Low-Carbon Steel Production

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ACT & CETP Knowledge Sharing Workshop

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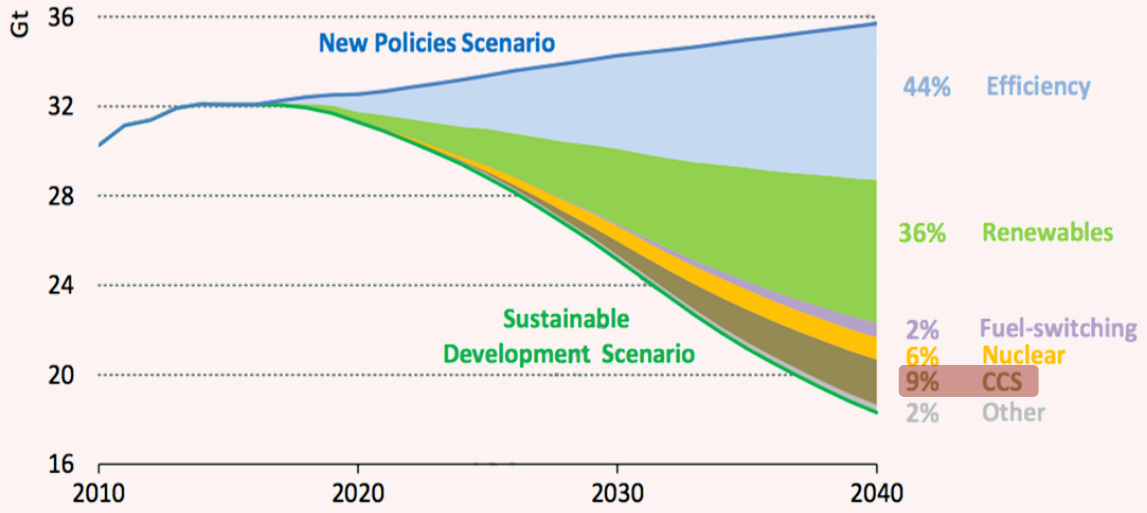
The GreenSmith project has received funding from RVO (The Netherlands), SWEA (Sweden) and MIMIT (Italy) under the umbrella of the CETPartnership

Why CCS and CCU in Iron and Steel ?

IN ALL SCENARIOS RELATED TO THE PARIS GOALS, CCS AND CCU PLAY A ROLE

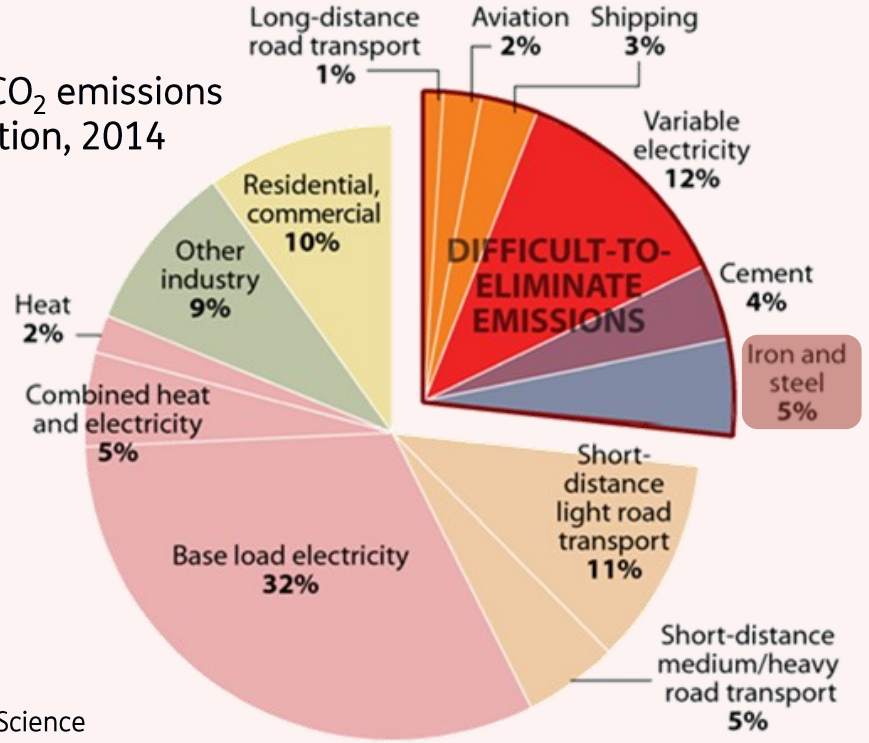
Global CO_2 emissions reductions in the New Policies and Sustainable Development Scenarios



