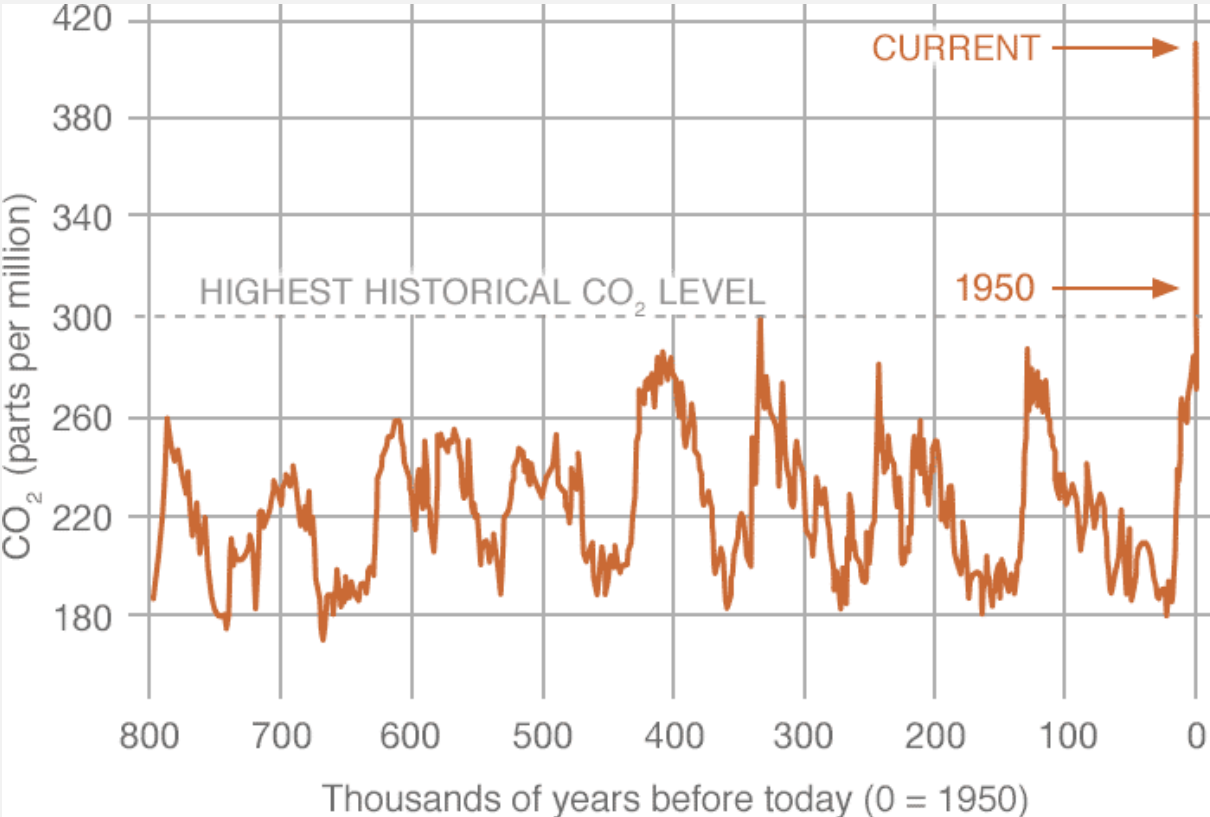
Agenda

- ▶ **Climate change calls for action**
- ▶ Hybrit initiative and milestones to date
- ▶ SSAB transformation plan

