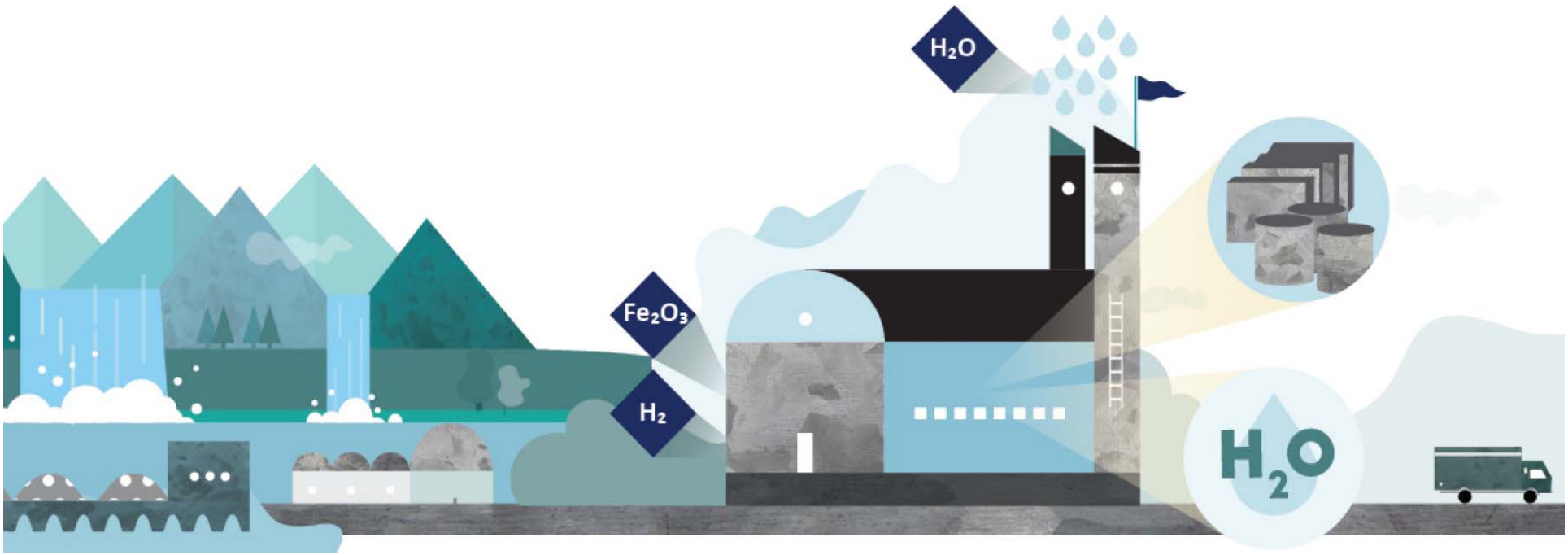
HYBRIT
FOSSIL-FREE STEEL

A joint venture between SSAB, LKAB and Vattenfall

HYBRIT –Towards fossil free steel



The world needs sustainable solutions

- Growing population, from 7 today to 9 billion year 2050
- Urbanization continues
- Need of new infrastructure
- Lack of resources
- Climate change and 2-degree C target

