Ovako’s innovative future uses of hydrogen

2023-05-25, Göran Nyström

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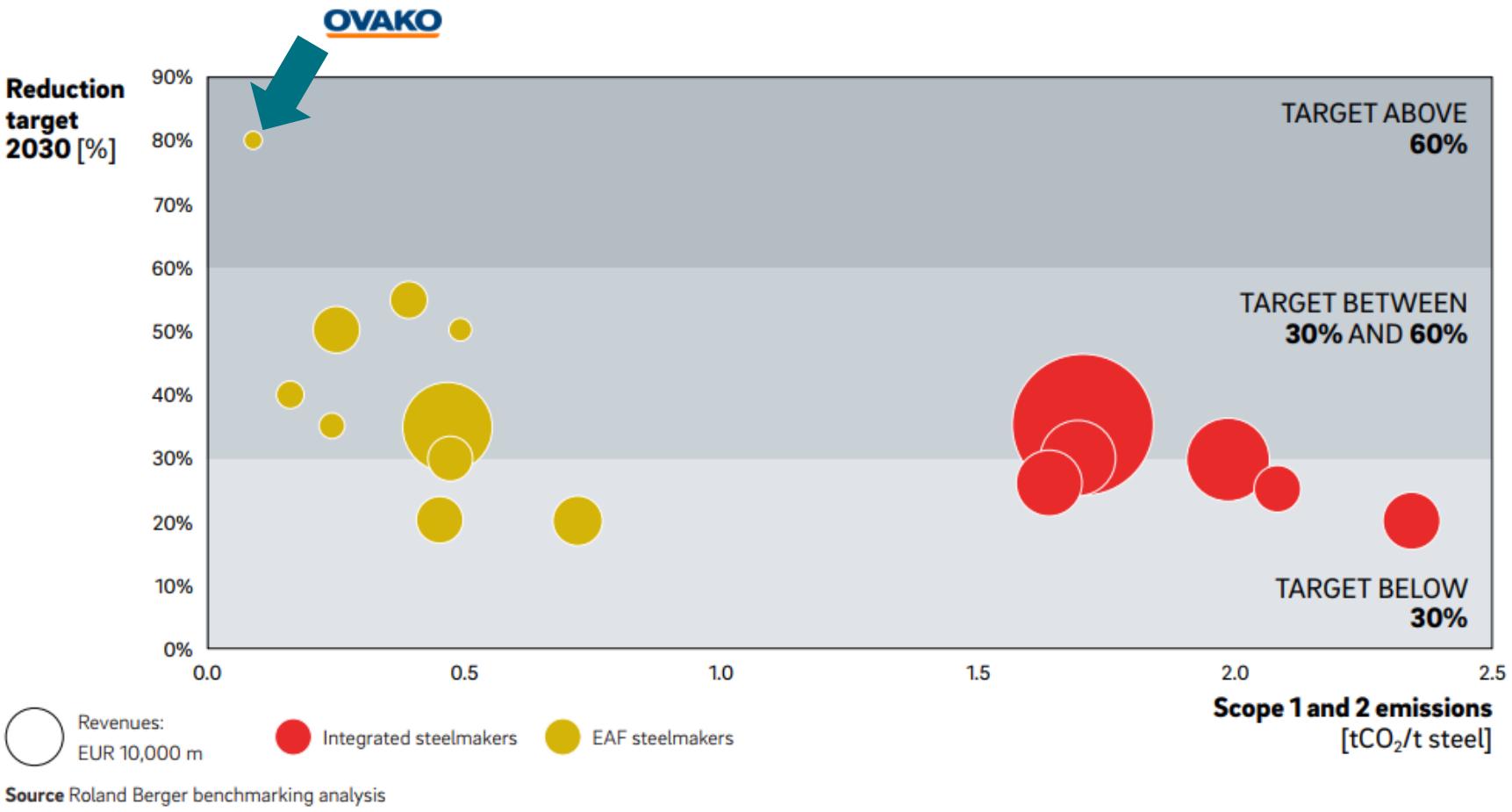
Circular Ovako

- Headquartered in Sweden, member of Nippon Steel Group
- A sustainability leader in the world of steel producers
- World-leading low carbon footprint and high recycled content (97%)
- Largest recycler of Nordic scrap, all categories
- 100% carbon-neutral operations from 2022, first in the steel world

A leader in a world today divided between scrap-based (circular) and ore-based (primary) steel-makers



Roland Berger

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Agenda

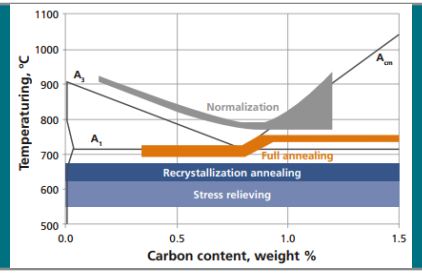
- Using hydrogen for
  - Industrial heating of steel for hot-forming
  - Reduction of iron-ore to create iron