Climate change calls for action

PROXY (INDIRECT) MEASUREMENTS

Data source: Reconstruction from ice cores.
Credit: NOAA

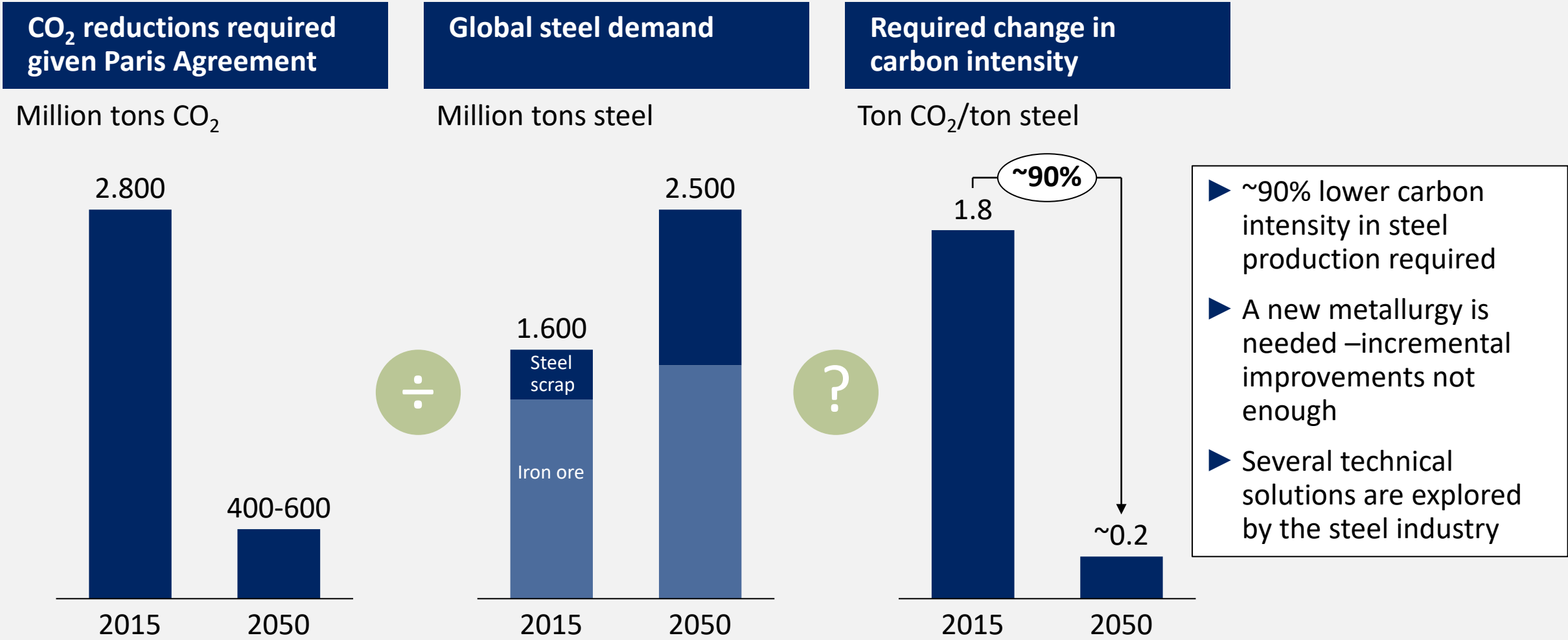


Steel is one of the most important materials

- ▶ Critical for society and new infrastructure
- ▶ Unique material and available everywhere
- ▶ 100% recyclable, again and again
- ▶ Global steel consumption per capita is foreseen to further increase as more countries modernize