Steel – an important part of the solution

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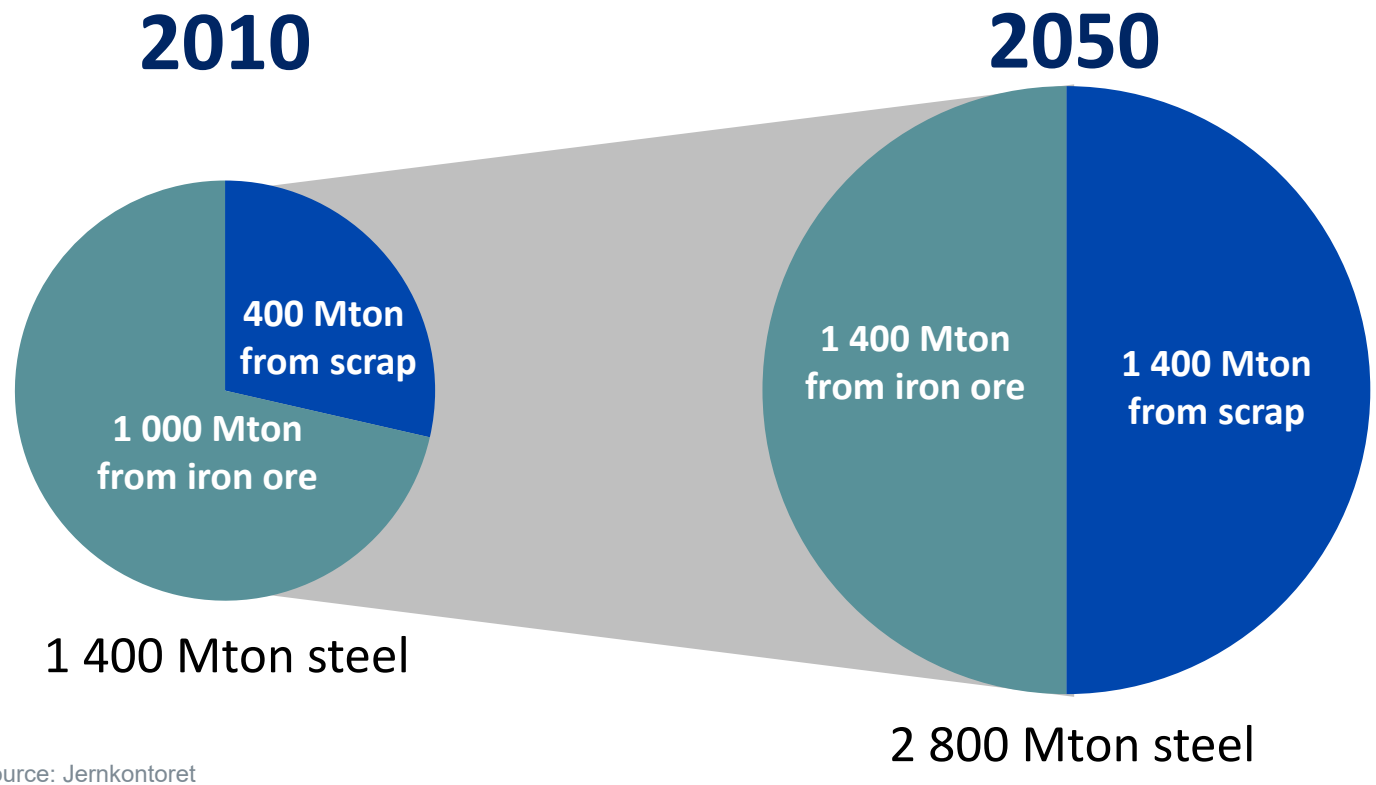
- Critical for society and new infrastructure
- Unique material and available everywhere
- 100% recyclable, again and again
- Global steel consumption per capita increased from 140 kg 2000 to 220 kg 2015

Increased demand for steel

In year 2050, approximately 50% of the global steel demand needs to be made from iron ore



Source: Jernkontoret

Long-term initiative for fossil-free steel (HYBRIT)