Ovako has one main area remaining for electrification

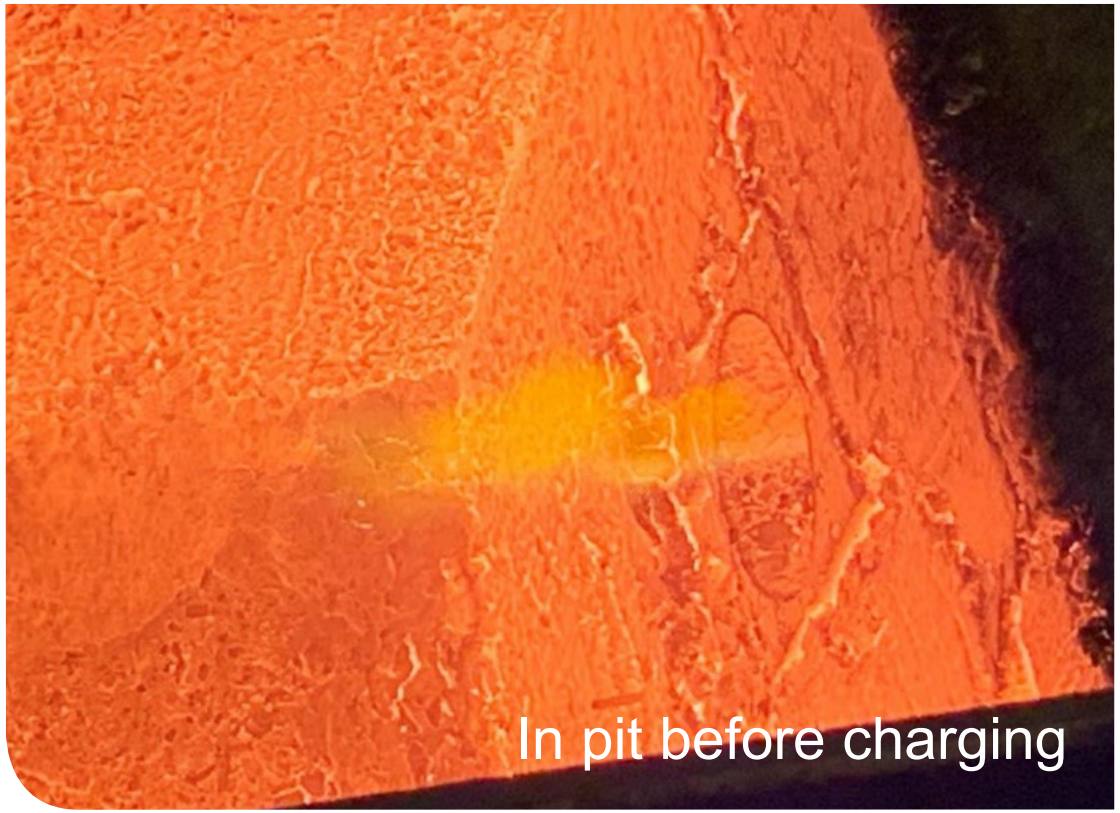
✓ Melting steel >1400°C

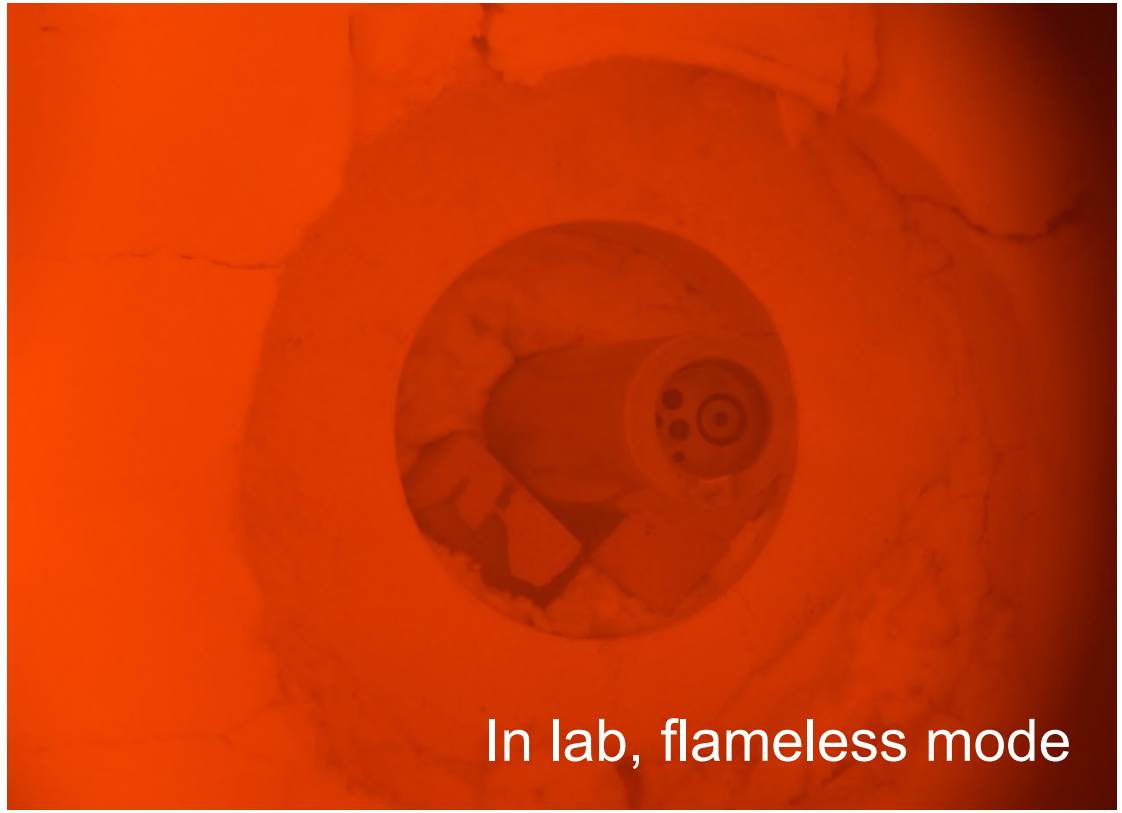
→ Heating steel for hot-forming ~1200°C

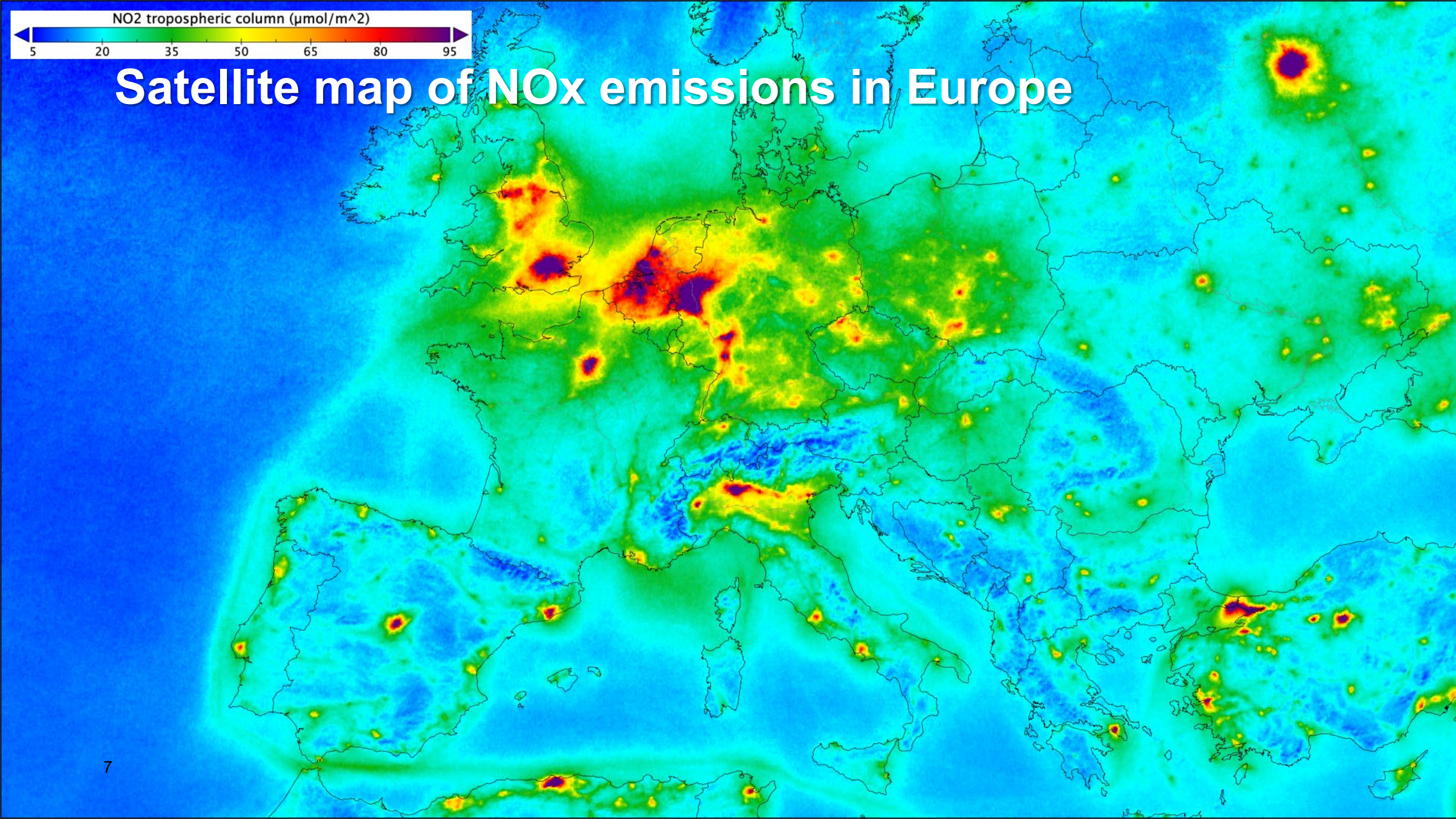
✓ Heat treatment for product properties <1000°C



