ESTEP SPRING DISSEMINATION EVENT

17-18 FEBRUARY 2026 - BRUSSELS (BELGIUM)

Green Smith

Low-Carbon Steel Production

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SMS Group

ESTEP

Overview

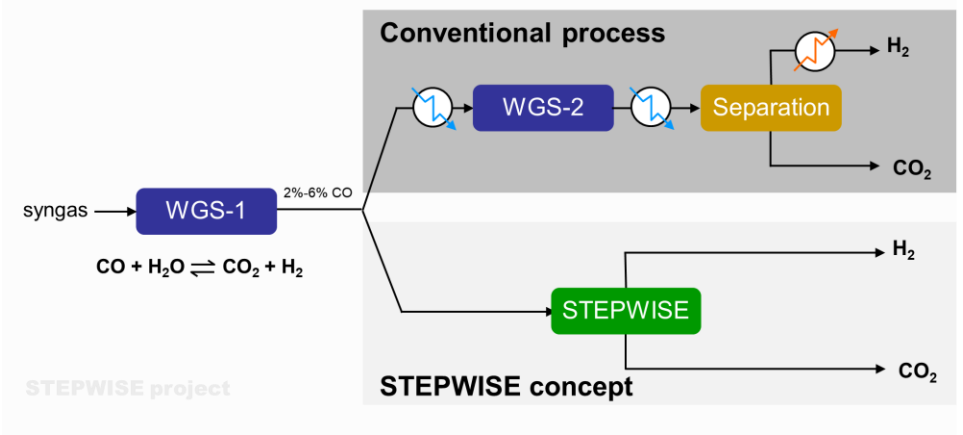
1. SEWGS technology, history and applications in the Iron and Steel sector
2. The GreenSmith project
3. Takeaways

1. SEWGS technology, history and applications

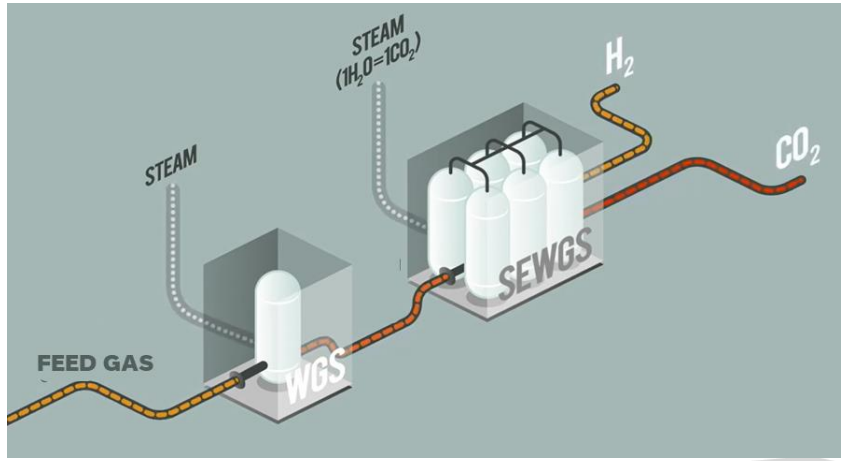
SEWGS technology: simultaneous CO_2 capture and Blue H_2 production

- **SEWGS** combines **pre-combustion CO_2 capture** and **Water Gas Shift (WGS)** in a single unit
- **WGS reaction**: (catalytic, exothermic, steam injection required)
- **Adsorption step**: CO_2 is captured on hydrotalcite sorbent, driving higher CO conversion and boosting Blue H_2 production.

$$CO + H_2O \rightarrow CO_2 + H_2$$

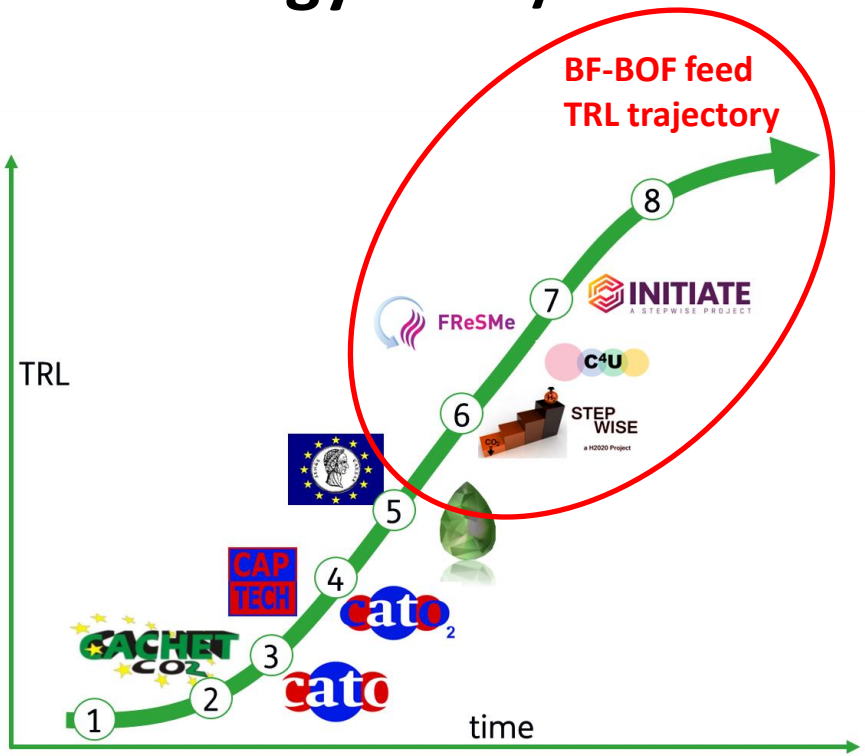


- **Outputs:**
  - High-pressure, Blue H_2 stream during adsorption phase*
  - **CO_2-rich** stream during sorbent regeneration phase.