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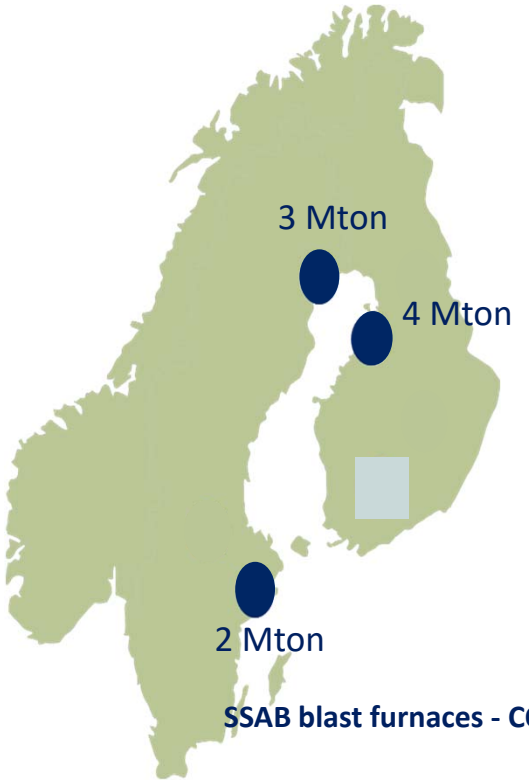
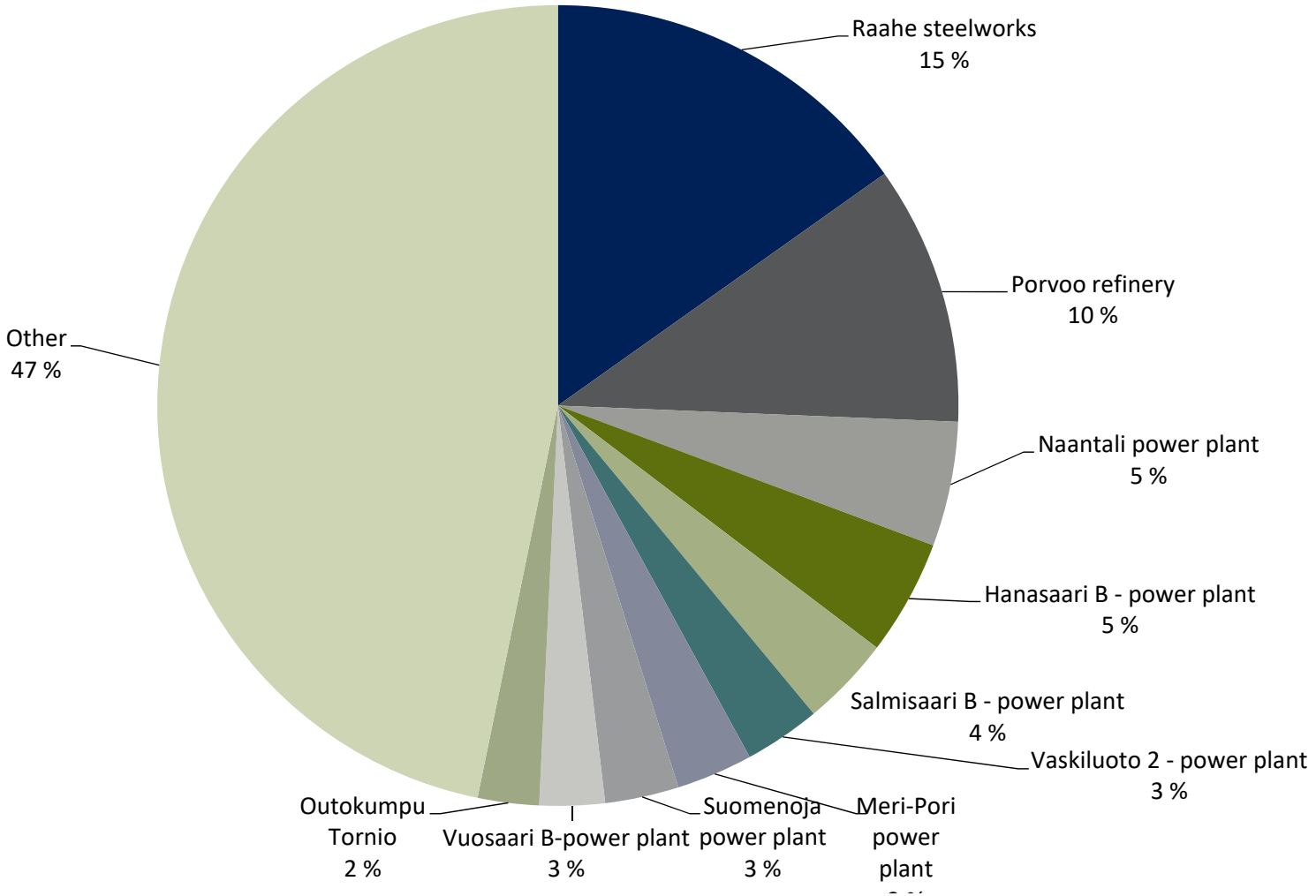


