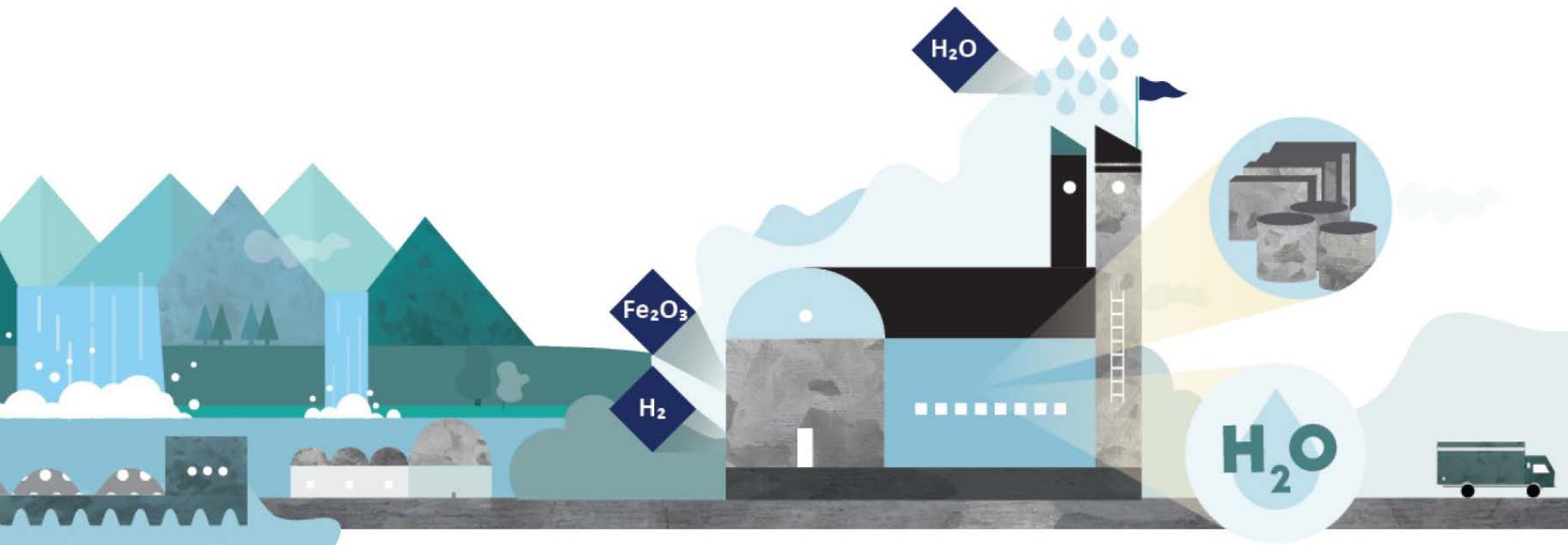


Time to make steel fossil-free



The world changes – and it requires steel

- ▶ Climate change, The Paris agreement and UN's global sustainability goals.
- ▶ Growing population from 7 billion today to 9 billion in 2050.
- ▶ Steel is necessary for building societies, infrastructure and well-being of people.
- ▶ Steel can be recycled over and over again.