* if feed gas contains N_2 (e.g. BFG), it exits with Blue H_2 stream

SEWGS technology history



STEPWISE (2015-2019)

Decarbonization of Bf gas CO_2 capture from steel gases for power generation

- **Energy efficient:** A SPECCA of less than 2 MJ/kg
- **Cost efficient:** Up to 35% cost advantage compared to state-of–the–art capture solutions
- **Robust demonstration**:
  - 2 campaigns, 5000 cycles over 112 days of operation
  - WGS operation as low as steam/CO=1.5 mol/mol demonstrated
  - >90% sulphur removal, <1ppm slip in H2-product
  - BFG operation: > 90% CO2 purity and > 90% CCR at S/Csewgs < 1.0 mol/mol demonstrated
  - 1st time demonstration of industrially produced sorbent material

FReSMe (2016-2021)

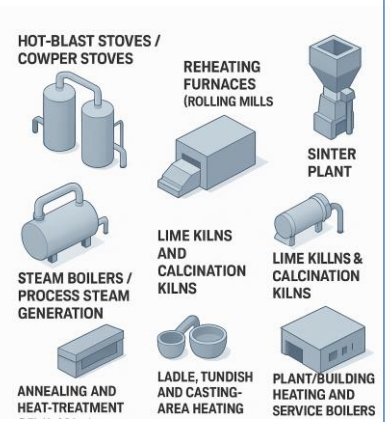
- **CCUS:** Demonstration of full production chain from BFG to methanol

INITIATE (2020-ongoing)

- 1st campaign showed improved sorbent formulation performance
- Suitability of WGS and SEWGS materials for BOFG operation
- **3 column SEWGS system** successfully demonstrated to reach high CCR and CP

SEWGS applications in the Iron and Steel sector

Heating application



Power Plant

<38% efficiency wasted energy

Biomass Gasifier

STEAM

STEEL GASES

BOF

BF

DRP

H_2 -rich

SEWGS (+PSA)

CO_2

Use in chemical facilities or storage

STEAM

SEWGS (+PSA)

Green H_2 -rich

H_2 -rich

CO_2

Use in chemical facilities or storage

Process application

BF

DRP

OBF or H_2 Smelting Reactor

Fluidized bed

H2 to market / value added chemicals production

Platform technology → flexible, multipurpose application

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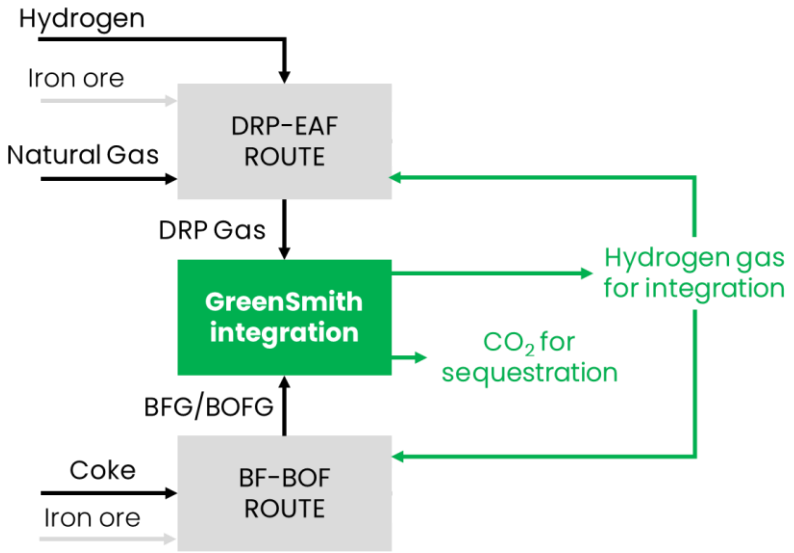
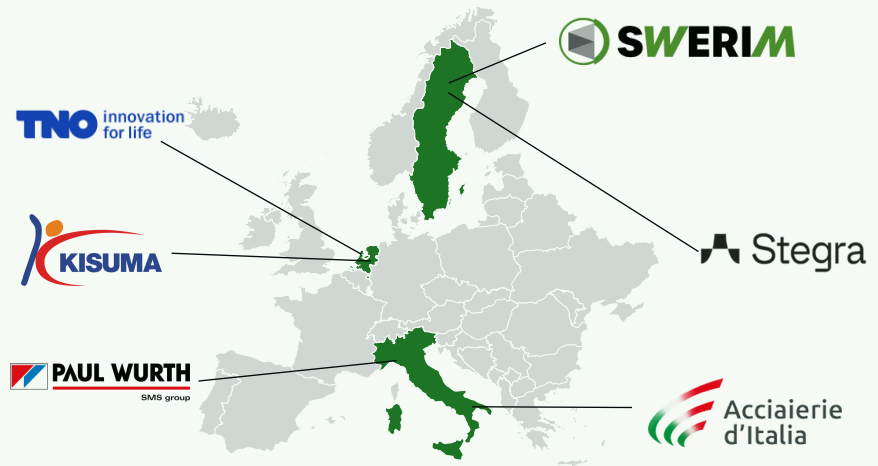
2. GreenSmith project

