FReSMe: From Residual Steel gases to Methanol

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- Partners

- EC funding: 11,406,725 €
- Private investment: N/A
- Leverage factor: N/A

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Project Case Study

1. The EU/ SPIRE needs

KC1 FEED: Valorisation of flue gases. Potential integration with some of the processes developed in the ULCOS project.
KC2 PROCESS: New energy and resource management concepts
KC3 APPLICATIONS: New materials contributing to develop energy and resource efficient processes
KC4 WASTE2RESOURCE: Piloting innovative capture of CO2 and maximum recovery of H2 in flue gases (BFG).

KC5 HORIZONTAL: dissemination of cross-sectorial transfer of good energy and resource efficiency solutions and practices
KC6 OUTREACH: comprehensive dissemination strategy

Methanol fuel can be considered an advanced fuel according DIRECTIVE (EU) 2015/1513 thus it contributes to the renewable energy content in transportation fuels set by the EC.

2. The Project Solution

FReSMe will demonstrate novel CO2 valorization strategies in the steel industry by developing efficient capture technologies specially suited for subsequent methanol production from CO2 and H2 contained in steel mill flue gases.

3. Value to Customers

- Increase decarbonisation potential in the Steel by developing a feasible business case for CCS+CCU.
- Providing new valorization alternatives for Blast Furnace Gases other than power production.
- Generation of new revenue sources by providing grid services and sales of methanol.

4. How will this happen?

Piloting the complete capture, pre-processing and synthesis of methanol from Blast Furnace Gas:
- SEWGS capture technology for CO2 capture, H2 separation and supplementary H2 production from CO in the Blast Furnace Gas.
- Supplementary H2 production through water electrolysis and research on its integration in the Steel mill.
- Integrated methanol synthesis pilot plant (1 ton/day)
What are the **key expected sustainability impacts of FReSMe?**

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<th>Indicator</th>
<th>Baseline (^{(1)})</th>
<th>Expected Impact</th>
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| Global Warming Potential (mainly CO₂ emission reduction)                 | 1.9 te CO₂ / t crude Steel cast                                                     | Base scenario implies 20% reduction in CO₂ emissions combined with sequestration (-14%) and CO₂ reuse for methanol synthesis (6%) assuming 110 MW of waster electrolysis capacity  
11 Mtons/year (without CCS) of CO₂ reduction if methanol production were to cover methanol imports in the EU and 3% v/v blending with gasoline is achieved |
| Alternative sources for fossil resources for chemicals and fuels         | HFO demand (Maritime): 27 Mtons/year \(^{(3)}\)  
Gasoline demand 77.5 Mtoe (2015)                                           | 10% substitution of HFO with Methanol would drive up methanol demand by 5.4 Mtons  
Up to 1.3% of fossil gasoline substitution in the EU with methanol blending (3% v/v) in standard engines would drive methanol demand 2.2 Mtons                                                                                       |
| Fossil energy intensity                                                  | ---                                                                                 | Highly dependent on the operation mode: H₂ from BFG only/ H₂ from BFG supplemented with H₂ from water electrolysis (fossil fuel intensity will vary depending on the energy mix in the area in which the plant is located and the mode of operation) |
The outputs & learning from FReSMe

• Optimised power plant operation when coupled with flexible hydrogen production for methanol production. Plants can be operated steadily at their maximum efficiency since flexible electrolysers can be adjusted to match supply and demand.

• Renewable hydrogen production: demonstration of flexible operation of water electrolysers can be used to decrease energy costs of renewable hydrogen production and reducing the reliance on natural gas steam reforming in other industries.

• SEWGS CO2 capture technology may reduce capture costs in other applications compared with amines.

• Surplus Oxygen from water electrolysis is a valuable co-product that can be used in other parts of the steel mill such as BOF.

• Job preservation: CCU+CCS can help carbon leakage sensitive industries other than steel such as the cement industry.

• Growth of cost competitive non-manageable renewable energy generation will spur a new set of business opportunities for those who can build business models based integrating renewable energy surplus and stabilising the electrical grid.

• FReSMe results could contribute to the reduction of the dependency on methanol imports for the chemical industry in the EU-28. An average of 5.8 Mtons\(^2\) where imported Jan-Nov 2016.

• Methanol produced in FReSMe is considered an advanced fuel and its renewable energy content can be double counted towards the Renewable energy content in transport. Moreover, direct blending of methanol with gasoline can reduce the imports of gasoline. A 3% v/v blending of methanol would add 2.2 Mton/year of additional methanol and displace up to 1 Mtoe of gasoline on an energy content basis.
From Residual Steel gases to Methanol: A new path to a low carbon economy

**Technology process**

- Steel production plant
- CO₂ capture and H₂ recovery
- Electrolysis: H₂ surplus from RES
- Methanol Synthesis
- Methanol Fuel
- Fossil fuel substitution by Methanol

**Benefits**

- Add value to CO₂ capture
- Increase competitiveness of the steel industry
- Reduce the European fossil fuels dependency
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