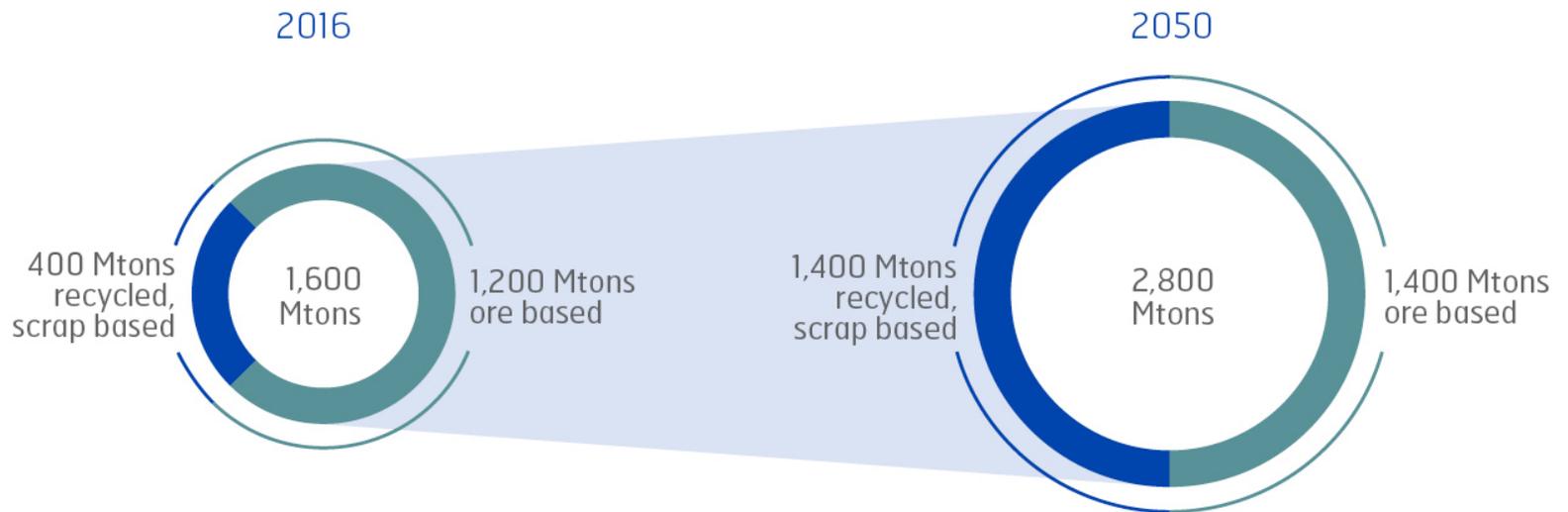


Mining, steel and electric power industry today

- ▶ SSAB's current steel production system is one of the most carbon-efficient in the world. Still, the steel industry is one of the highest carbon dioxide emitting industries, accounting for 7% of global CO₂ emissions. SSAB alone stands for 10% of Sweden's and 7% of Finland's CO₂ emissions.
- ▶ Sweden has unique conditions for initiatives like HYBRIT with good access to fossil free electricity, Europe's highest quality iron ore and a specialized and innovative steel industry.
- ▶ Before a solution for fossil-free steel is in place, SSAB will reduce their direct carbon dioxide emissions in Sweden by 25% about 2025, mainly due to process conversions.