SSAB blast furnaces - CO_2 emissions

Background

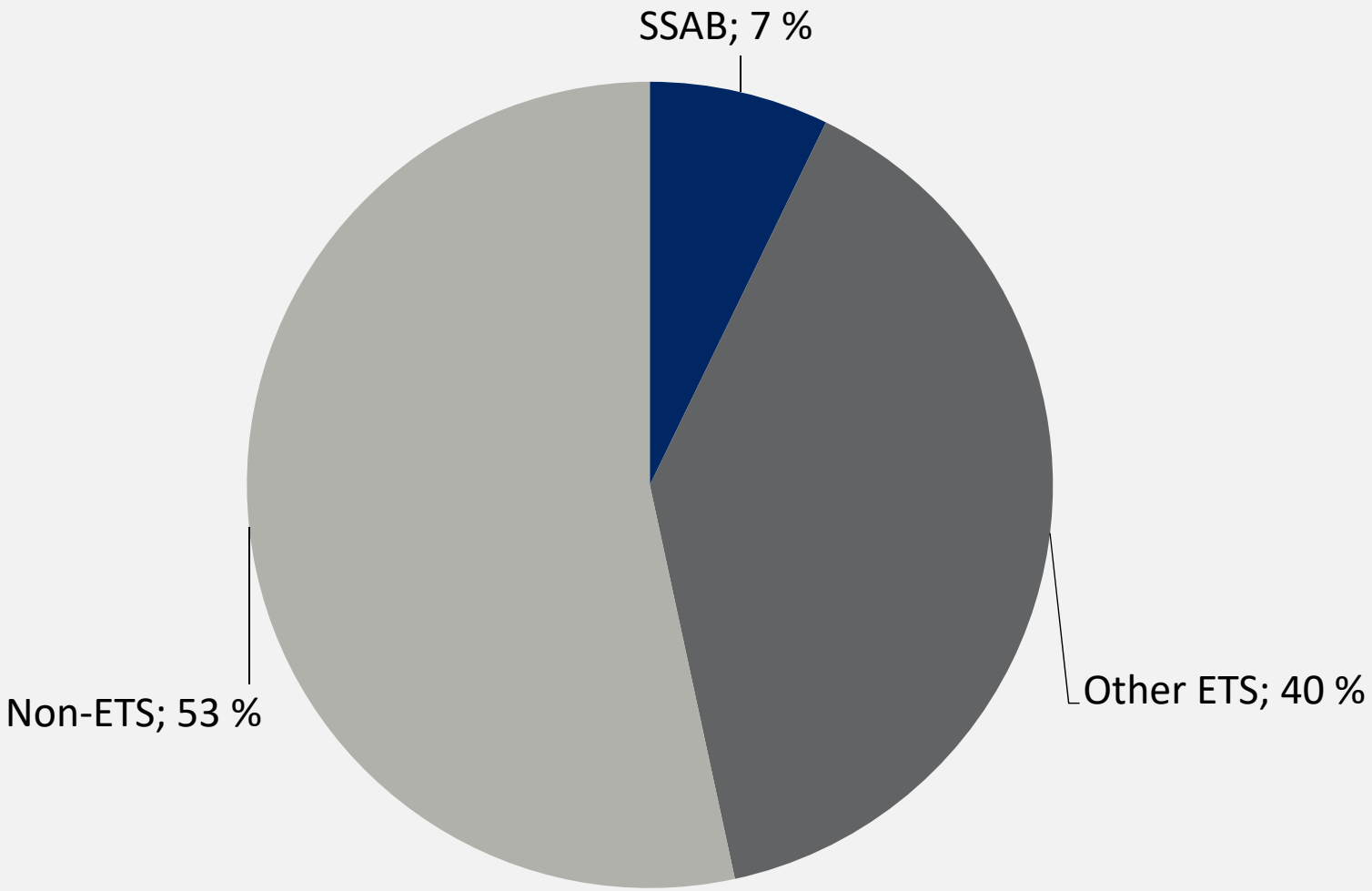
- In year 2050, approximately 50% of the global steel demand needs to be made from iron ore
- SSAB's blast furnaces close to theoretical minimum of CO_2-emission with today's technology
- Still SSAB stands for 10% of Sweden's and 7% of Finland´s total emission and ca 30% of ETS system in Sweden and 15% in Finland

Raahe´s share of the ETS sector´s GHG emissions in Finland



Total 27,2 Mt

SSAB´s share of the total GHG emissions in Finland



Total 58,8 Mt

HYBRIT-Towards fossil-free steel

- HYBRIT-towards fossil-free steel is a joint venture between SSAB, LKAB and Vattenfall.
- By using hydrogen instead of coke and coal in the steel making the ambition is to create a process that emits water – instead of carbon dioxide.
- The initiative was announced in the spring of 2016 and the joint venture was formed one year later. The research will go on until 2035.
- If successful, HYBRIT, would mean a major contribution to a fossil-free society.

Long-term initiative for fossil-free steel (HYBRIT)

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- Today coal and coke are used to produce iron. This creates carbon dioxide as a by-product.
- HYBRIT aims at using hydrogen instead. The by-product will then be water.
- Main challenges:
  - to develop an effective process to use 100% hydrogen on an industrial scale.
  - to produce hydrogen in an energy-efficient way so that it is economically justifiable.