- ▶ Current production technology from iron ore emits large amounts of CO₂ into the atmosphere



A breakthrough in steelmaking technology is needed



SSAB today

Steel making since

1878



Annual steel
production capacity:

8.8 MILLION
TONNES

12 BILLION
EUR

annual net sales in 2022

14,500

professionals
in 50 countries

Operating profit 2022 (adj)

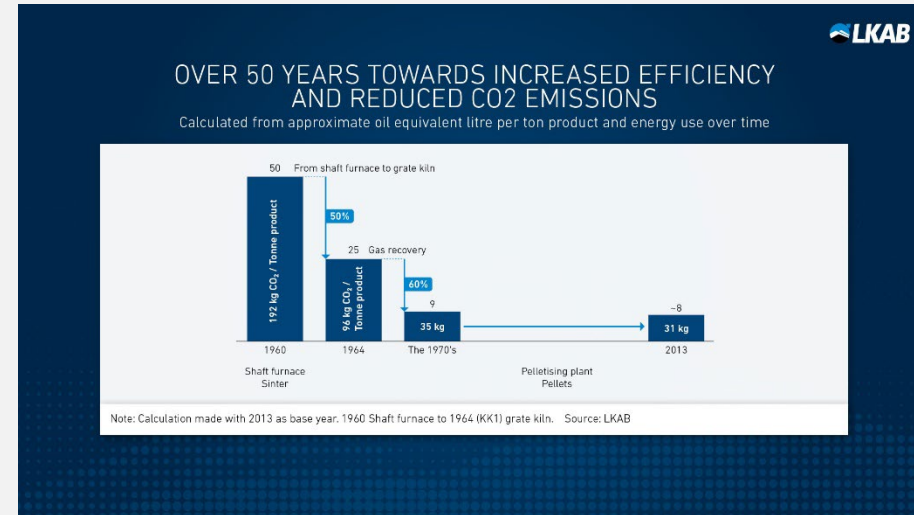
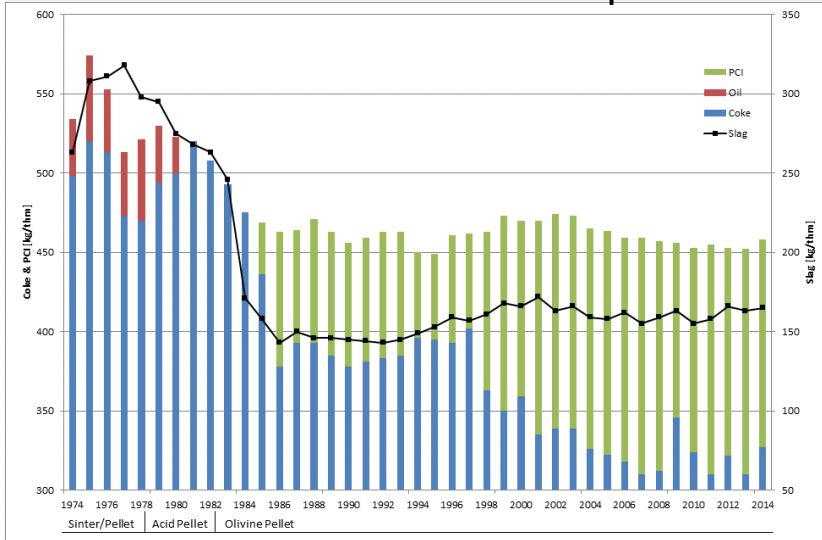
2.7 BILLION
EUR