A key enabler for cost-efficient electrolysis: Oxyfuel – also energy efficient and reduces NOx emissions

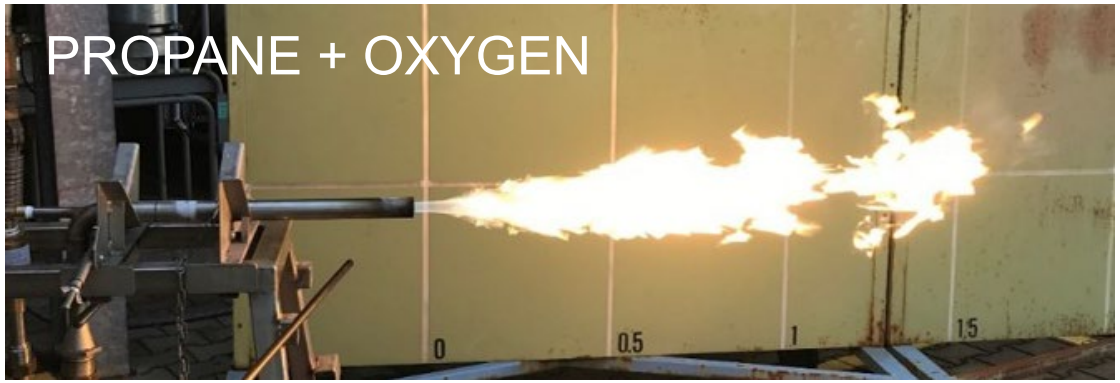


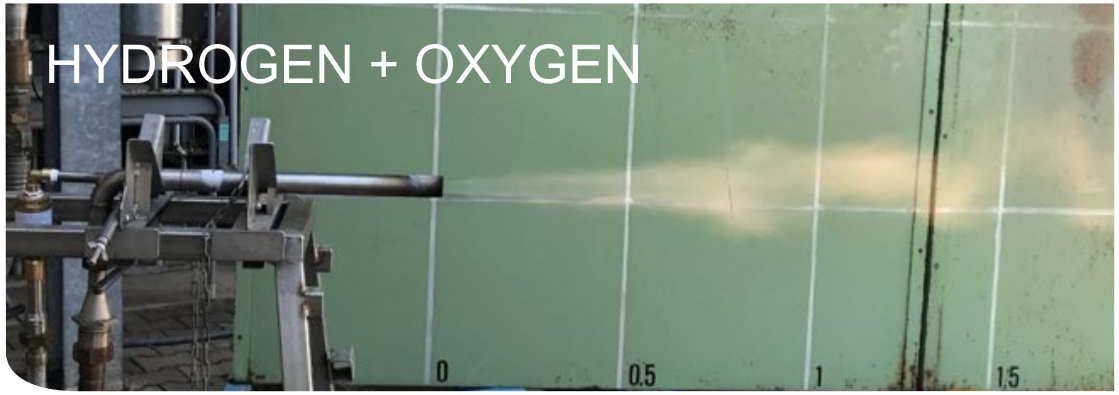


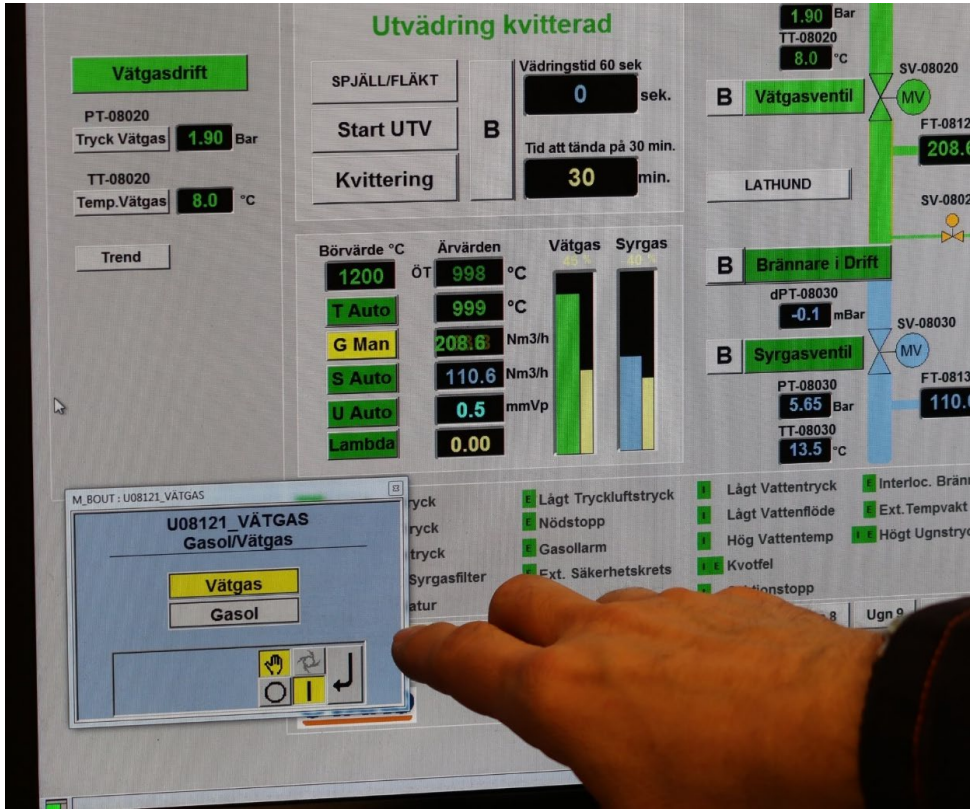


Satellite map of NOx emissions in Europe

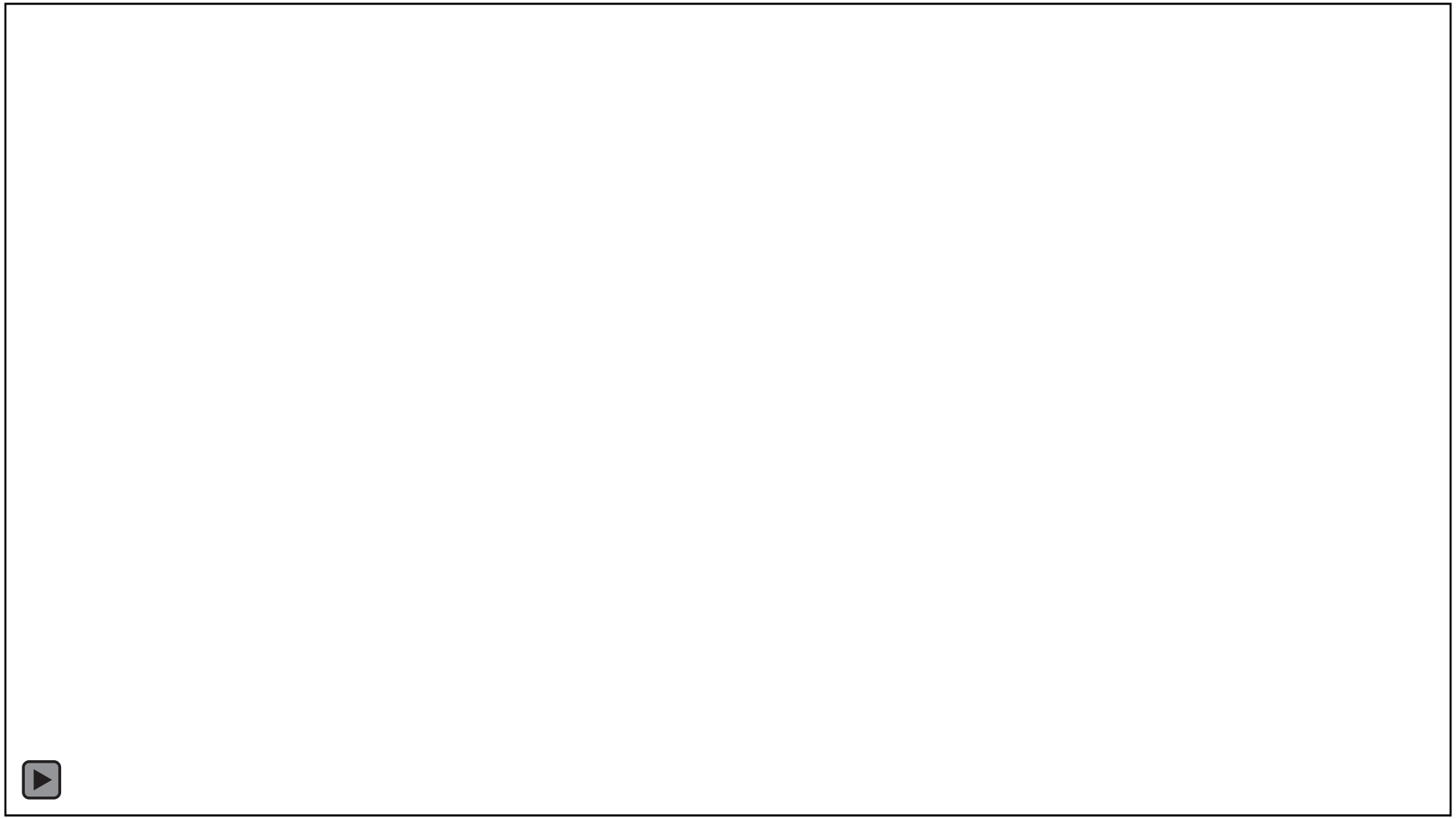
2019-2020: Technical proof of concept





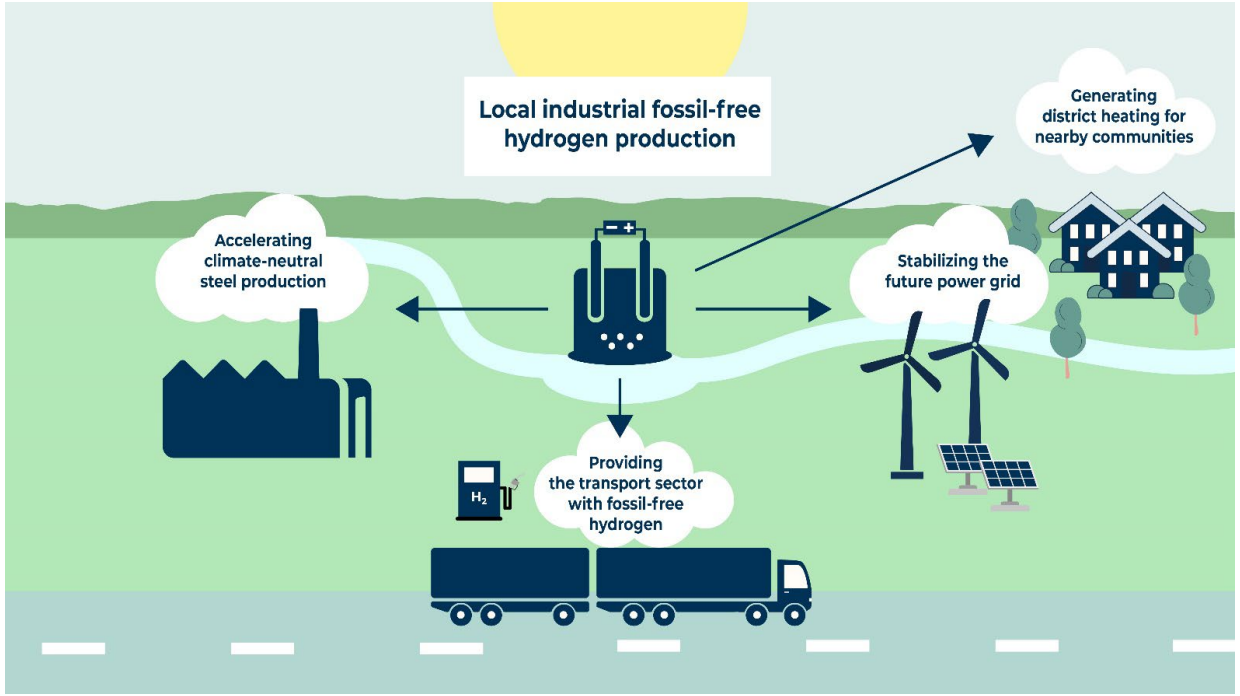


2021-2023: First implementation of H2 for steel heating



The hydrogen concept

- Efficient
  - Energy-efficient
  - CO2-removal-efficient
  - No storage or transport needed
  - Calendar-time-efficient
- Scalable to many locations
- Important opportunities
  - Industrial synergy and “hydrogen valleys”
  - Power grid balancing
  - Fuel-cell trucks



- Piggy-backing!
  - 40 MW capacity covers all need for hydrogen at Hofors site
  - Could potentially add an extra 40 MW, at no extra manning and with heat and oxygen subsidizing total cost
  - In this way, cost-efficient fossil-free H2 could be available for others

Hofors soon completed
Financial support for Smedjebacken received

Nya Ludvika Tidning

Smedjebacken

Ovako i Smedjebacken beviljas 90 miljoner i stöd - ”Målet är en helt koldioxifri stålproduktion”

31 januari 2023 05:30

Ovako Bar AB beviljas 90 miljoner kronor i stöd till energikonvertering i Smedjebacken. Det meddelar Naturvårdsverke som delfinansierar åtgärderna inom EU-projektet, Klimatklivet.