Need for steel increases

Steel demand – today and forecast 2050



HYBRIT – a groundbreaking effort

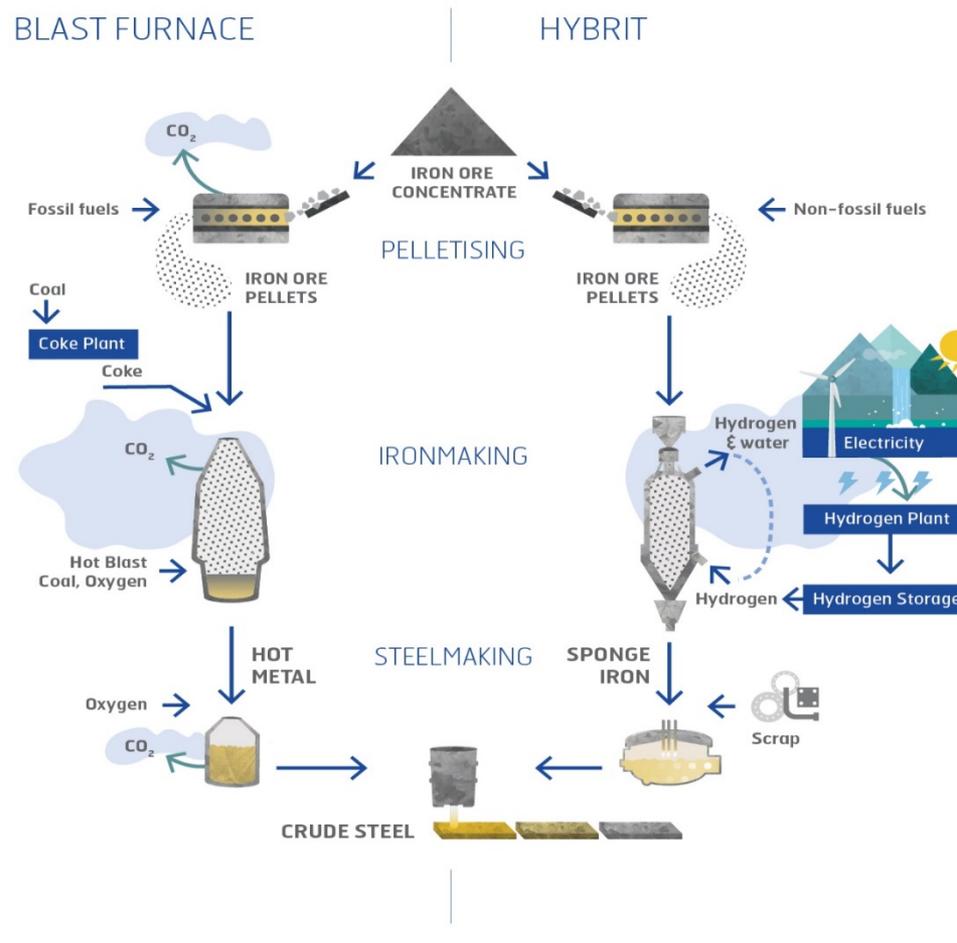
- ▶ Joint venture between LKAB, SSAB and Vattenfall established in 2016.
- ▶ Aiming to replace coking coal, traditionally needed for ore-based steel making, with hydrogen.
- ▶ The world's first fossil-free steel-making technology with virtually no carbon footprint. Emissions will become water.



Customers benefit from HYBRIT

- ▶ Helping customers create a strong environmental profile.
- ▶ Fossil-free steel as marketing tool.
- ▶ Competitive advantage for the entire value chain.