2017 IEA - World Energy Outlook

AN IMPORTANT REASON FOR THIS IS THAT OVER 25% OF CO_2 EMISSIONS ARE DIFFICULT TO AVOID WITH OTHER MEASURES

Global CO_2 emissions distribution, 2014



Davis et al, Science

Challenge for Iron and Steel

Facts

- Iron & Steel: 3.0 $GtCO_2/yr$ = 7% of the world wide CO_2 industrial emissions
  1.7 - 1.9 ton of CO_2 per ton steel (typical European values)
  360,000 employees in EU

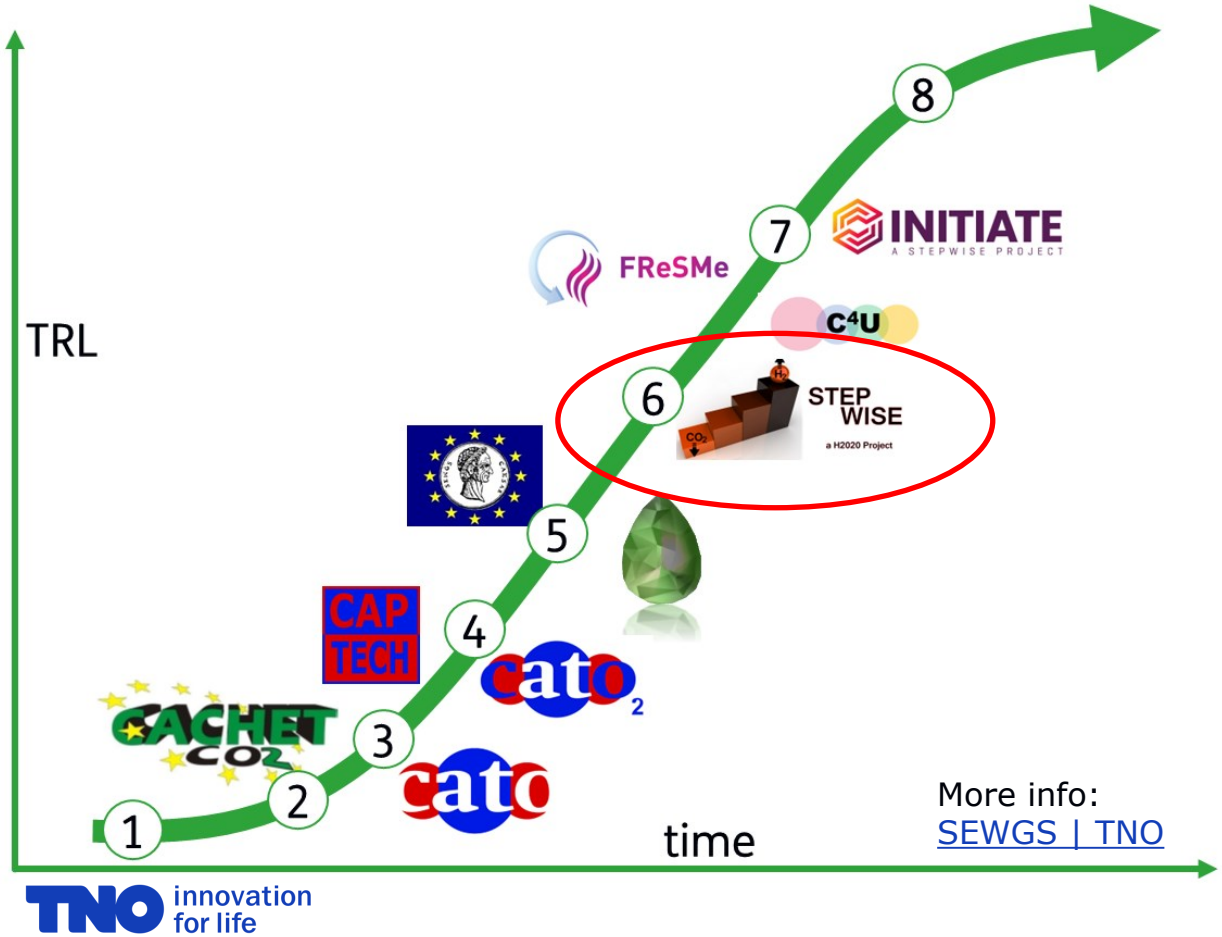
Reduce CO_2-footprint

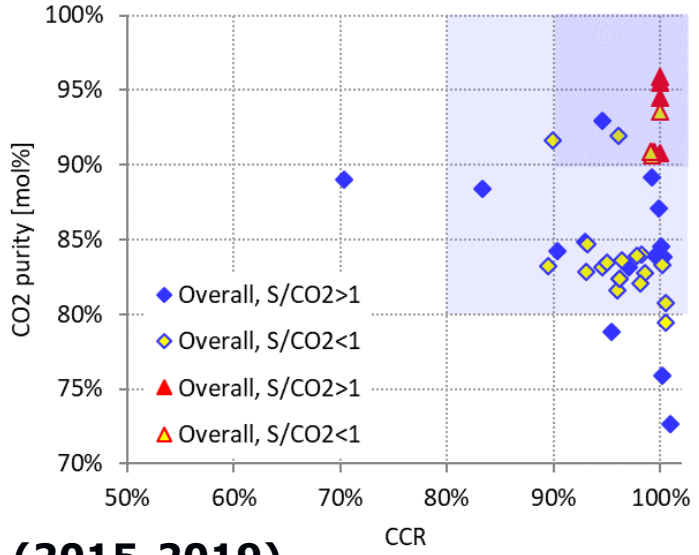
- Recycle more scrap
- Improve efficiency of iron making e.g. Hisarna
- Switch reductants e.g. H_2, electrical routes
- Capture CO_2 and permanent sequestrate

Green Smith

STEPWISE Technology applying Sorption Enhanced Water-Gas Shift (SEWGS)

STEPWISE technology





STEPWISE (2015-2019)