Production in Sweden, Finland and US



A step change in 1980's – iron ore resource in north Sweden

SSAB Luleå BF fuel-rate development



Successful joint development of LKAB-SSAB production system in 1980's – **“Optimised utilization of Swedish iron ore resources in Norrbotten with intermediate P-content”**:

- 100% pellets operation at all SSAB's BFs
- Yearly average fuel rate 450 – 465 kg/thm
- Low slag volume 150-160 kg/thm
- Recirculation of LD-slag and other by-products, cold bonded briquettes & BF-dust injection

HYBRIT – Hydrogen Breakthrough Ironmaking Technology

SSAB blast furnaces – CO₂ emissions



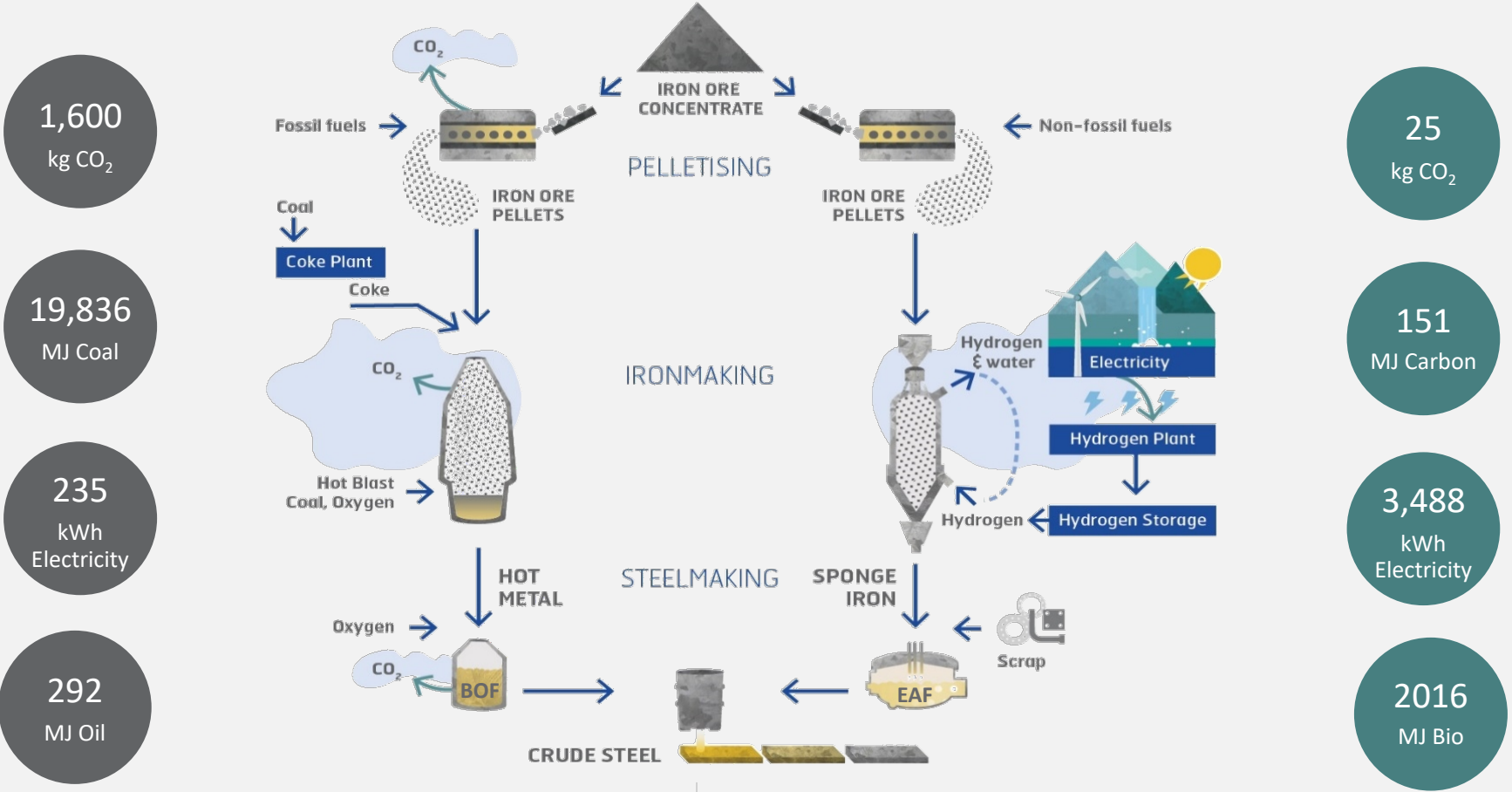
Background

- ▶ SSAB's blast furnaces operate with lowest CO₂ emissions worldwide
- ▶ Still SSAB accounts for 10% of Sweden's & 7% of Finland's total CO₂ emissions
- ▶ Sweden has a large surplus of fossil-free electricity – large potential to build more wind power mills
- ▶ Sweden & Finland – world leading R&D competence
- ▶ Long tradition of cooperation