GreenSmith

Demonstration of **multiple integration routes** of BF, CH_4- and H_2- based DRP advancing the decarbonization of Iron and Steel and maintaining a competitive plant configuration via SEWGS technology implementation





Project Passport	
Duration	July 2024- Sept 2026
Budget	2.8 M€
Consortium	Full Value Chain covered: • End-Users • Technology Suppliers • Research organisations

cet Partnership

Co-funded by the European Union

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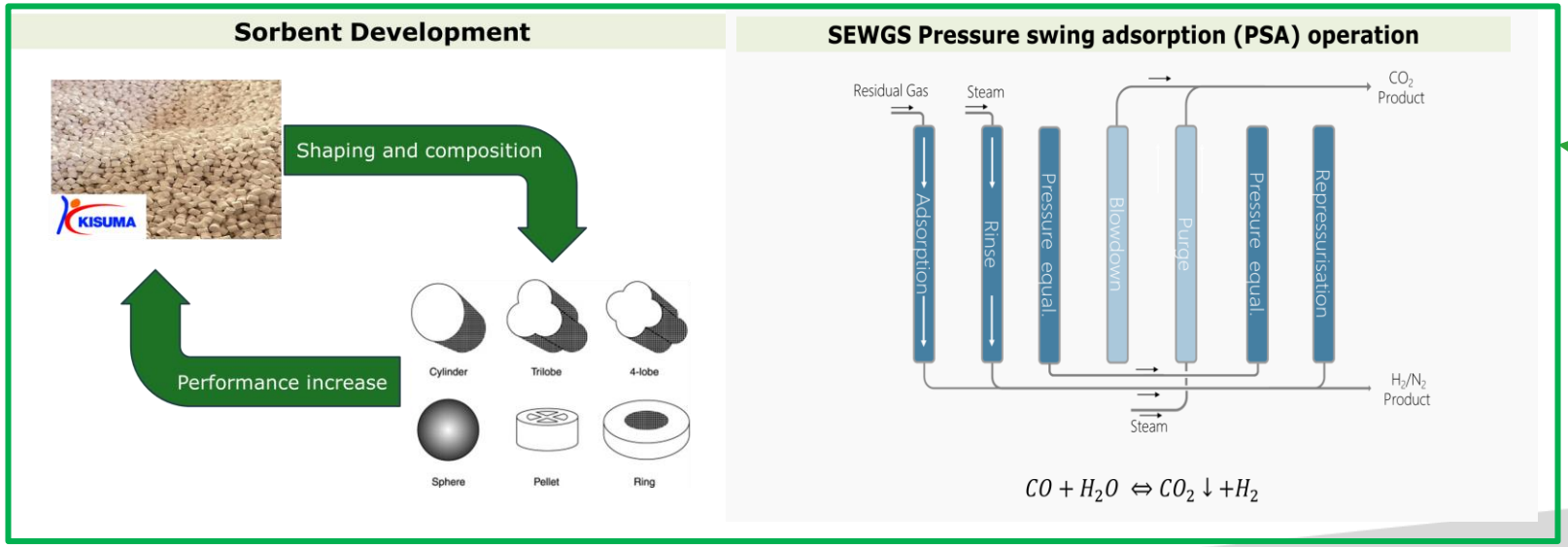
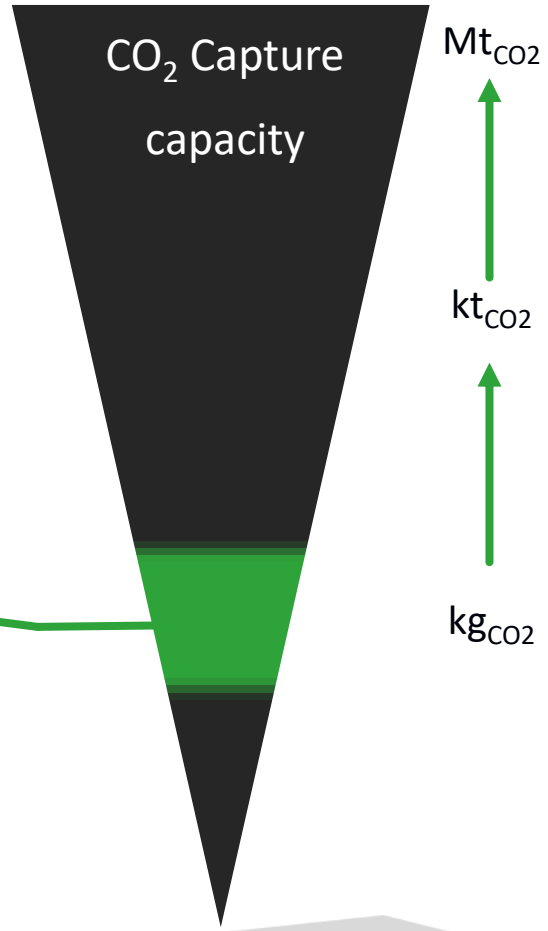
GreenSmith Goals and Outcomes