CO_2 capture from residual steel-off gases for power generation

High efficient capture performance

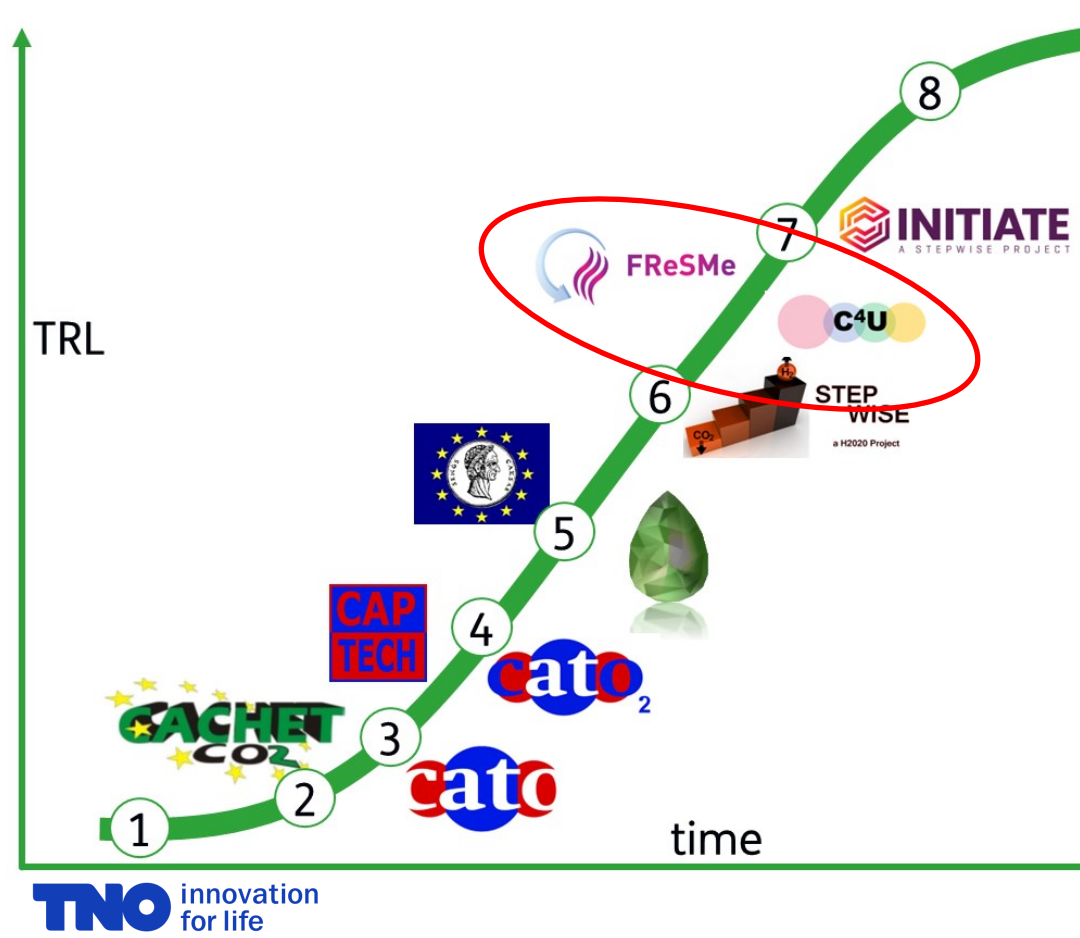
A SPECCA of less than 2 MJ/kg

Up to 35% cost advantage compared to state-of–the–art capture solutions

Lower impact on all LCA factors relative to amine scrubbing technologies

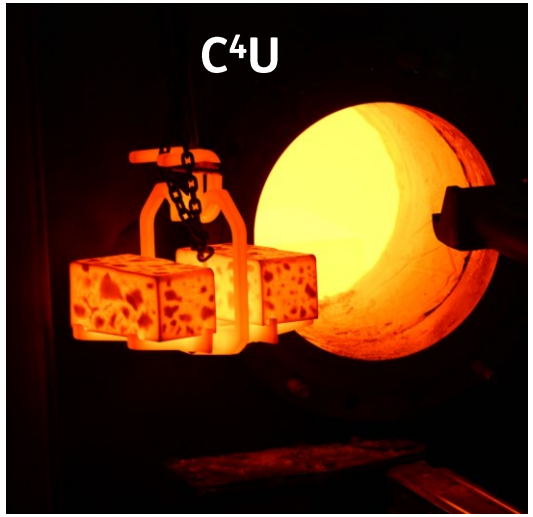
Publications:
https://doi.org/10.3390/su11071825
https://doi.org/10.1016/j.egypro.2017.03.1764
https://doi.org/10.1016/j.ijggc.2019.102935

STEPWISE technology



C⁴U (ongoing, start 2020)
Full decarbonisation of traditional steel mills

First time demonstration of decarbonised blast furnace gas as fuel for reheating furnaces