The HYBRIT technology

CURRENT PROCESS - BLAST FURNACE + BOF

NEW PROCESS – HYBRIT + EAF



1,600
kg CO₂

19,836
MJ Coal

235
kWh
Electricity

292
MJ Oil

25
kg CO₂

151
MJ Carbon

3,488
kWh
Electricity

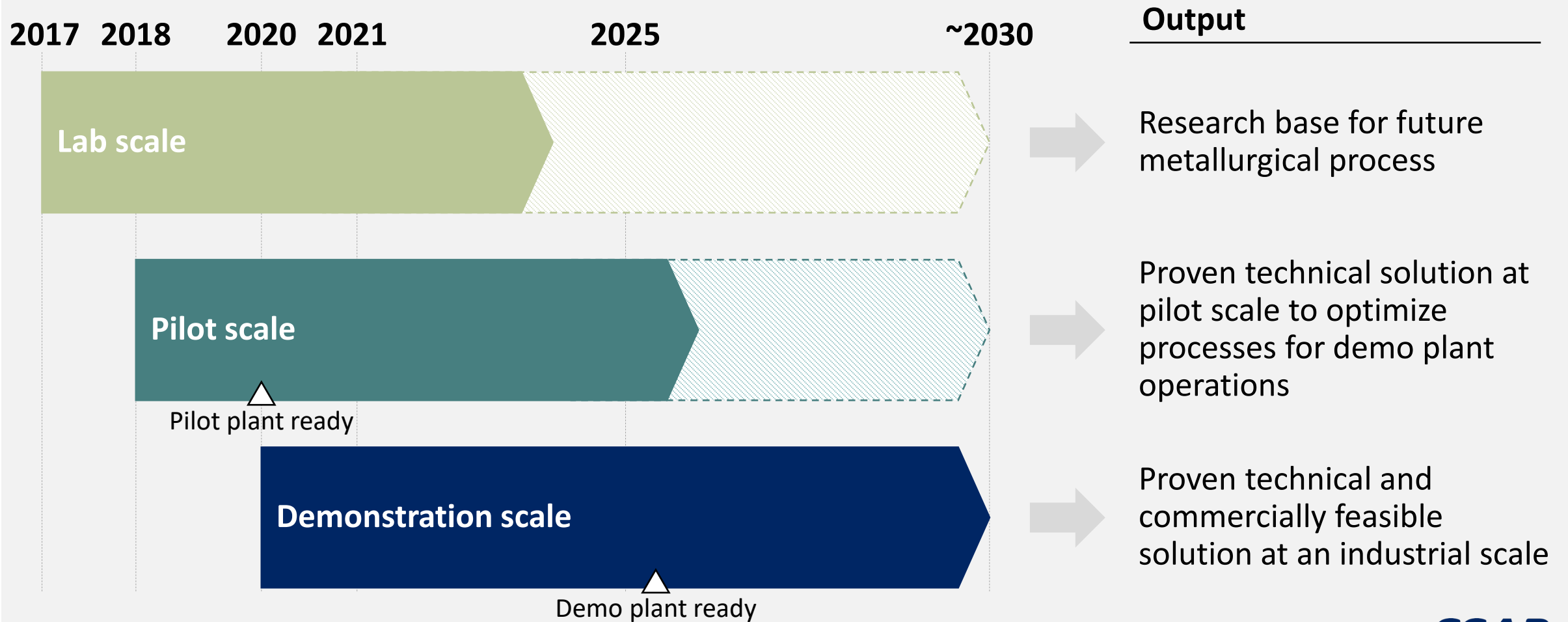
2016
MJ Bio

*Figures refer to per tonne of crude steel

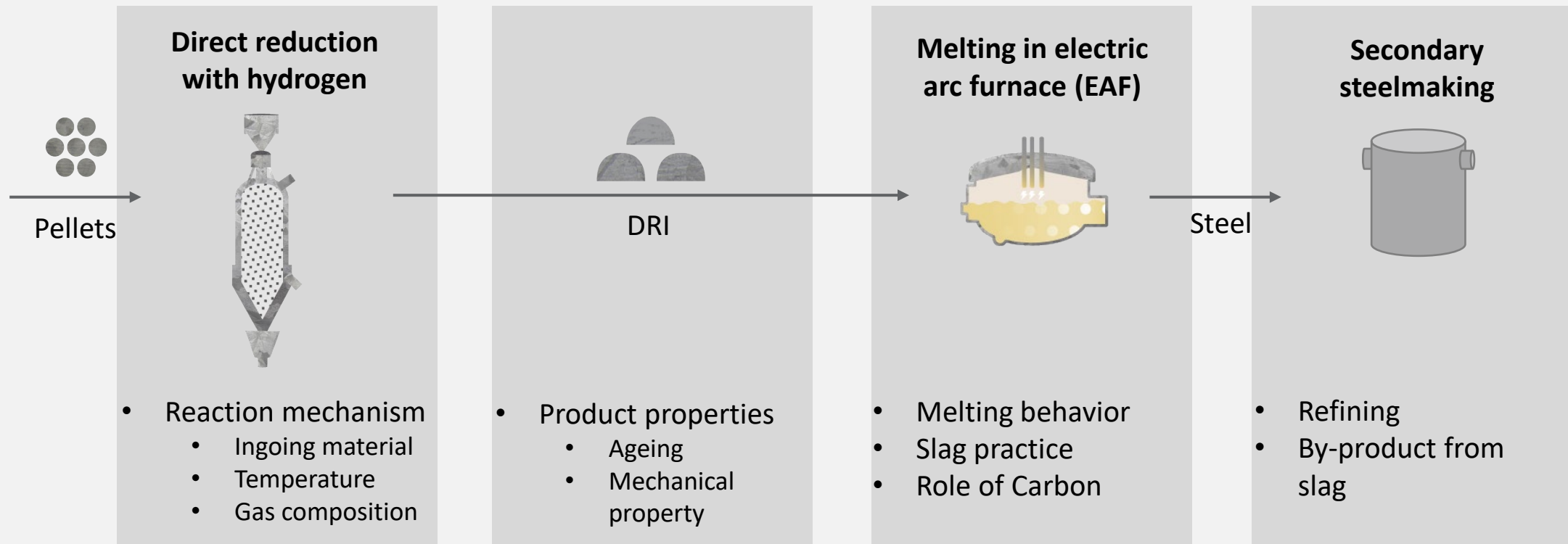
Agenda

- ▶ Climate change calls for action
- ▶ **Hybrit initiative and milestones to date**
- ▶ SSAB transformation plan

HYBRIT development phases – to industrial scale



Metallurgical Research - Connecting the Value Chain



Experimental Furnaces

- ▶ 4 High Temperature Experimental Furnaces
 - 2 Reduction Furnaces
 - 1 Melting Furnace
 - 1 Combined Reduction/Melting furnace
- ▶ Mechanical Property Testing of Pellets/DRI
 - Tumbling
 - Standard Compression Load Test Equipment
- ▶ Re-Oxidation Station (ageing)