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Fossil-free steel

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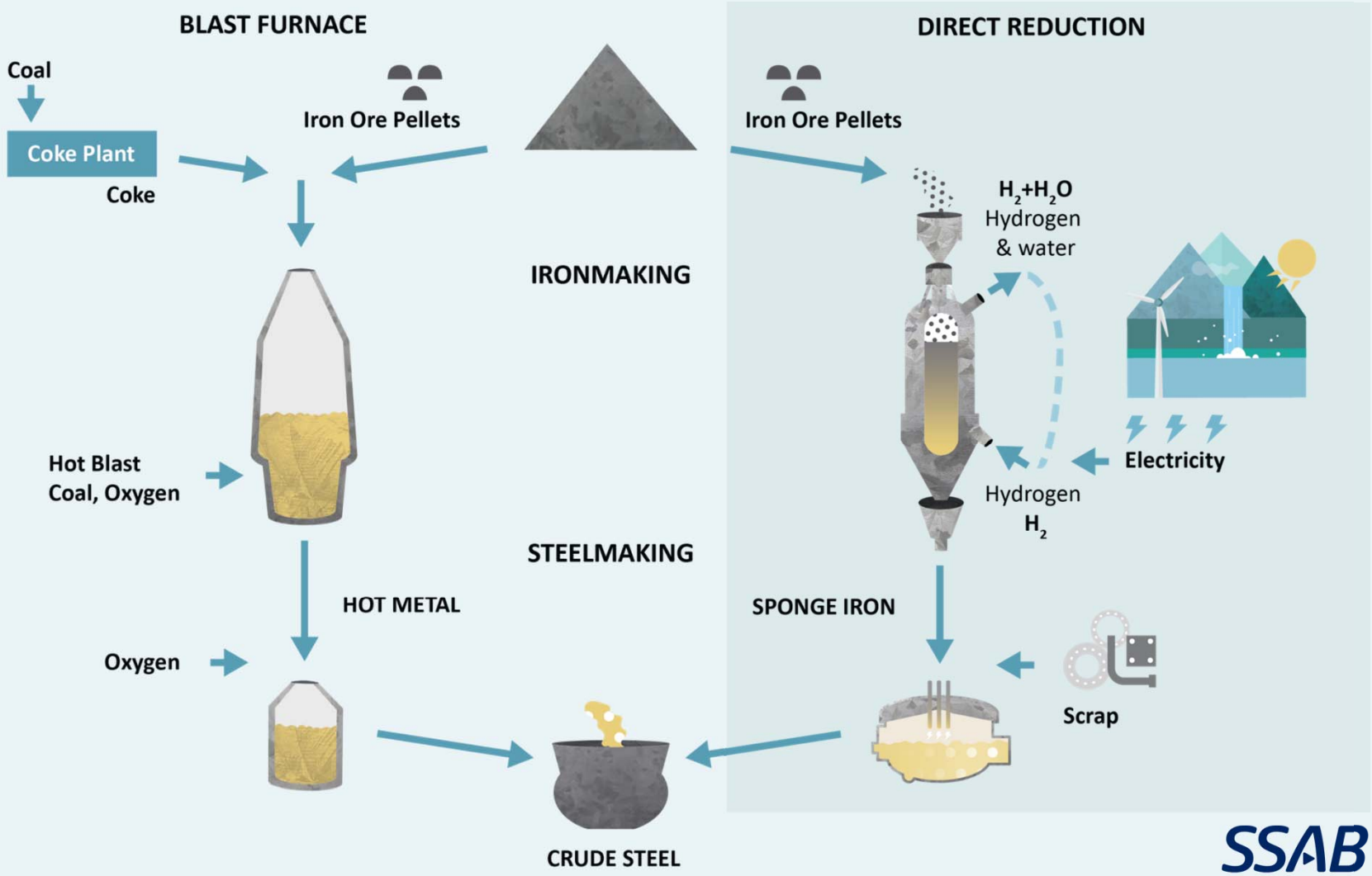
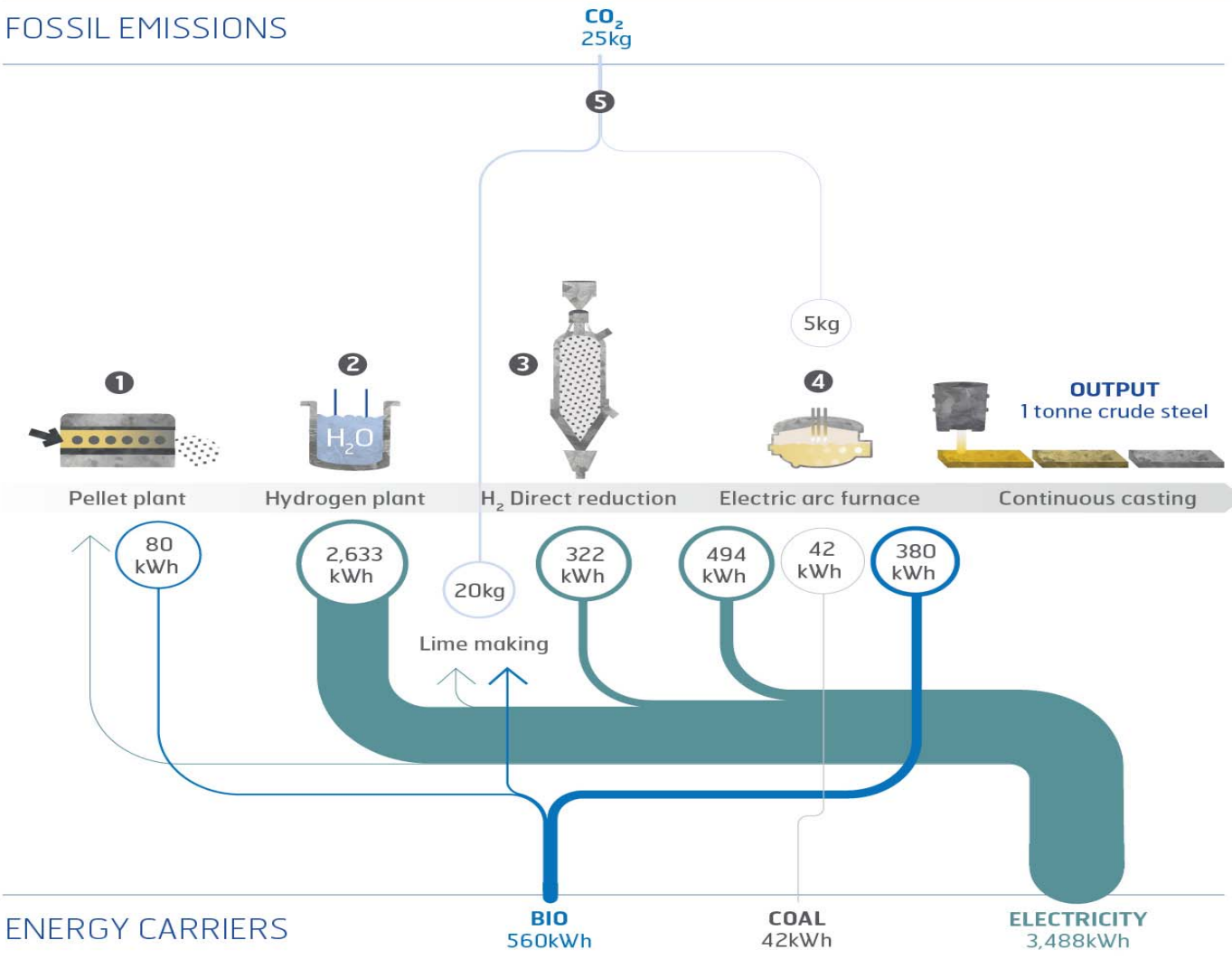