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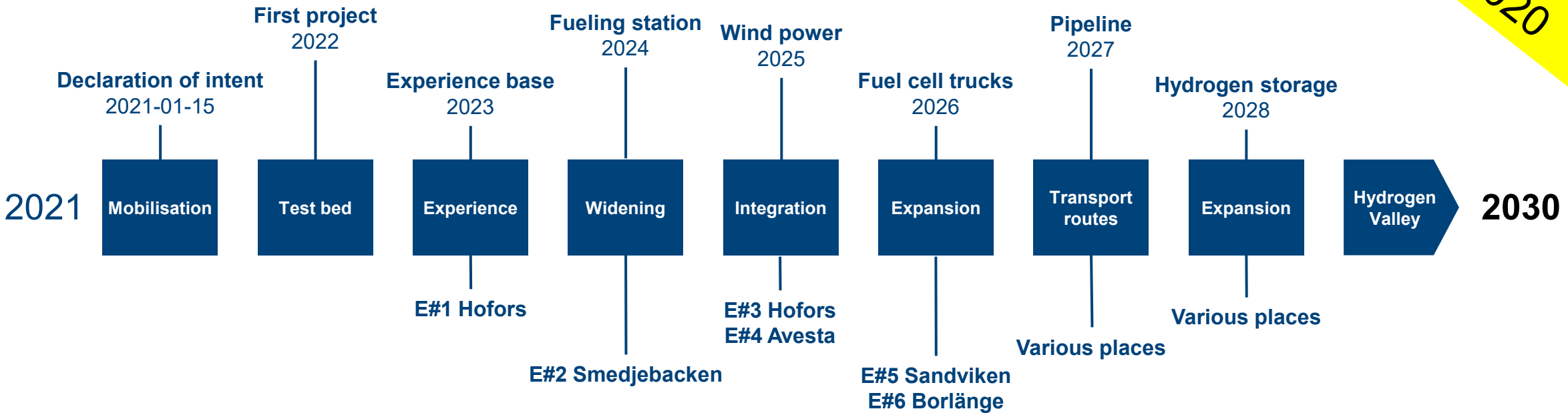
Mid-Sweden Hydrogen Valley
- at the start of an important time-line

For discussion purposes
From end of 2020



1 – proof of concept	2 - integration	3 – Hydrogen Valley
2021 – 2023	2024 – 2027	2028 – 2030

Agenda

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Dagens industri START BÖRS MARKNADSNYTT

Debatt: Vi kan tillverka fossilfritt stål med en tiondel av elbehovet

Publicerad: 4 maj 2023, 09:00

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Generating syngas from biomass residue

Biomass gasification is a mature technology pathway that uses a controlled process involving heat, steam, and oxygen to convert biomass to hydrogen and other products, without combustion. Because growing biomass removes carbon dioxide from the atmosphere, the net carbon emissions of this method can be low, especially if coupled with carbon capture, utilization, and storage in the long term.

Gasification plants for biofuels are being built and operated, and can provide best practices and lessons learned for hydrogen production. The U.S. Department of Energy anticipates that biomass gasification could be deployed in the near-term timeframe.