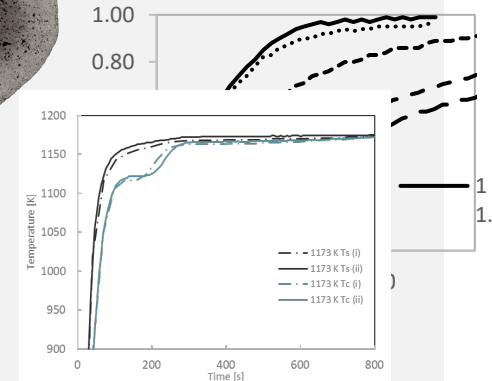
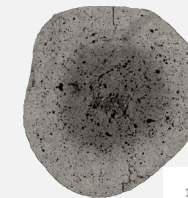
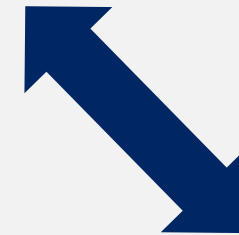
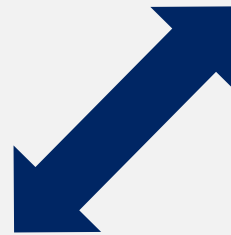
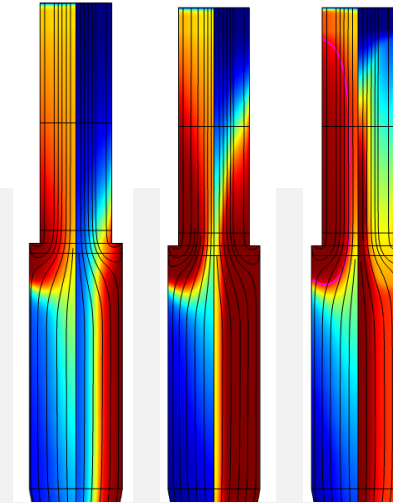
HYBRIT
▶▶▶ FOSSIL-FREE STEEL

 **SWERIM**

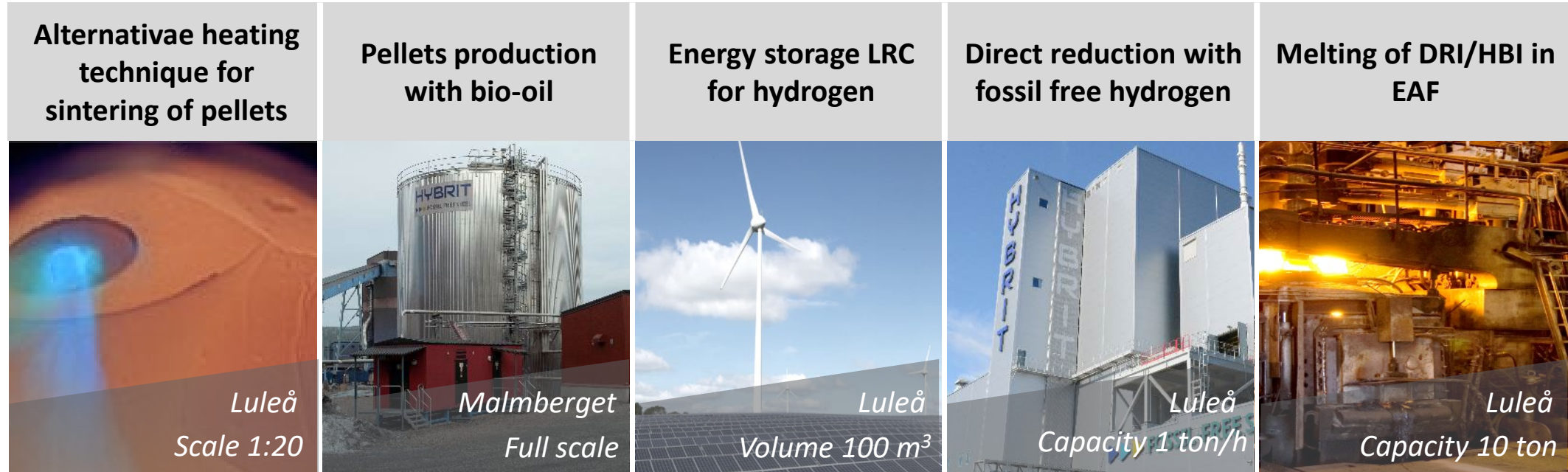


The HYBRIT Integrated R&D Program

Lab – Pilot - Modelling



HYBRIT's pilot projects covering the whole value chain



Fossil free heating replacing coal & oil for sintering of iron ore pellets

Hydrogen storage important component for future electricity grid with more wind/solar

H₂ replacing C for iron ore reduction, resulting in H₂O instead of CO₂

Fossil free melting & refining from iron to steel

HYBRIT – Successful pilot trial of 100% H₂-reduced DRI/HBI

June 21, 2021



Hydrogen direct reduced iron with superior quality

▶ H-DRI has superior quality vs NG-DRI:

- Carbon-free & highly metallized
- Superior mechanical and ageing properties
- Can be safely transported and stored
- Good melting property in an EAF
- Patent application filed at EPO by HYBRIT Development AB