Taking the green route



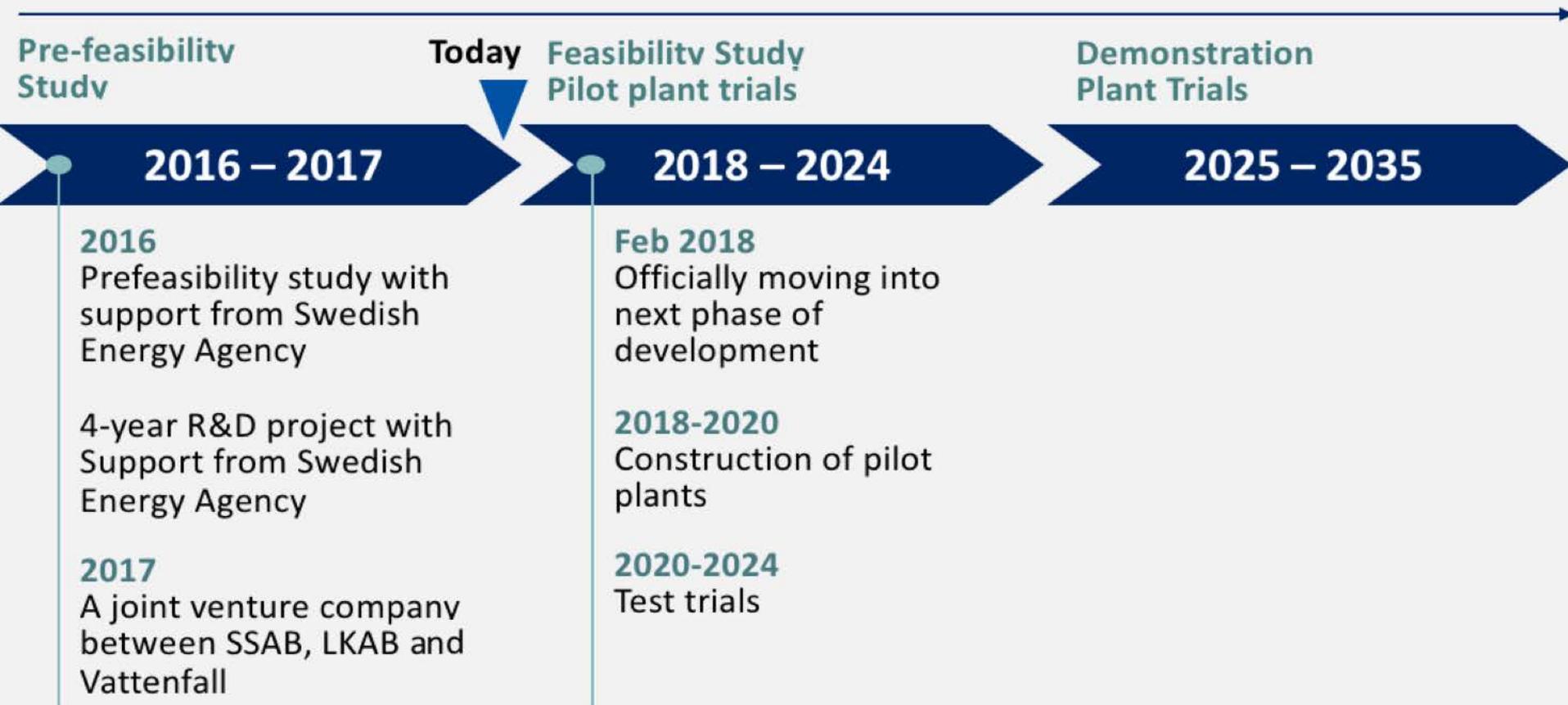
Main findings in pre-feasibility study

- ▶ A pre-feasibility study was conducted during 2016-2017. The study has strengthened our belief in HYBRIT. The study gives the green light to proceed to next phase.
- ▶ During the spring we will start to plan and design a world-unique pilot plant for fossil-free ore-based steel production in Luleå and Malmfälten.
- ▶ At the same time we will also investigate the possibility to broaden the initiative to Finland.
- ▶ Factors like the price of electricity, coking coal and carbon dioxide emissions will be crucial. However our assessment is that **fossil-free steel will be able to compete with traditional steel in the future.**
- ▶ Significant national efforts from the government and research institutes are still required.

Pilot plant in Luleå and Norrbotten iron ore fields

- ▶ Planning and designing the construction of a globally-unique pilot plant for fossil-free steel production in Luleå and Norrbotten iron ore fields, 250 km north west of Luleå, starts in spring 2018.
- ▶ The ground will first be broken before summer 2018.
- ▶ The initial work is estimated to cost SEK 20 million, half of which will be funded by the Swedish Energy Agency. SSAB, LKAB and Vattenfall will contribute the remaining SEK 10 million.