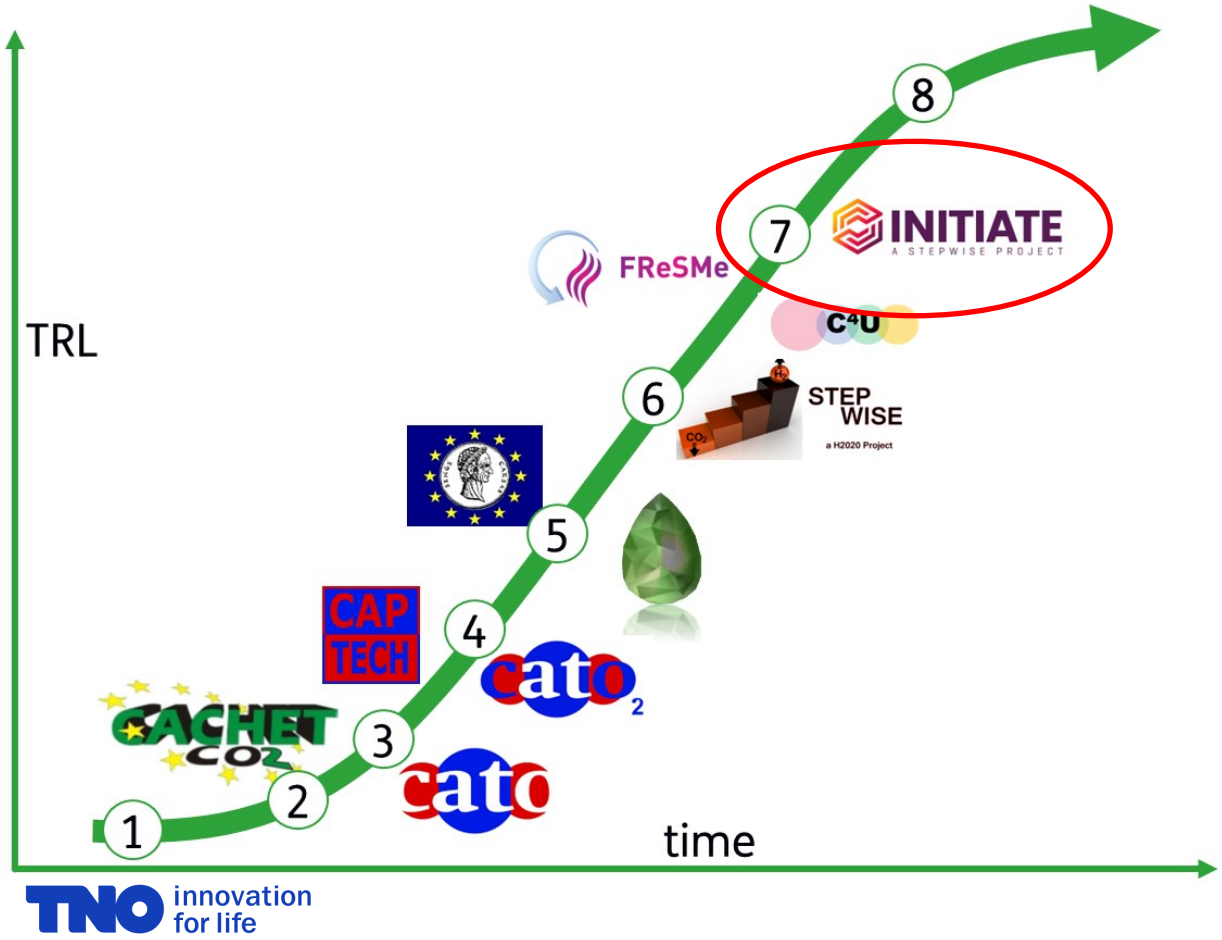


FReSMe (2016-2021)
Methanol production from residual steel residual gases

Demonstration of full production chain from steel residual gases to methanol used on STENA ferry

Positive business case for valorising energy content of the residual gases for MeOH production

