FReSMe: From Residual Steel gases to Methanol

4th clustering meeting on H2020 CCS/CCU/Alternative Fuels and Flexible Power Plants projects

17th September 2019, Brussels

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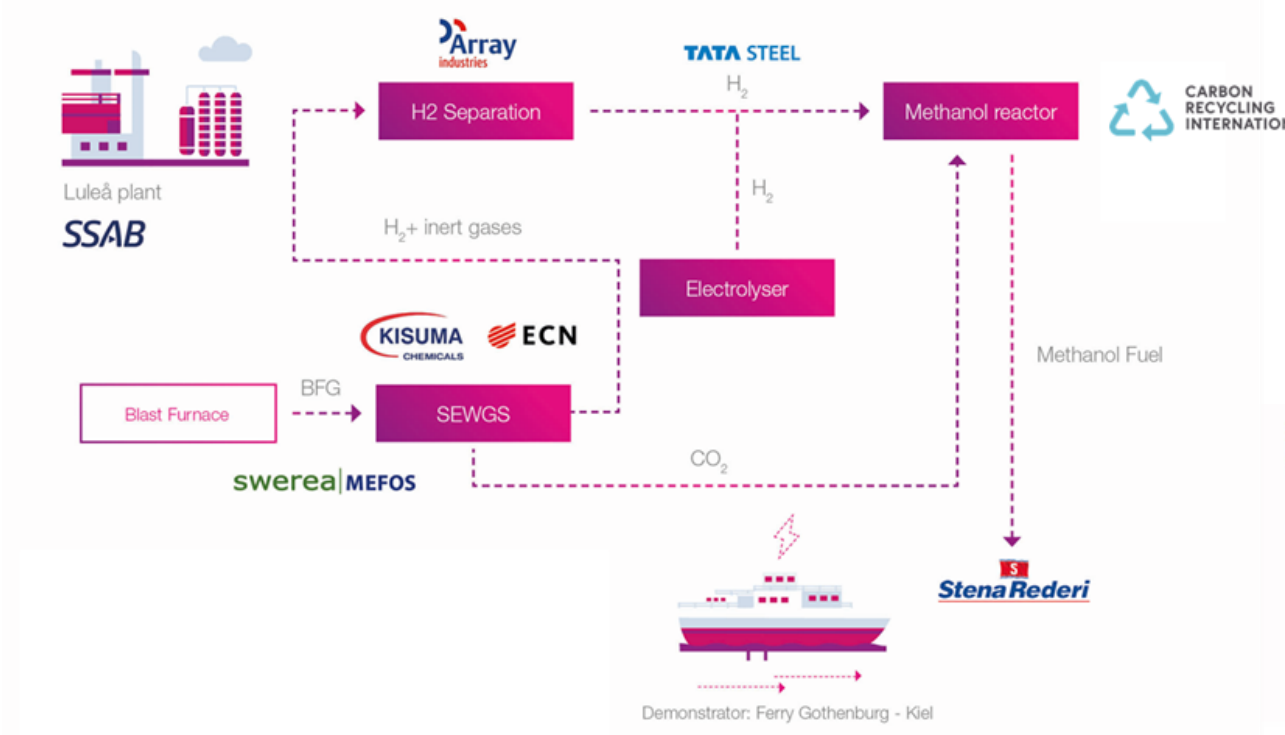
1. Concept

Objective

"To demonstrate feasibility of valorising CO2 and H2 capture from blast furnace gases (BFG) by turning into a versatile platform chemical and renewable fuel such as Methanol (MeOH)"

Benefits

- Add value to CO2 capture making a more suitable business case for CCU+CCS
- Increase competitiveness of the steel industry while reducing GHG emissions
- Reduce European dependency on imported fossil fuels by demonstration the use of Low Carbon methanol as marine fuel



Using the results of **two H2020** projects

KEMIJSKI INŠTITUT	Catalysis and chemical reaction engineering
i-deals everis group	Coordination, exploitation and dissemination
POLITECNICO MILANO 1863	LCA and techno economic assessment

2. Progress so far

Commissioning

Almost all the equipment is already on-site and commissioning is expected for Sep-Nov. 2019 before the first of the three test campaigns.

a) b) c) d) e) f)

a), b) Gas cooling units; c) H2 buffer tank d) Electrolyser (100 Nm3); e) Methanol Reactor; f) Crude methanol tank

Underpinning developments

- Sorbent development: research on K promoted hydrotalcytes to expand the CO_2-H_2O interaction with the material to better understand the regeneration of the column.
- Research on transient operation of SEWGS at different temperatures
- Impurities impact such as N2 and H2S will be researched on methanol production and activity.
- P-T, gas composition and flow rate test have been conducted using standard CZS catalyst and Perovskite catalysts in order to identify the best operational range for the process. In addition, long term behavior tests on the catalyst have been performed in order to assess the aging process

2. Progress so far

Process optimization

One of the key areas of research is the integration of electrolysis in the Steel Mill. Two scenarios are considered with varying BFG utilization. The goal is to determine:

- The **grid emissions breakeven** which allow the production of MeOH with lower footprint than the fossil analogue
- The MeOH **production capacity achievable with lower CO2 footprint** than fossil methanol

O2 use in the steel mill is investigated with different approaches:

- O2 by-product from electrolysis as a way to lower the energy for O2 production by reducing ASU utilisation
- O2 could be used for reheating furnaces using H2-rich gases

Tests campaigns (pending)

Three 1 month test campaigns are envisaged:
A. Low load: minimum supplementation of electrolyser derived H_2 (Q2 2020)
B. Full capacity: supplementation of electrolyser derived H_2 (Q2 2020)
C. Electrolyser only: full capacity with CO2 from BFG and H_2 from electrolyser (Nov/Dec 2019)

3. Challenges

Challenges

The deployment rate of the technology developed in FreSMe is dependent on the existence of a favorable framework.

- Low carbon methanol can be considered a **RFNBO or a recycled carbon fuel** and both types and could be **eligible to meet the targets for renewable fuels** although MS may exempt RFNBO's from complying with the minimum share of **advanced fuels**
- **REDII** does not consider RFNBO or recycled carbon fuels in **Annex IX** thus **eliminating double counting.**
- The necessity to **match renewable energy generation with fuel production reduces the plant's capacity factor** thus negatively affecting the business case
- Electrolysers **cost reduction pace is not fast enough** to improve substantially business cases. Long permitting process are driving up soft costs and increasing delays in projects kick-off

Opportunities

- The contribution of fuels supplied to the **maritime sector** is considered **1.2 times** their energy content.
- **Incentives** for low carbon **chemicals** could further reduce CO_2 emissions and fossil fuel dependency in the chemical sector but they are not in place yet
- **LCA methodologies** for recycled carbon fuels are needed to validate emission reduction potentials
- Although recent spike in **CO_2 prices** can make **CCS more attractive**, it also increases **carbon leakage risks.** CCU is gaining momentum combined with CCS to accomplish deep decarbonisation goals

FReSMe

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