- Demonstrating a two-fold increase of SEWGS productivity by utilizing **novel adsorbents** crafted with advanced shaping techniques;
- **Achieving TRL5 demonstration** of H_2-rich product streams recovery by **SEWGS** (Sorption Enhanced Water-Gas Shift)
  - at different feed **mixtures** of steel gas from and novel CH_4- and H_2-based **Direct Reduction Plant (DRP)** route
  - at different configurations **allowing SEWGS to tune the outlet CO/H_2 content**





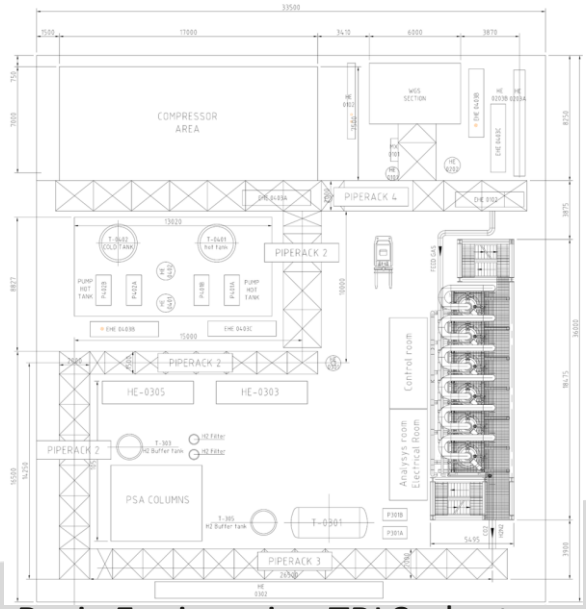
GreenSmith Goals and Outcomes

- Establish a generic **Basic Engineering Design Package for a TRL8 roll-out of the technology** (50 ktonCO2/y from BFG at ADI's site in Taranto, Italy), enabling the replication potential and market diffusion.
- Showcasing competitive performance in terms of sustainability and economics for two implementation cases through **full scale techno-economics** and **life-cycle analysis**