Alleima

SVEASKOG

OVAKO

Lantmännen

UDDEHOLM

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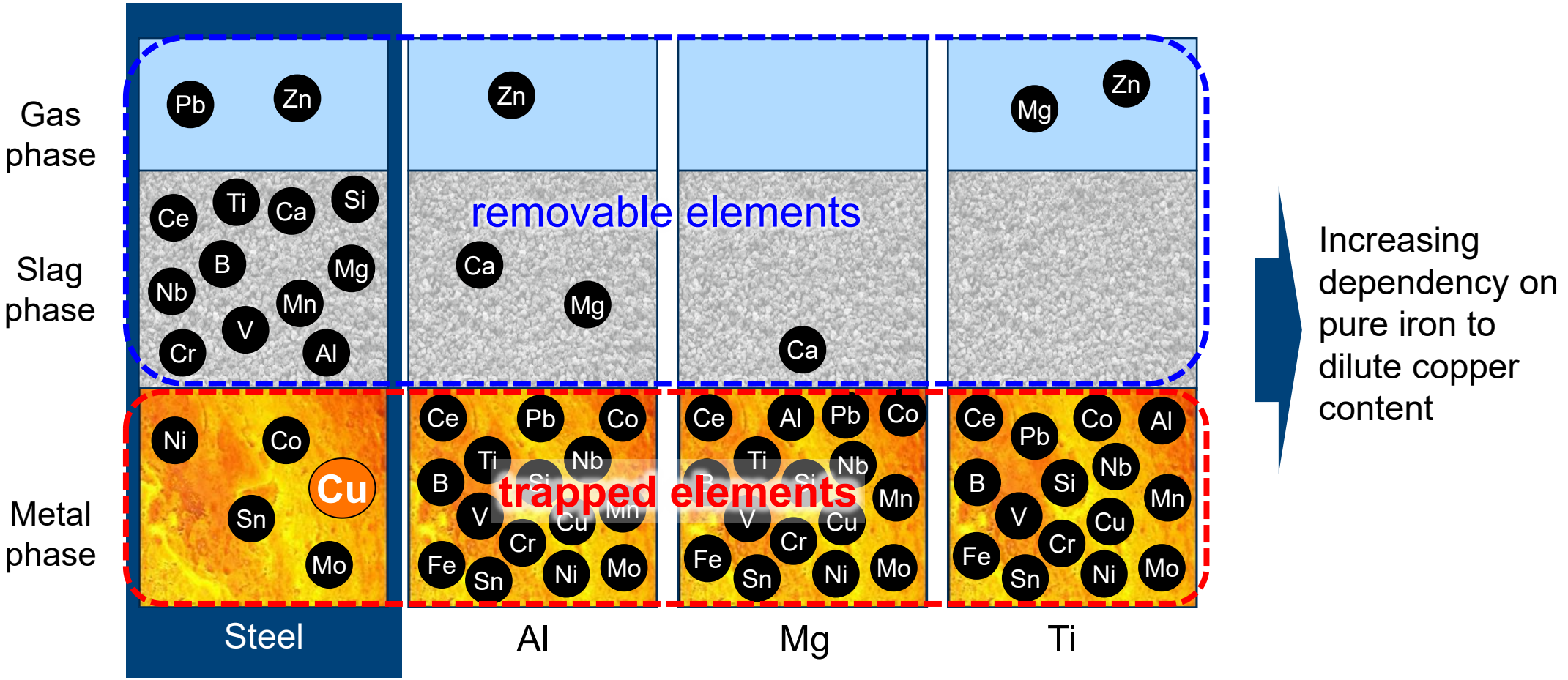
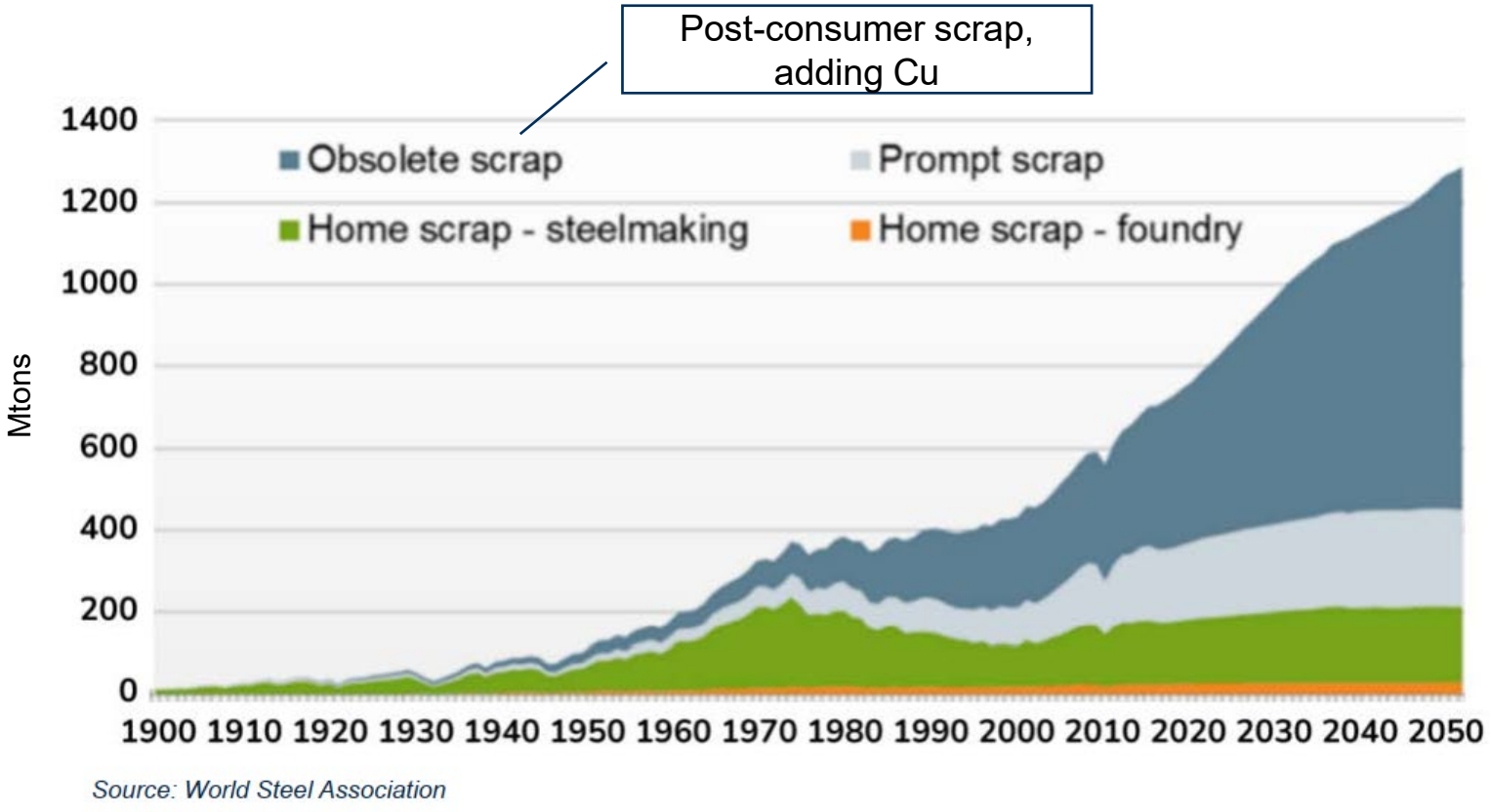
Metals refining works particularly well for steel, but the copper content is a growing concern

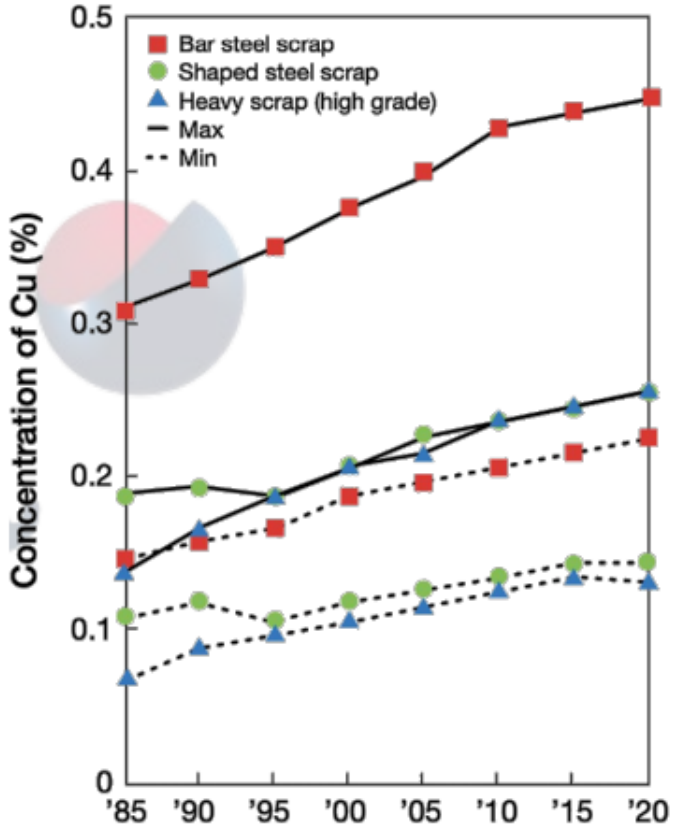


Source: Nippon Steel, Hiraki et al (2012)

Global scrap volumes will increase but quality will deteriorate → Direct Reduced Iron is needed