SSAB

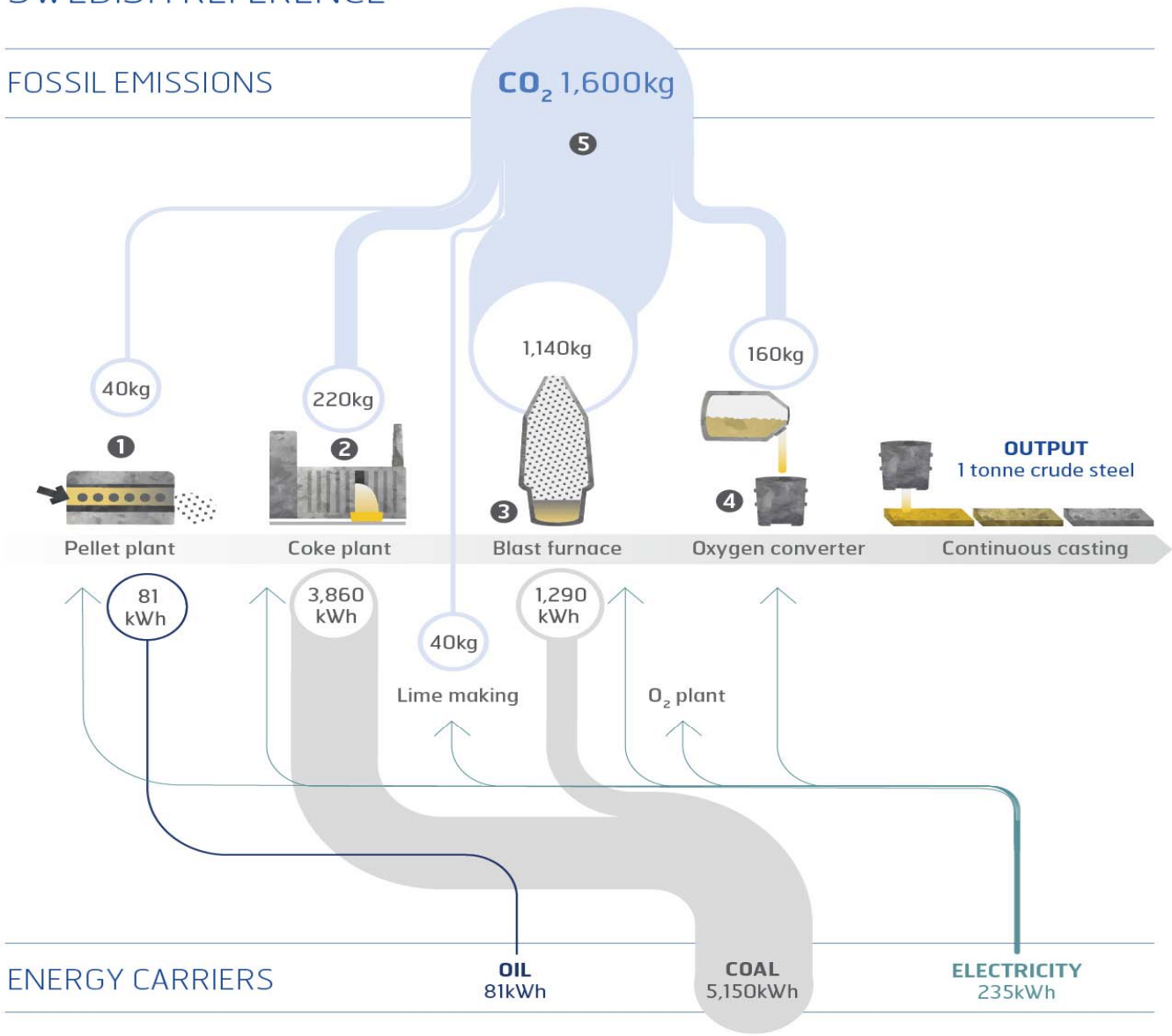
HYBRIT



All numbers per tonne of crude steel.

SWEDISH REFERENCE

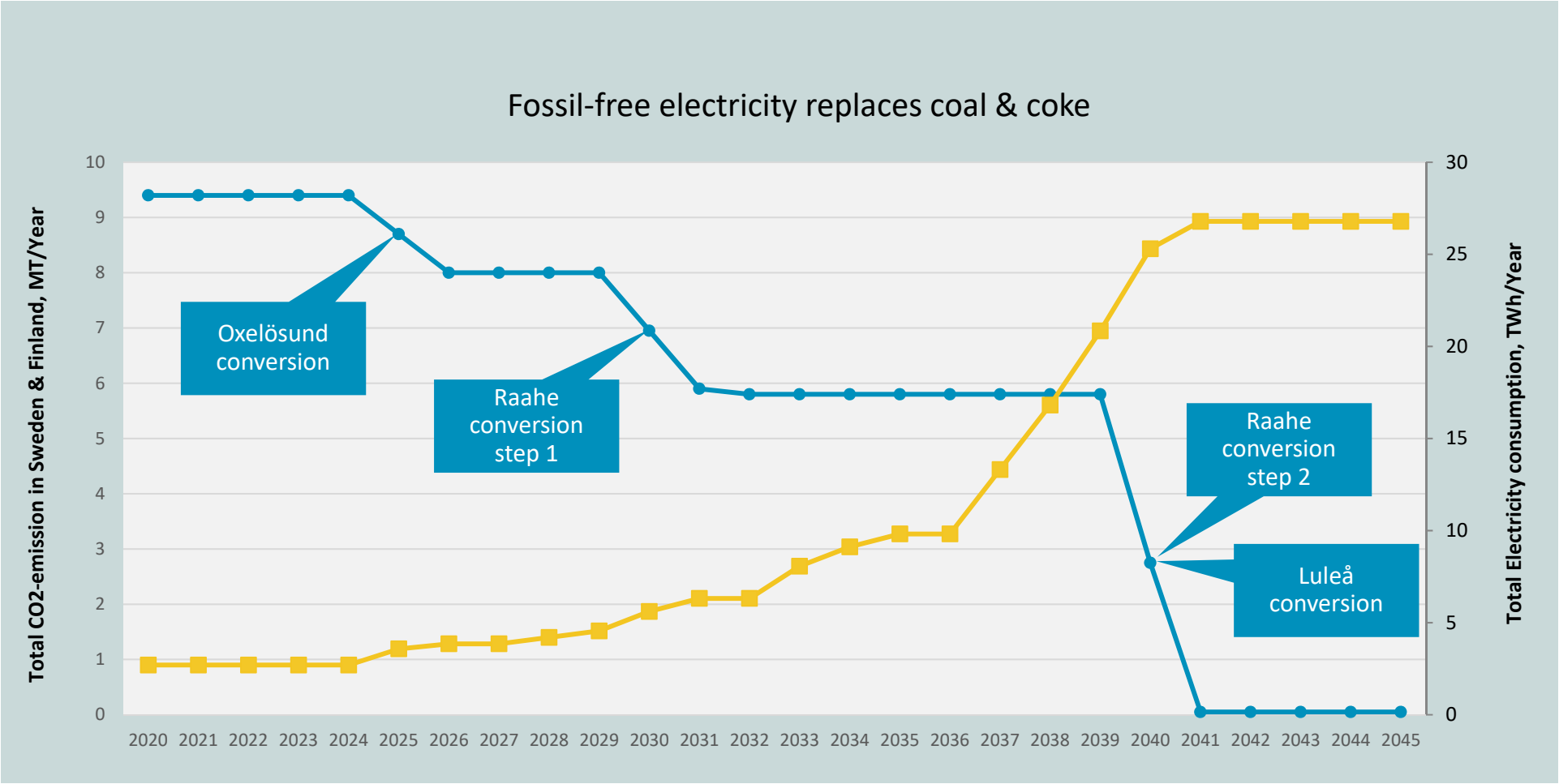
FOSSIL EMISSIONS



ENERGY CARRIERS

Principal system description. Numbers do not reflect a specific production site or time period.
All numbers per tonne of crude steel.