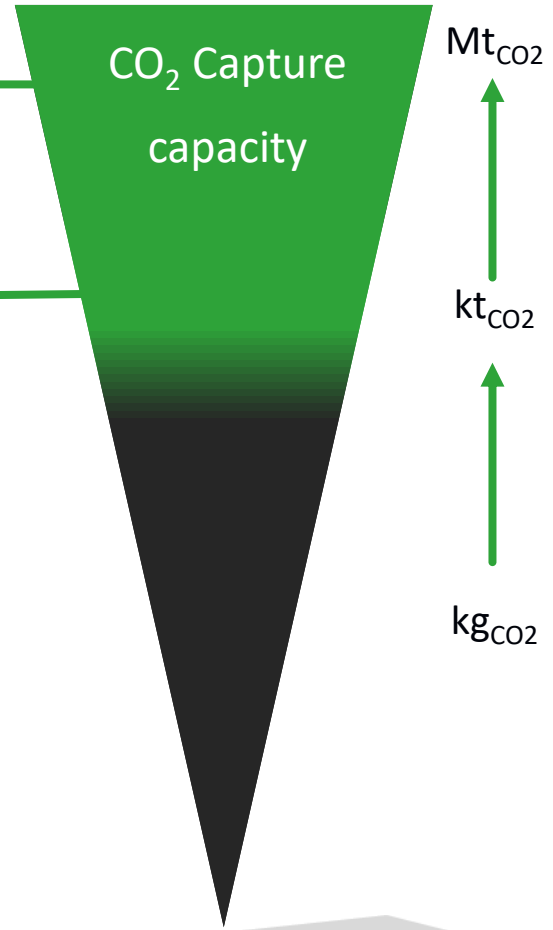
Analysis of large-scale application

AdI's Taranto Site

Stegra's Boden Site



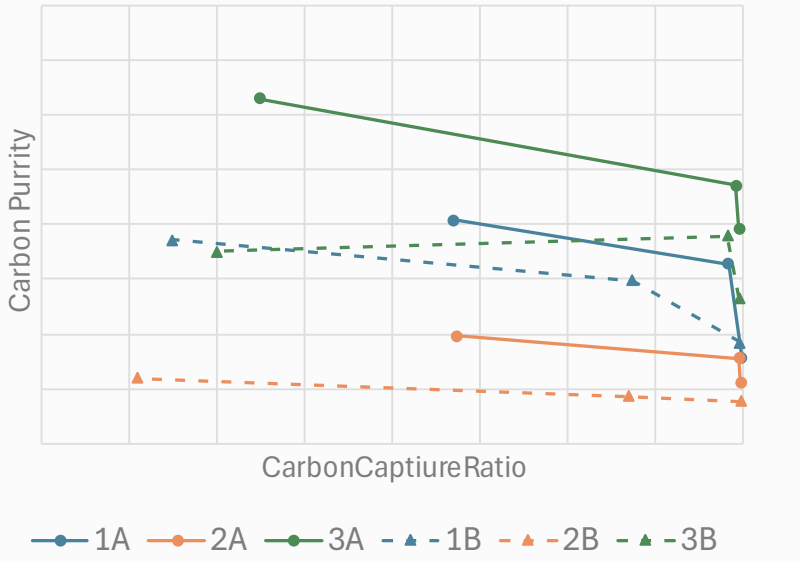
Basic Engineering TRL8 plant



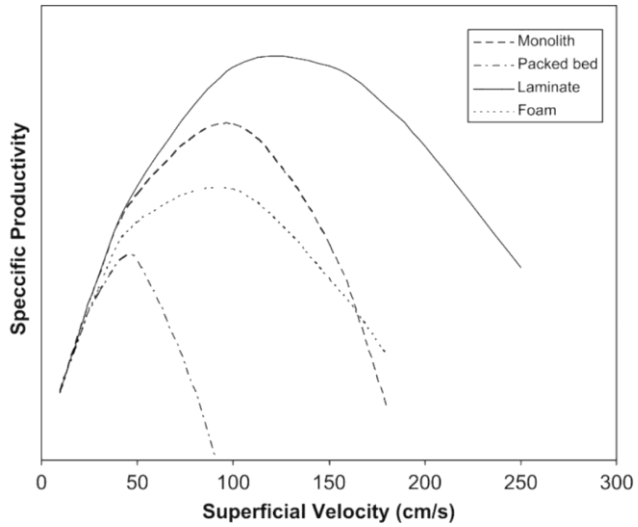
Sorbent development

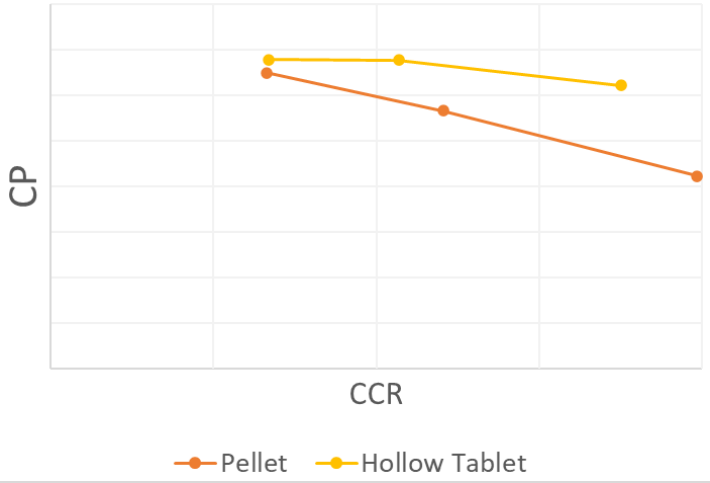
Ongoing

Novel composition



Why shaping matters



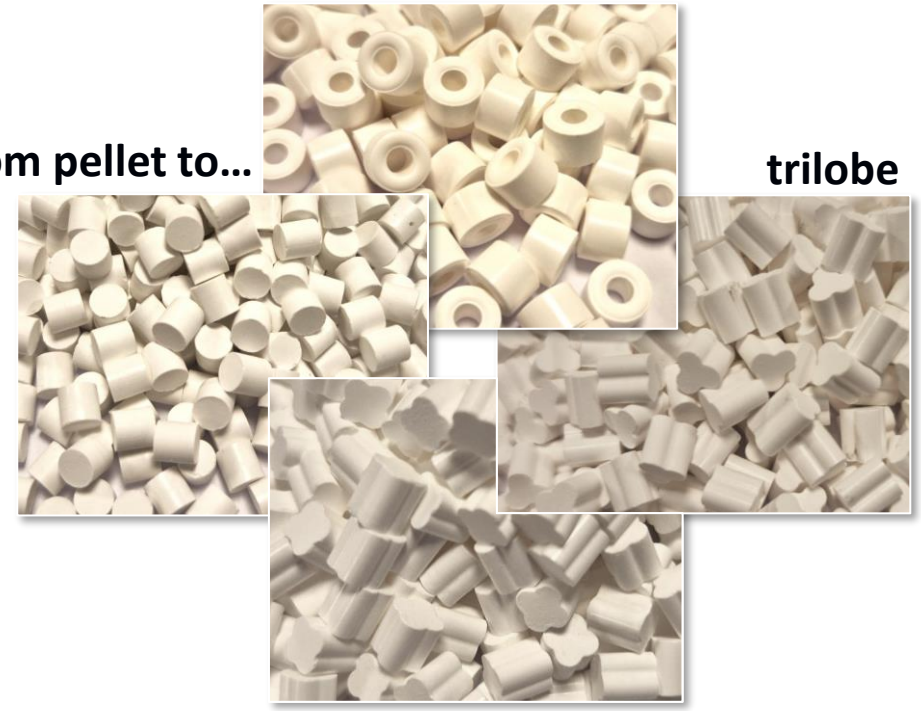


From pellet to...