SSAB – First delivery of steel made from HYBRIT-DRI/HBI

Aug 18, 2021



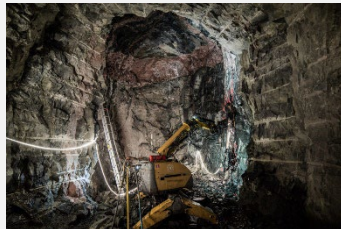
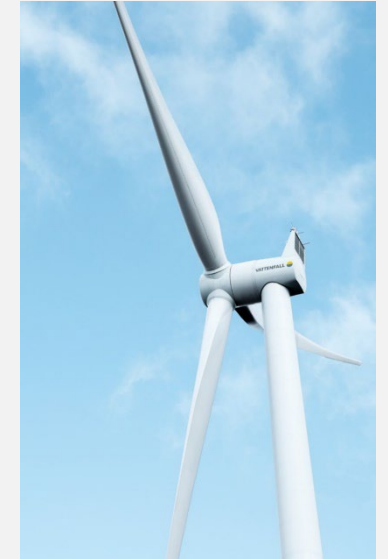
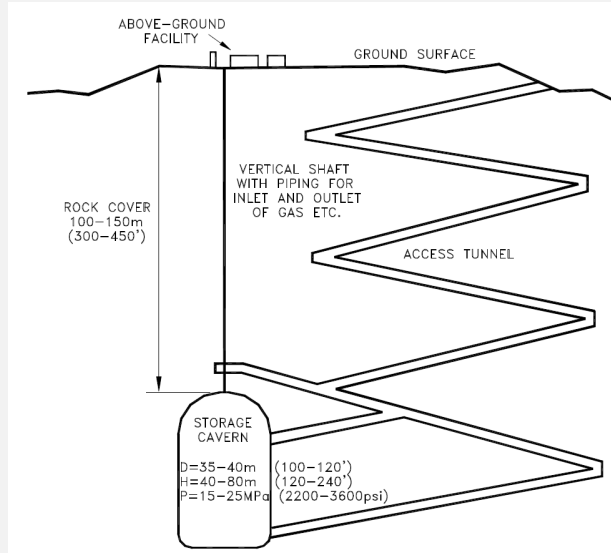
SSAB

Volvo launches world's first vehicle using fossil-free steel

Oct 13, 2021 (Tara), and 2022 delivery of the A30 truck to NCC



Hydrogen storage – a link between electrified industry and electricity grid with intermittent power generation



- ▶ H₂-storage pilot successfully commissioned:
 - Water pressure test up to 275 bar
 - Compressed H₂-gas up to 250 bar (designed pressure)
 - The storage construction is mechanically stable
 - Leakage monitoring system verified
- ▶ 2-year test program ongoing

Demonstration of fossil free value chain aiming at commercial deliveries starting in 2026


Production of fossil-free pellets




IRON ORE PELLETS



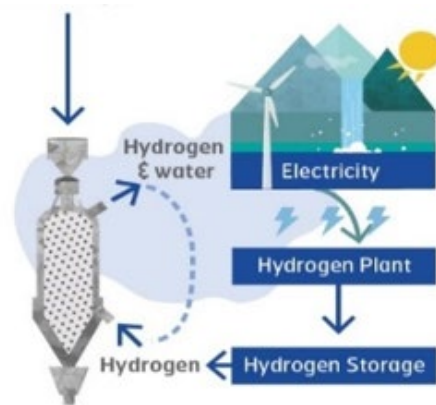
Production of fossil-free electricity



Electricity



Production of fossil-free sponge iron




Hydrogen & water

Electricity

Hydrogen Plant


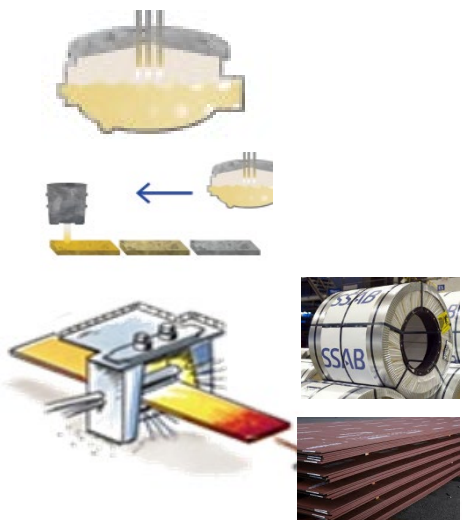
Hydrogen Storage

Hydrogen



FOSSIL-FREE STEEL

Production of fossil-free steel



Customer partnerships



Agenda

- ▶ Climate change calls for action
- ▶ Hybrit initiative and milestones to date
- ▶ **SSAB transformation plan**

SSAB's transformation plan

A broader offering
of fossil-free
products

A step change in
efficiency and
flexibility

- SSABs America: **SSAB Zero** – on market from 2023
- Build new **EAF meltshop in Oxelösund by 2026**
- Build **new state of the art “mini-mills” in Luleå and Raahe**, close existing coal based blast furnaces and steel plants
- **Mini-mills with an initial scale of 2.5+ million tons each**, in line with current capacity
- Complete **transformation during by around 2030**, before next scheduled blast furnace relining's
- New mills to be built **fossil-free from start**, including power supply