STEPWISE technology

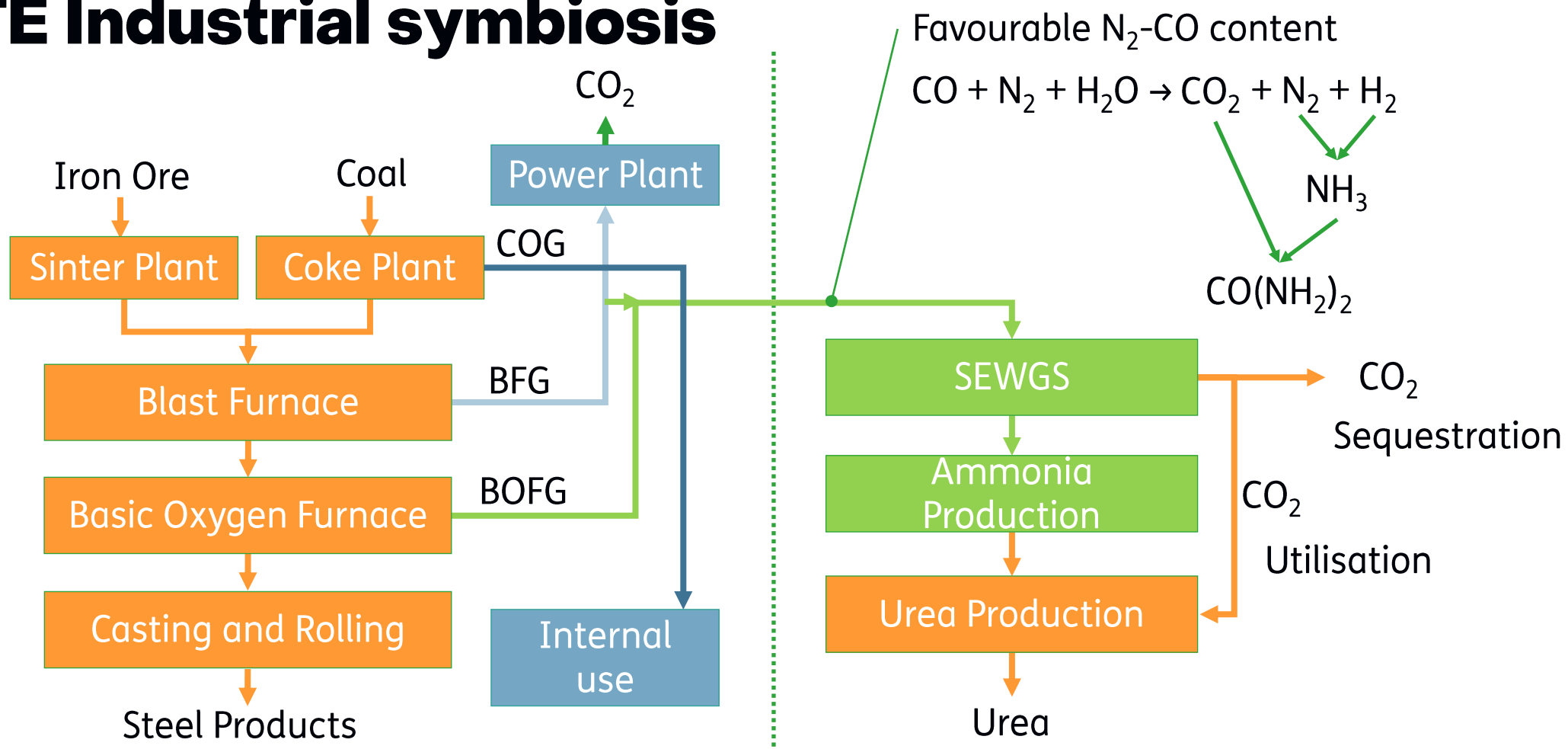


INITIATE (ongoing, start 2020)