Progressing to the next phase

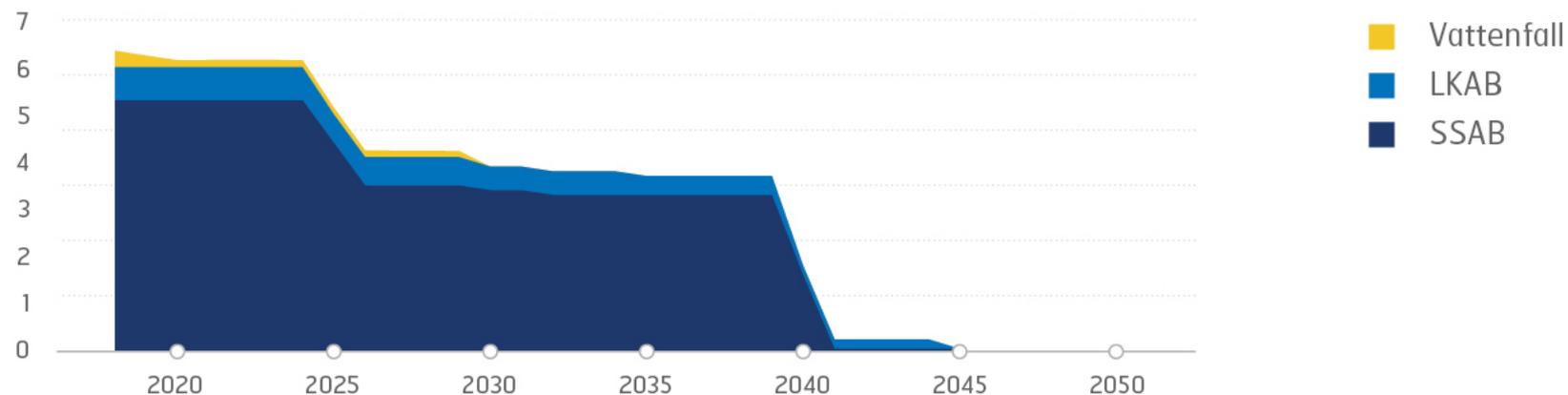


Stepwise CO₂ reduction

- ▶ SSAB's will reduce its CO₂ emissions by converting their blast furnaces to electric arc furnaces, starting 2025.
- ▶ LKAB will increase the energy efficiency, reduce the CO₂ emissions and change their process technology to reach a positive CO₂ balance by 2045.
- ▶ Vattenfall's goal is that both the company and its customers will be completely fossil-free within one generation.

Contribution to territorial Carbon footprint in Sweden

(Mtonnes/year)



Main challenges

To develop an efficient process to use 100% hydrogen on an industrial scale, which has never been done before.

To produce hydrogen in an energy-efficient way so that it is economically justifiable.

What do others do?

Several projects within the European steel industry are trying to **reduce** CO₂ emissions:

- CCS (Carbon Capture Storage)
- CCU (Carbon capture and utilization)

There are also projects aiming at **replacing** CO₂ :

- CDA (Carbon Direct Avoidance)

HYBRIT stands out because it has the most aggressive timeline to address **the root cause** of the CO₂ emissions.

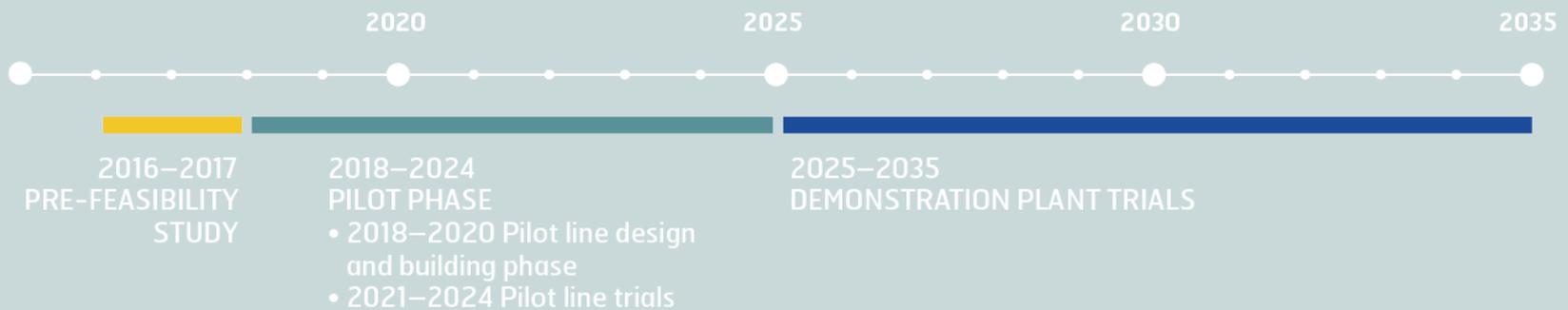
Longterm support from society needed

Most urgent is:

- ▶ Continued good access to fossil free electricity, improved infrastructure and rapid expansion of high voltage nets for electrification of the mining and steel industry, eg a 400 kV power line is a prerequisite for a conversion of the blast furnace in Oxelösund in 2025
- ▶ Competence development and funding for research in the relevant areas of knowledge
- ▶ Faster processes for permission to build pilot and demonstration plants and to reach climate targets
- ▶ The government's active support for pilot and demonstration plants, as well as support for creating long-term conditions for the initiative at EU level.

When is HYBRIT ready?

Main project phases



HYBRIT

 **FOSSIL-FREE STEEL**

A joint venture between SSAB, LKAB and Vattenfall