hollow tablet

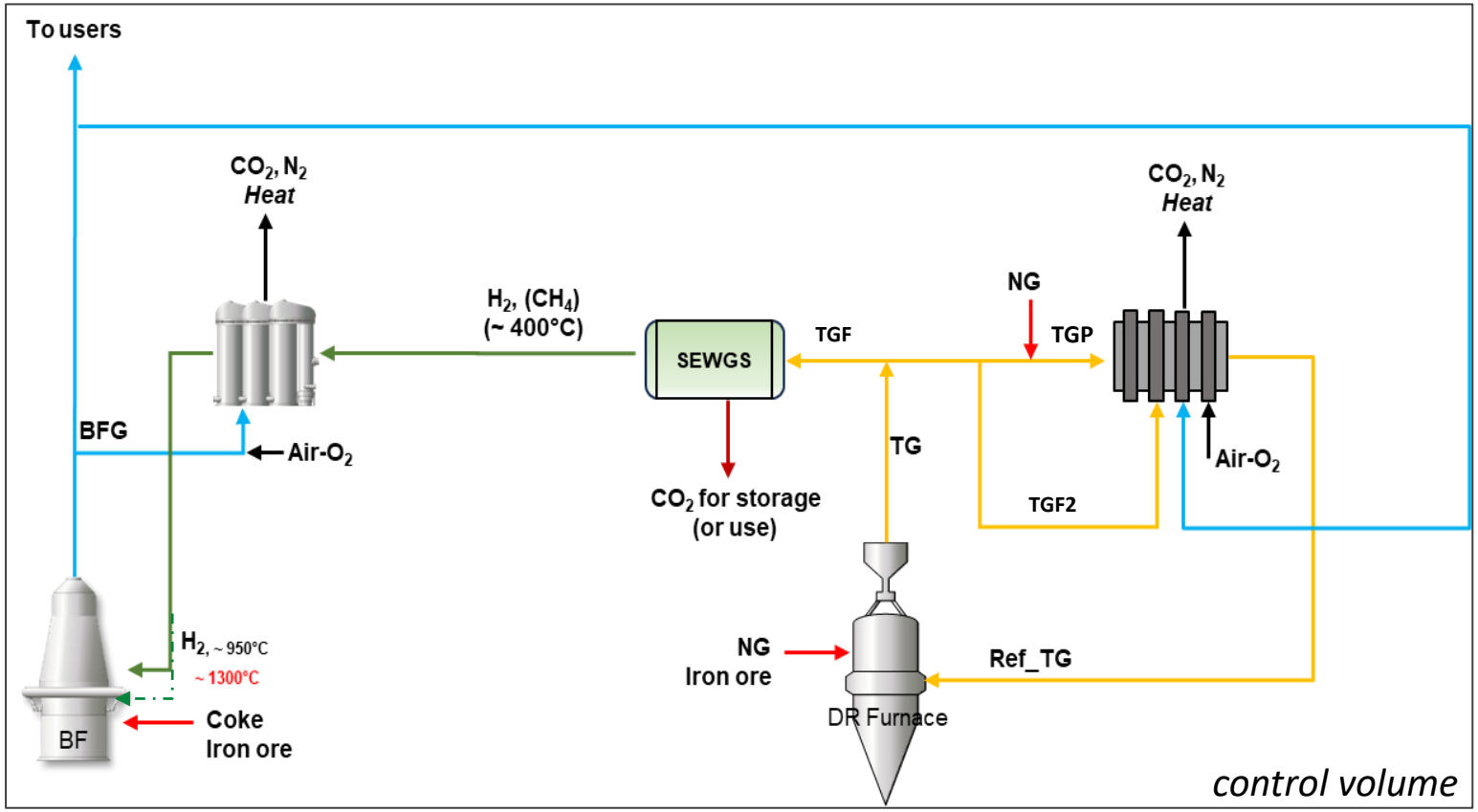
trilobe

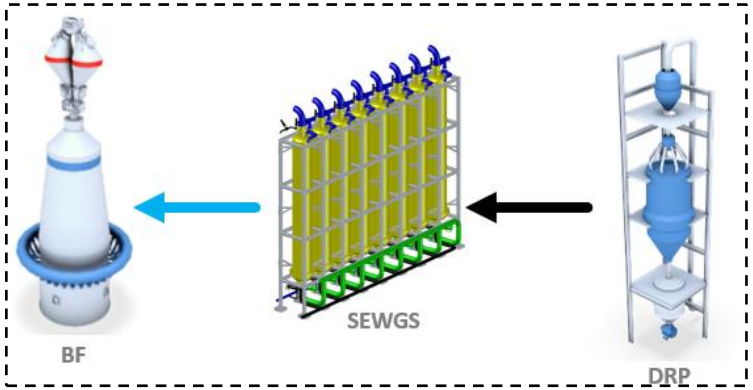
quadrilobe



Ongoing

SEWGS Process integration DRP – BF





- **Energy Integration:** BFG (Blast Furnace Gas) and TGF2 are utilized as fuel to power the reformer and the H_2 heating process.
- **Decarbonization:** The synergy reduces CO_2 emissions by converting all CO the TGF in CO2, lowering the Coke Rate and optimizing PCI (Pulverized Coal Injection) operations.