Source: World Steel Association



Source: Tenova Projections of copper levels in Japanese scrap to 2020

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Vision of FerroSilva

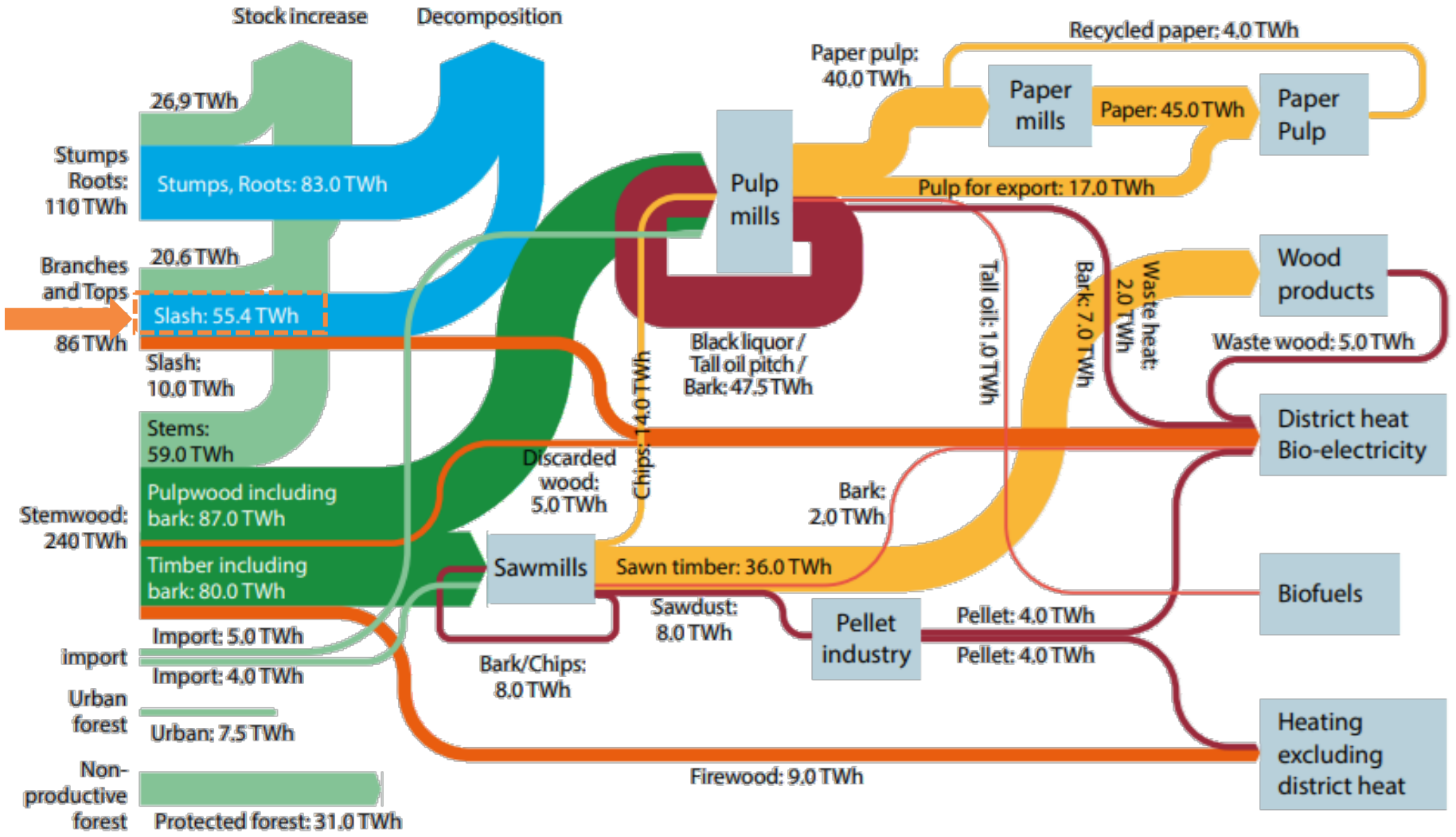
To radically reduce GHG emissions and bring the world:

- cost-competitive,
- carbon-negative,
- fully carburized

iron raw material and biochar for the Electric Arc Furnace steel production of the future.

Making best possible use of waste products from forestry and agriculture, generating only valuable by-products, such as biogenic liquefied carbon dioxide for e-fuels and more.

The Swedish forest-bioenergy system (TWh)



Why not
efficiently use the chemical energy inherent in biomass residue?

Why not
make use of residue that would otherwise emit Greenhouse Gases?

Why not
collect, liquefy and deliver green carbon for value adding processes?

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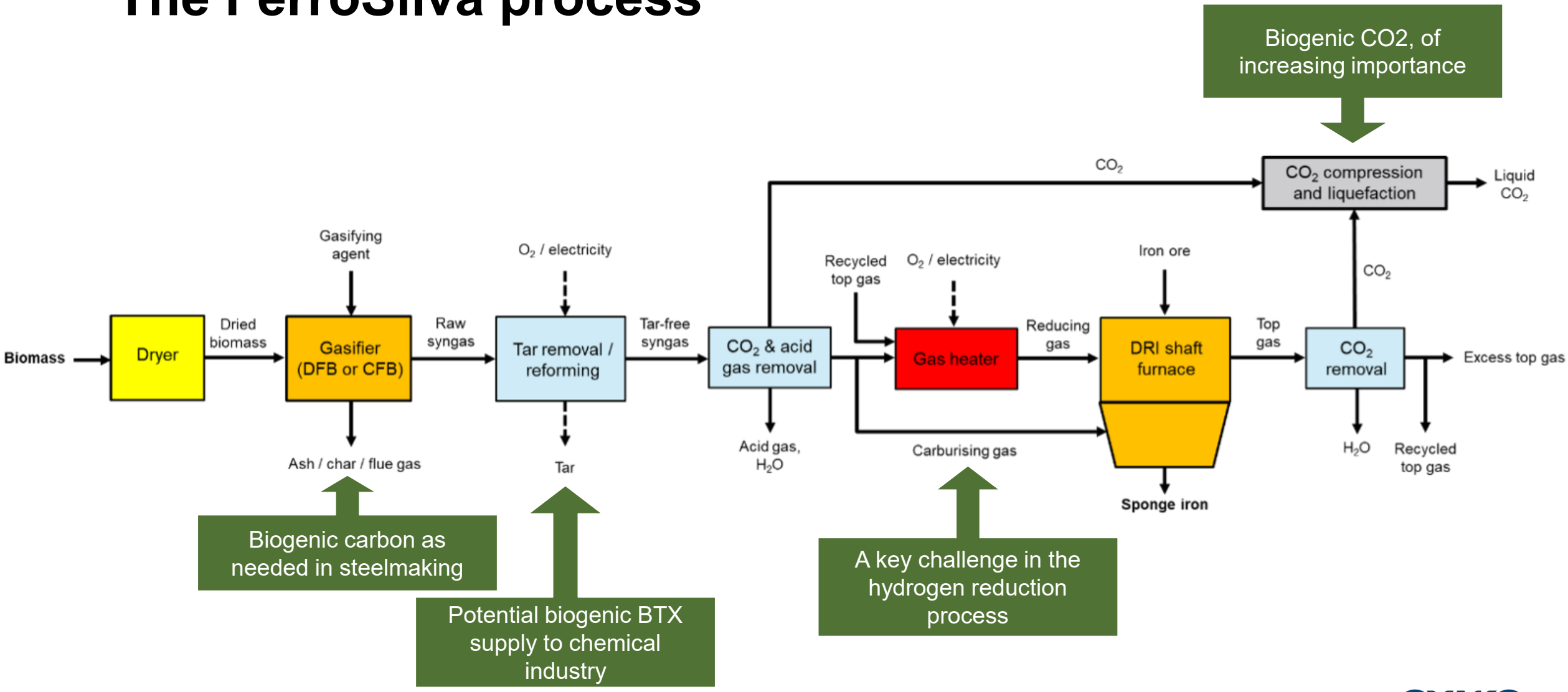
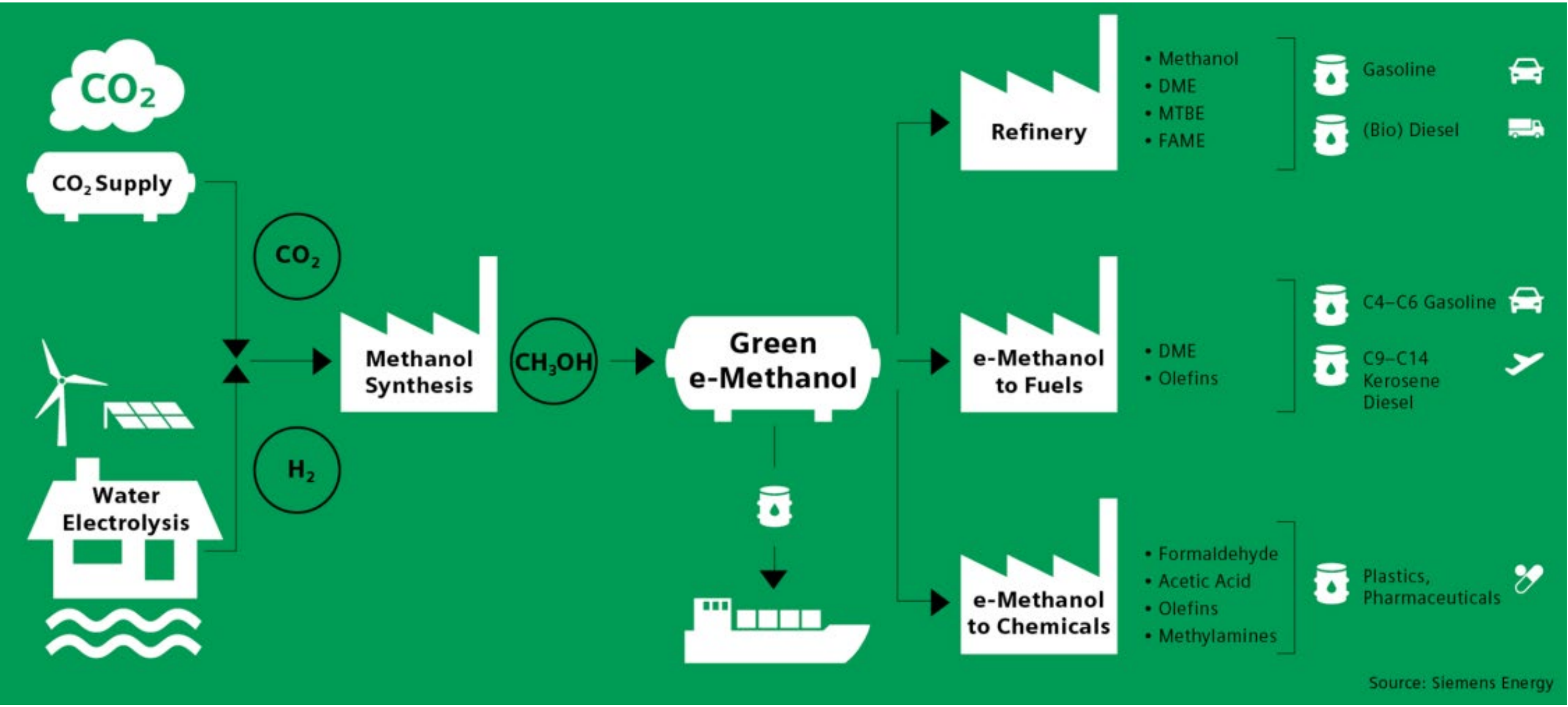
The FerroSilva process