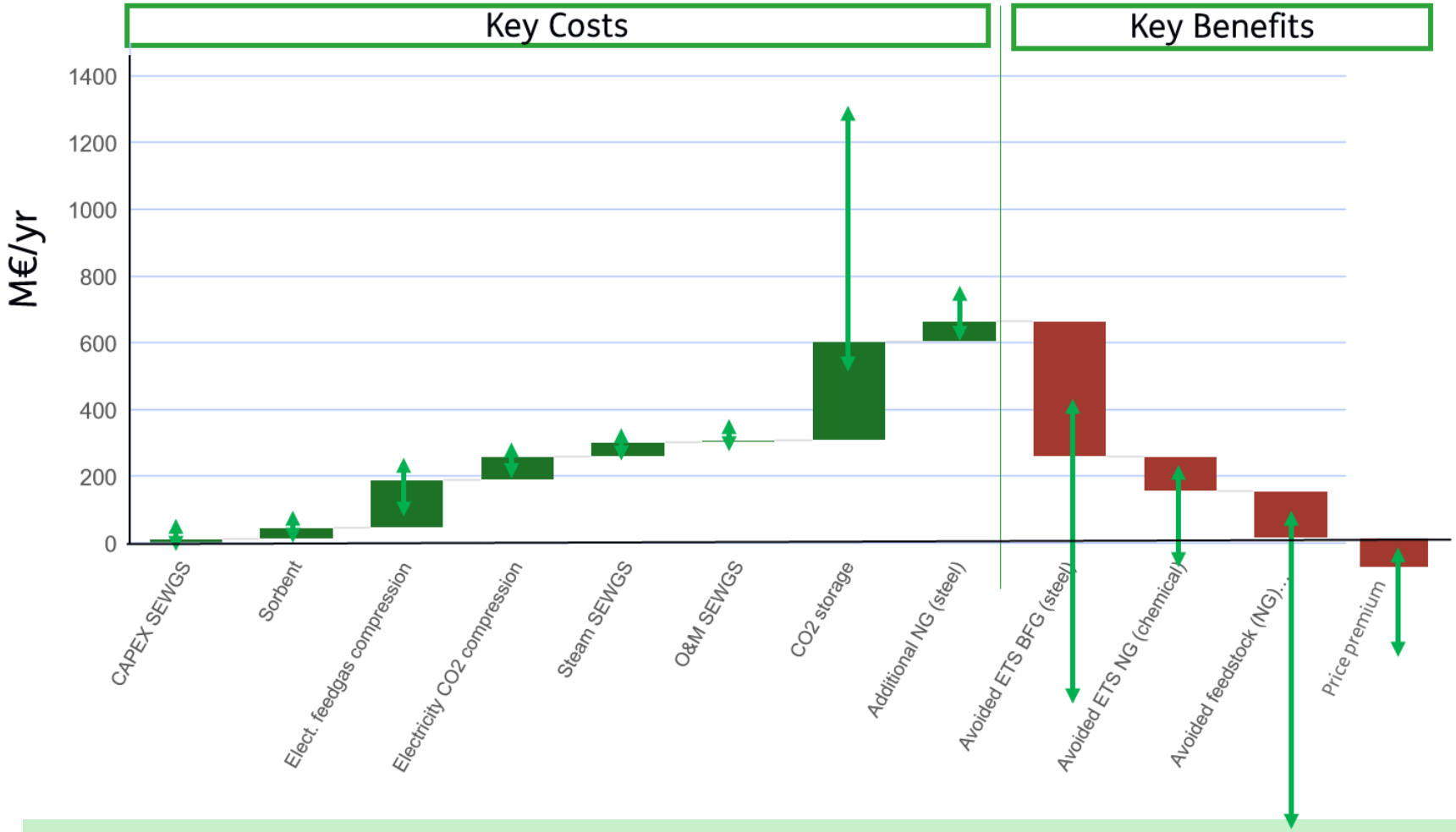
Industrial Symbiosis between the Iron & Steel and NH_3 & Urea industries