BF capacity	*1.15*	*Mt_{HM}/y*
DRP capacity	*2.7*	*Mt_{DRI}/y*
Electrical Energy Price*	*50*	*€/MWh*
CO2 credit = transport & storage cost		

**no steam from external sources, only self-produced*

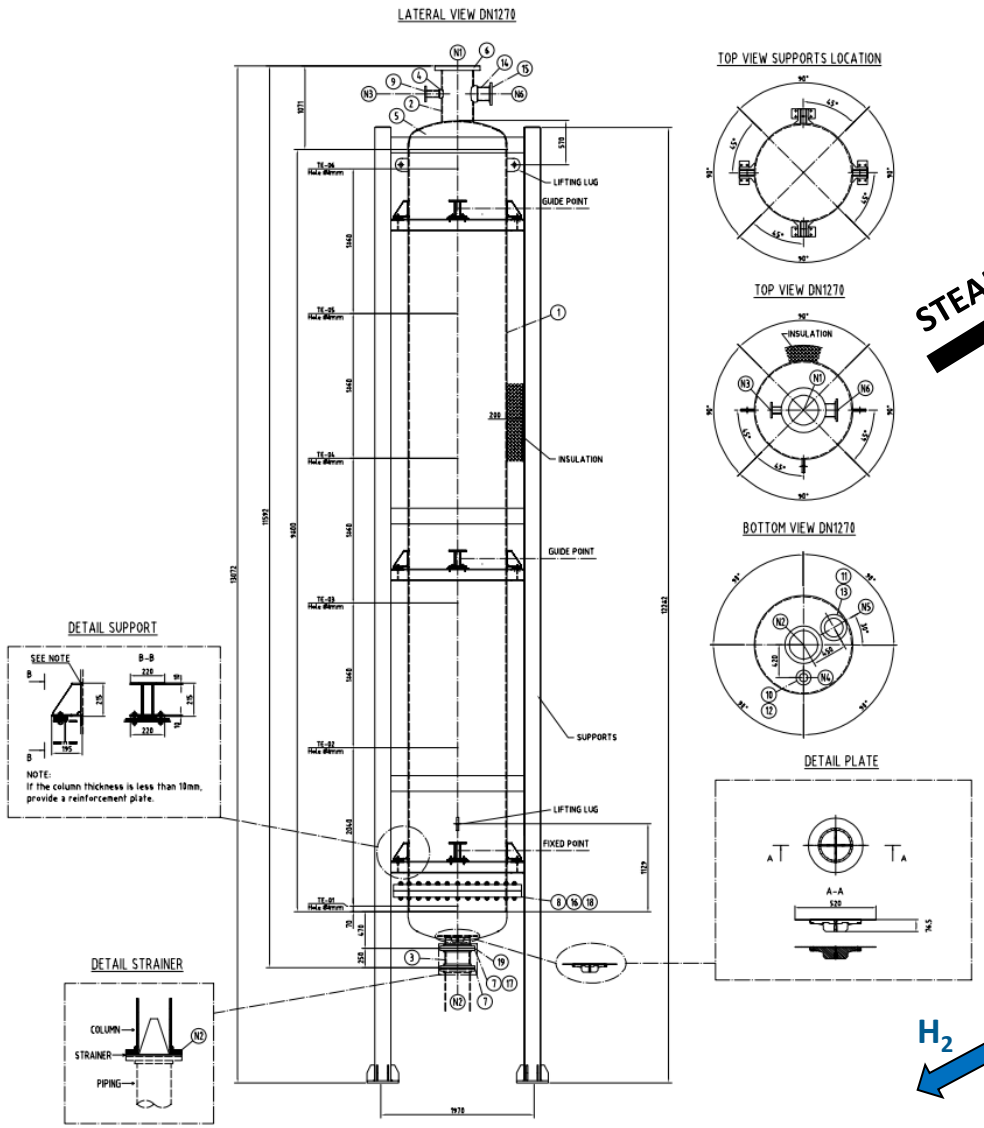
CO2 avoided**	%	45%
△OPEX**	€/t_{steel}	-2.5
	M€/y	-19