Oxelösund converted to electric arc furnace 2026

New electric arc furnace in Oxelösund, Sweden



- Policy decision May 2020
- Investment decision May 2023
- Start-up 2026
- New EAF and steel mill upgrade
- New infrastructure for biofuels, scrap and sponge iron handling systems
- Rolling mill and quenching lines maintained as today
- Closing the coking plant (from 1952) and 2 blast furnances on site

Build new fossil-free mini-mills in Luleå and Raahе

Planned new steel mill in Luleå, Sweden



- Policy decision Jan 2022
- Full scale mini-mill, incl cold rolling
- Will also supply Borlänge with coils
- Existing coal based assets closed

Planned new steel mill in Raahе, Finland



- Policy decision Jan 2022
- Full scale mini-mill, plus plate mill maintained
- Will also supply Hämeenlinna with coils
- Existing coal based assets closed

Partnering with customers that share our ambition to lead and build a fossil-free value chain



Mercedes-Benz



Polestar

FORVIA
faurecia

Autoliv

VOLVO
VOLVO GROUP

 **CARGOTEC**
HIAB · KALMAR · MACGREGOR

 **Epiroc**

 **OSHKOSH**

**ALFA
LAVALE**

 **PEAB**


Lindab

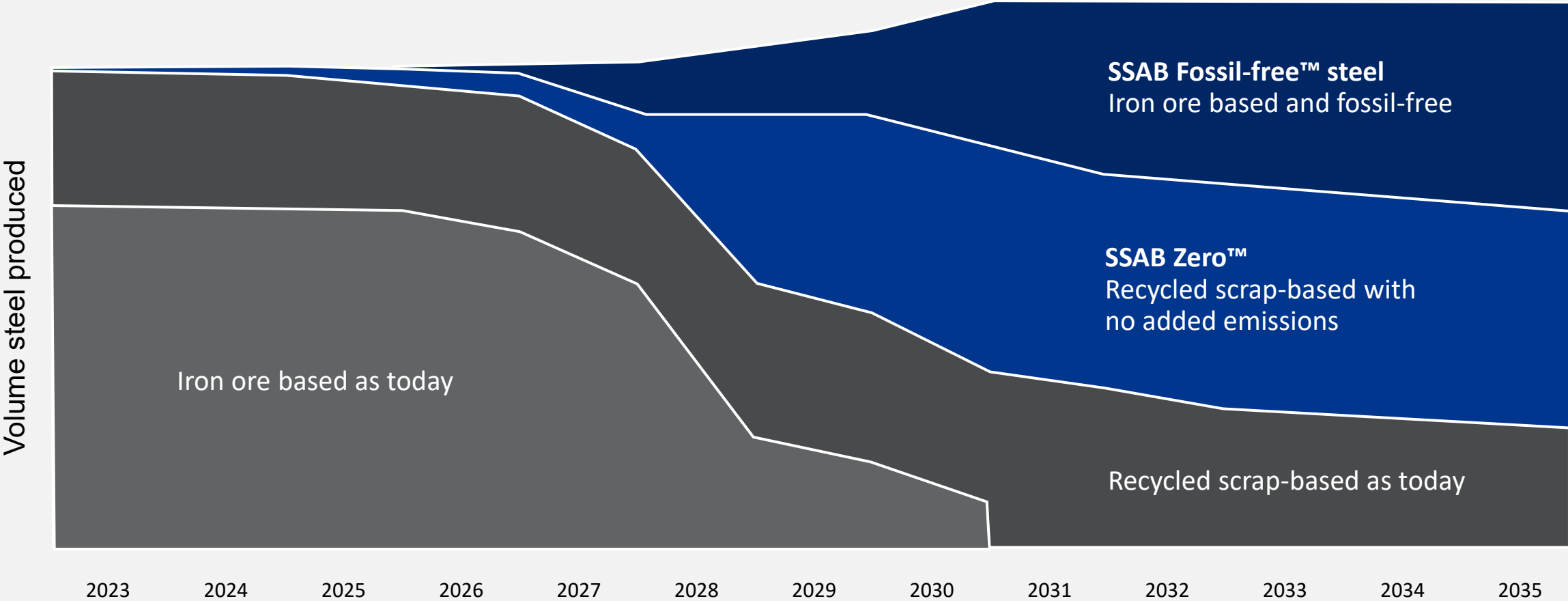
 **shape**
CORP

+ more

SSAB

Targeting a fully sustainable steel portfolio

Illustrative



SSAB



*A stronger,
lighter and more
sustainable world*