CO_2
CO_2 Supply
CO_2
H_2
Water Electrolysis
Methanol Synthesis
CH_3OH
Green e-Methanol
Refinery
• Methanol
• DME
• MTBE
• FAME
Gasoline
(Bio) Diesel
e-Methanol to Fuels
• DME
• Olefins
C4–C6 Gasoline
C9–C14 Kerosene Diesel
e-Methanol to Chemicals
• Formaldehyde
• Acetic Acid
• Olefins
• Methylamines
Plastics, Pharmaceuticals
Source: Siemens Energy

FerroSilva vs the electrolyzer route

Significantly lower product cost

Much lower carbon footprint

A carbon-negative process

Valuable biogenic by-products

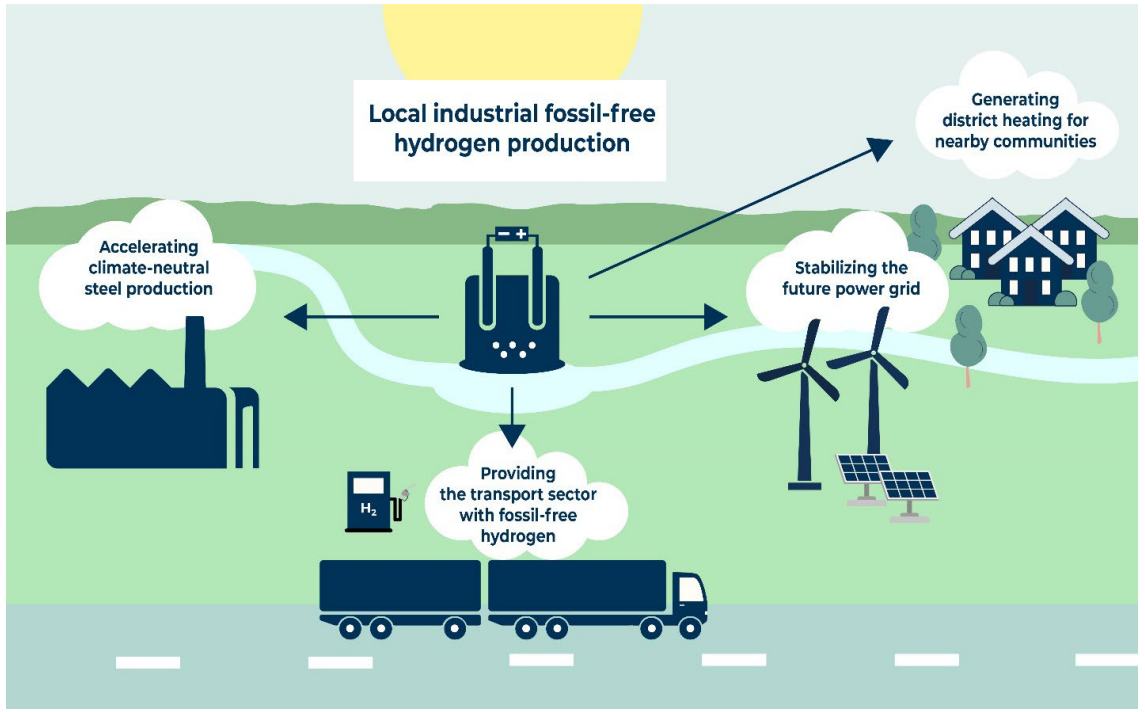
Much lower electricity needs

Higher technology maturity

In-process carburized DRI

In summary: Two uses of hydrogen with a large impact on GHG emissions that can be implemented rapidly

DRI with some 90% lower electricity need vs an electrolysis-based process



Hydrogen economy quick-started with no need for large initial infrastructure

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