https://www.initiate-project.eu/

INITIATE Industrial symbiosis



INITIATE – Key cost drivers and uncertainties



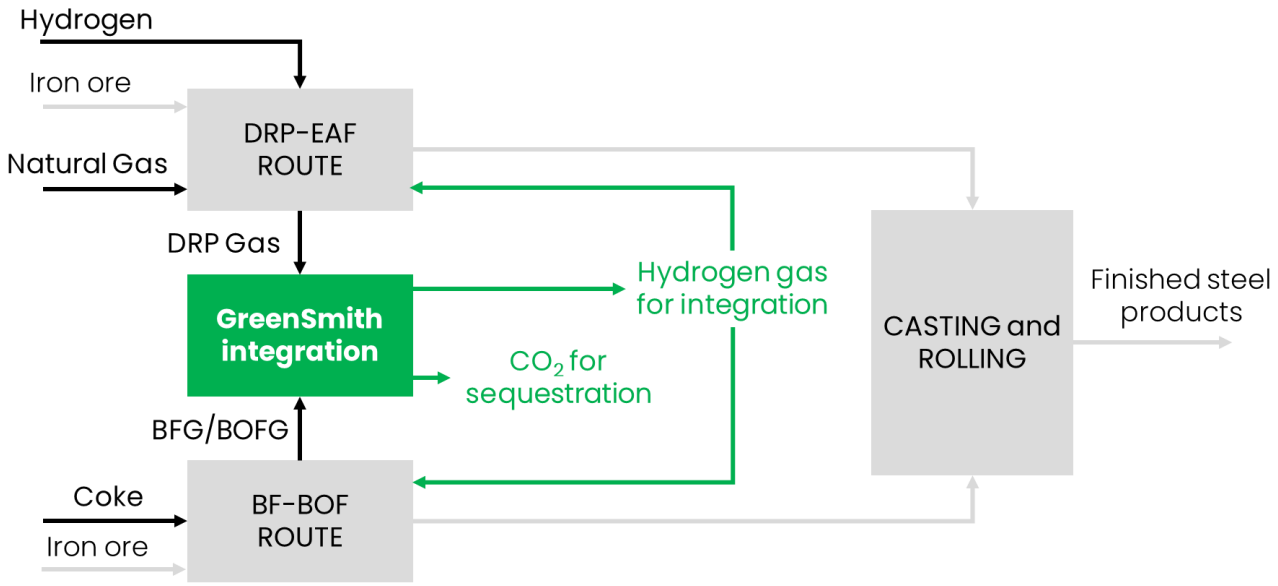
Summary key uncertainties

Level	Key drivers and uncertainties
EU	• ETS price • CBAM / free allowances • RED3 fuels/chemicals
EU + local	• Legal • Extra price/value products • Subsidies
Local	• CO_2 storage costs, specs, availability • Market volume products • Green electricity / natural gas costs & availability • H_2 costs & availability
Internal (consortium)	• SEWGS OPEX • Production at scale • Chemical plant availability (CAPEX)

Positive business case, but some large uncertainties remain - mainly on benefit side

The GreenSmith Project

Demonstration of hydrogen recovery from various integration routes of BF and DRP:



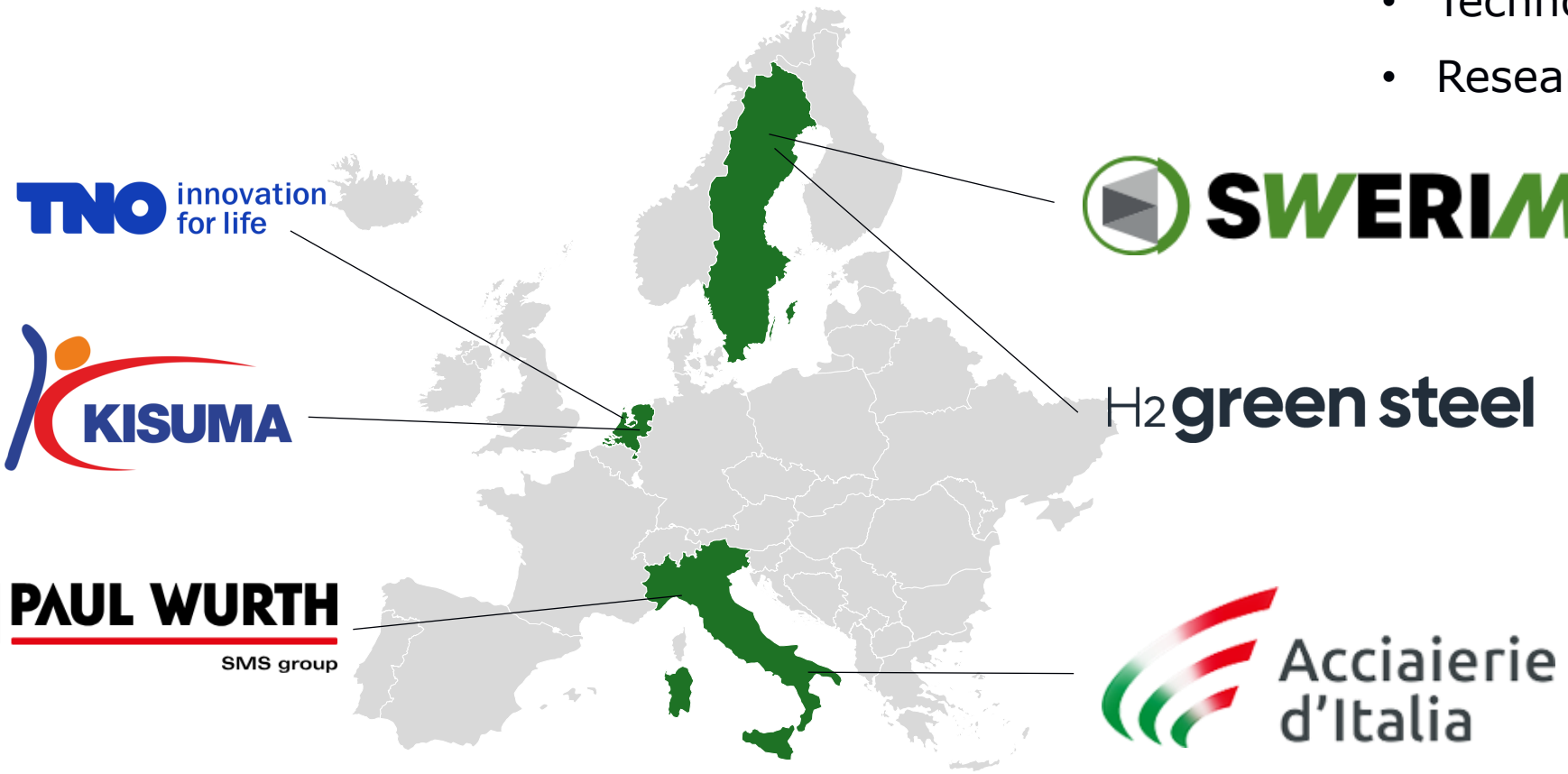
Main Goals:

1. Development of a novel shaped sorbent
2. TRL5 demonstration of H_2 recovery from various gas streams (BF, CH_4 and H_2 based DRP)
3. Basic Engineering Design Package for TRL8 roll-out
4. Conceptual design, TEA and LCA for two large-scale implementation cases

GreenSmith – Partners

Full Value Chain covered:

- End-Users
- Technology Suppliers
- Research organisations



TNO innovation for life

KISUMA

PAUL WURTH SMS group

SWERIM

H2 green steel

Acciaierie d'Italia

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