SSAB roadmap to reduce CO_2



Timeline for HYBRIT

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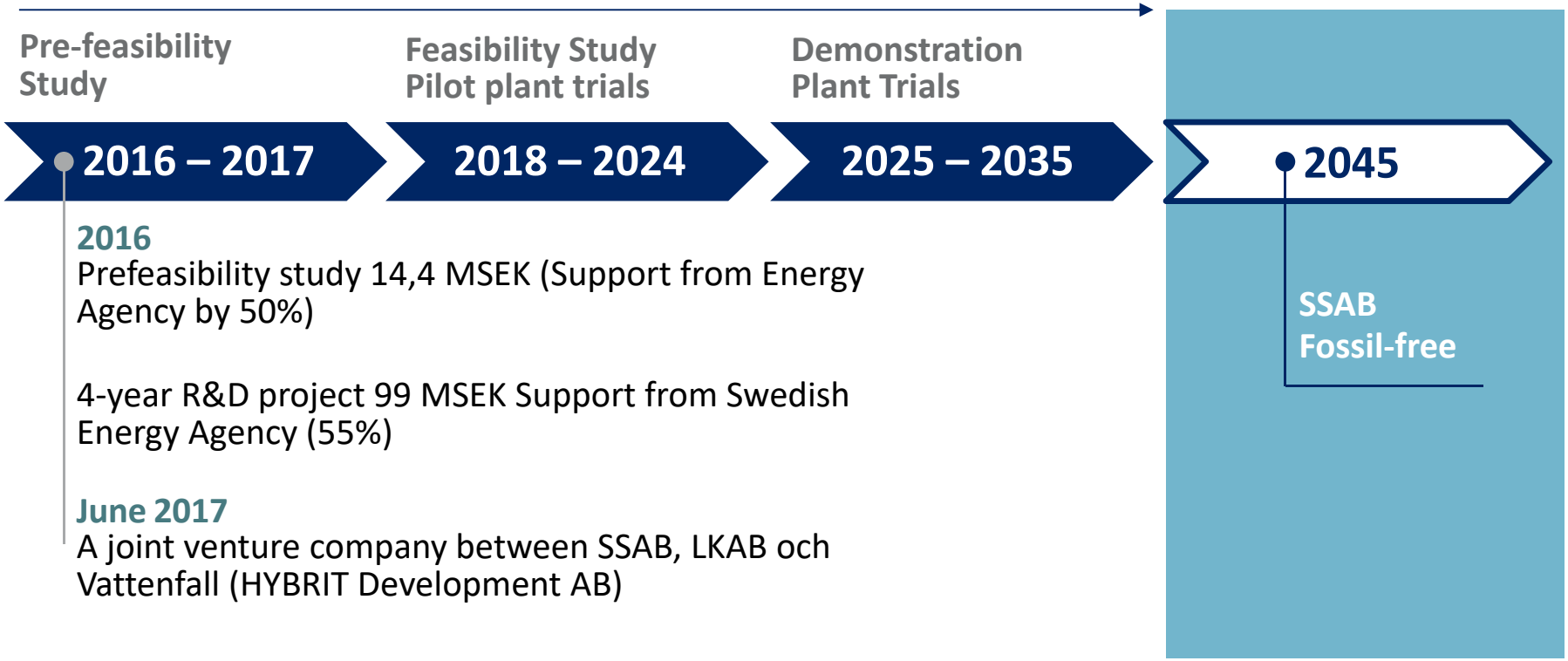

2016
Prefeasibility study 14,4 MSEK (Support from Energy Agency by 50%)

4-year R&D project 99 MSEK Support from Swedish Energy Agency (55%)

June 2017
A joint venture company between SSAB, LKAB och Vattenfall (HYBRIT Development AB)

A joint venture between SSAB, LKAB and Vattenfall

A unique opportunity

- A unique opportunity for HYBRIT:
  - Modern mining and steel industry
  - Good availability of CO2 emission free electricity
  - Outstanding research and development capabilities

- This project will help us to take important steps to reduce the CO2 emissions and make the necessary changes towards a more sustainable society.

- One of the initiatives that truly tries to move away from the root cause of the CO2-emissions from the steel making process

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