***reference case: separated & conventional BF and DRP*

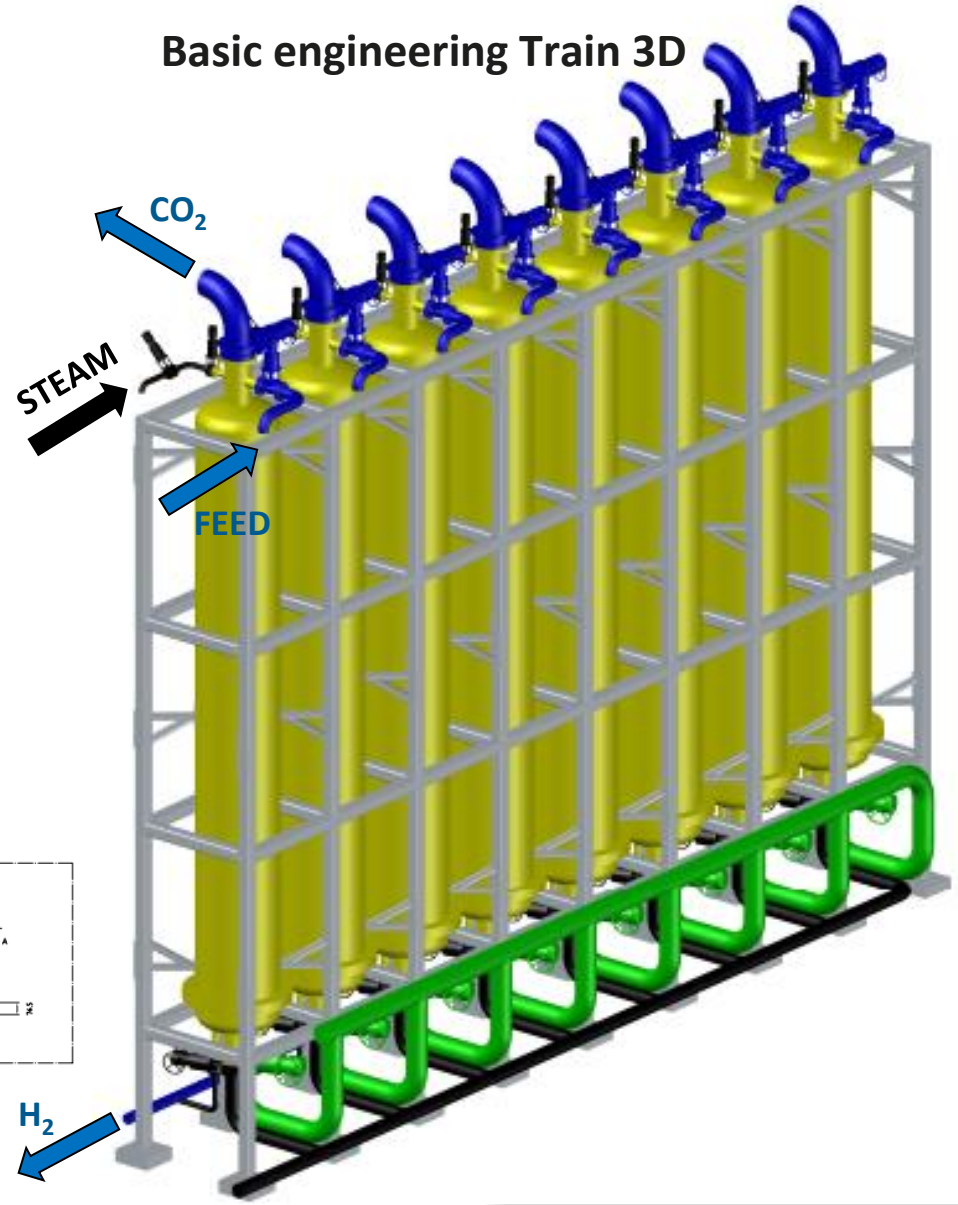
MECHANICAL DESIGN: modular approach for fast commercialization

Ongoing

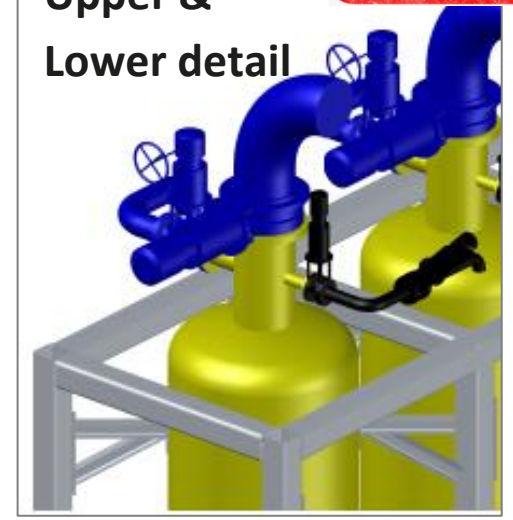
Basic Column drawing

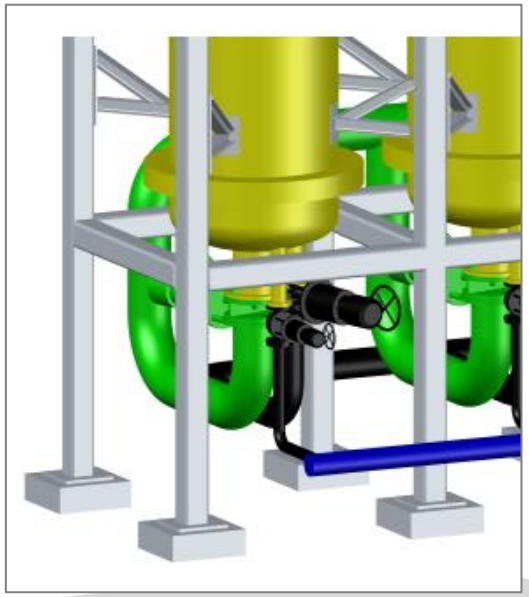


Basic engineering Train 3D



Upper & Lower detail





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3. Takeaways

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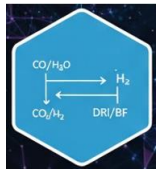
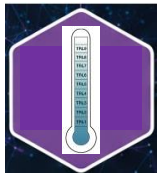
SEWGS takeaways



Process Integration: SEWGS is not just a CC technology, it produces high-pressure Blue H_2 maximizing thermal efficiency

Feedstock variability: Full flexibility on BFG, BOFG, H_2- and NG-DRP, Fluidized Bed etc: transforming off-gases into energy resources (H_2) and purified chemical assets (CO_2). SEWGS is a "*connecting point for technologies*"



Industrialization: SEWGS evolves from proven technology (TRL 7) into a modular, scalable, and bankable solution.

Sorbent scalability: Hydrotalcite is a well-known commercial material which can be shaped and scaled-up for SEWGS industrial deployment

Incremental Deployment: A true "add-on" modular solution: ensuring site operational continuity minimizing shutdown of primary production.

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More info at: greensmith-cetp.eu

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Questions?

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