FReSMe

From Residual Steel gases to Methanol

Final Project Event

WP4 – ETL technology and methanol market

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NATIONAL INSTITUTE OF CHEMISTRY · array INDUSTRIES · POLITECNICO MILANO 1863 · CARBON RECYCLING INTERNATIONAL · TATA STEEL · TNO innovation for life · i-deals everis group · Stena Rederi · KISUMA · SSAB · SWERIM

SPIRE Sustainable Process Industry through Resource and Energy Efficiency

"This project has received funding from the *European Union's Horizon 2020 research and innovation programme* under grant agreement No 727504".

The ETL plateform

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Inputs

Recycle CO_2 from **emissions**

Recover stranded H_2 from **industry**

Generate green H_2 from **electrolysis**

Process

CRI patented ETL process

Globally traded methanol

Green chemicals feedstock
Versatile replacement for fossil alcohols and hydrocarbons

Fossil fuel replacemnt
Methanol is a highly efficient fuel and releases no sulphur or soot

Technical advantage and intellectual property

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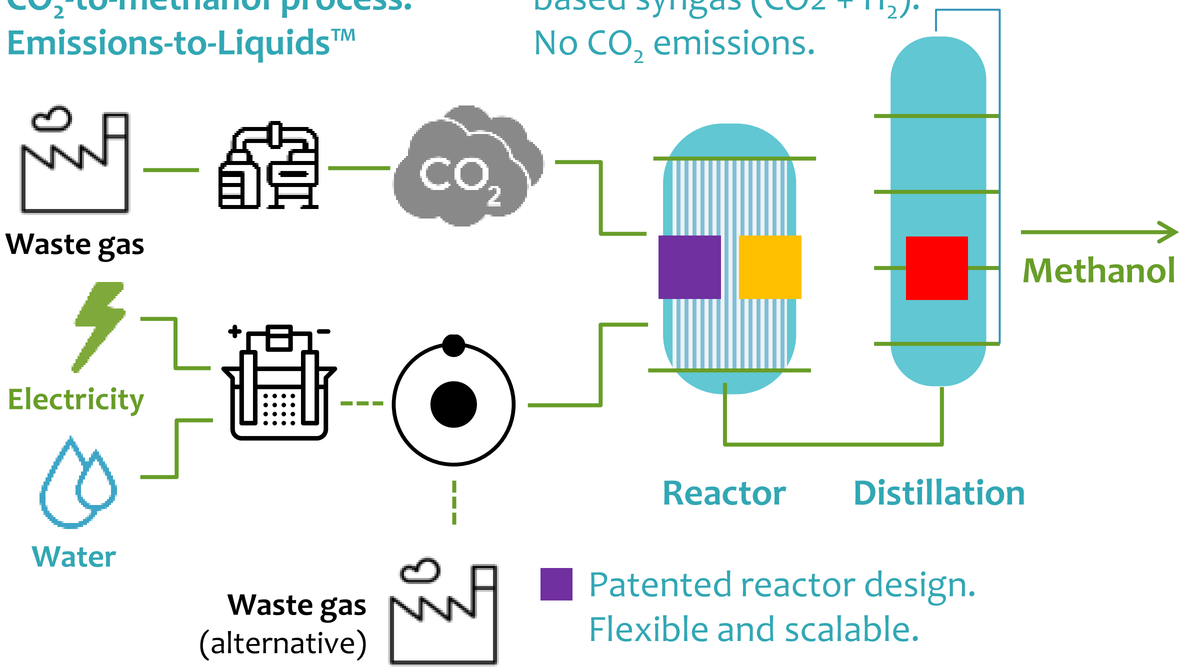
CRI's proprietary CO_2-to-methanol process: Emissions-to-Liquids™

Direct hydrogenation of CO_2 based syngas ($CO2 + H_2$). No CO_2 emissions.

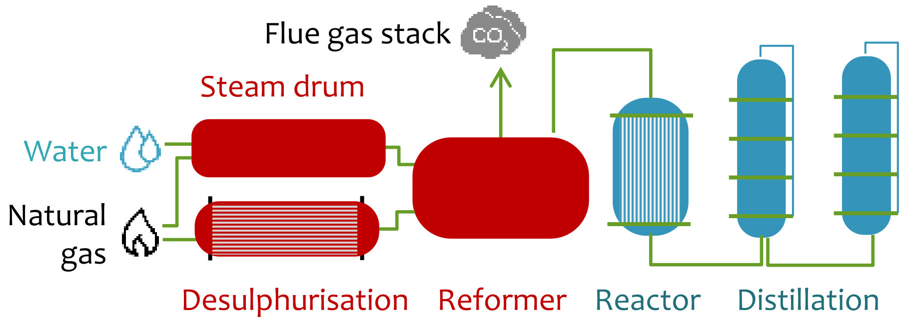


- Patented reactor design. Flexible and scalable.
- Patented 1-step distillation system
- Patent for flexibility to variations in load (intermittency)

- *No hot front end*
- *No steam drum*
- *No flue gas stack, small vent*

Traditional Steam Methane Reforming to methanol process

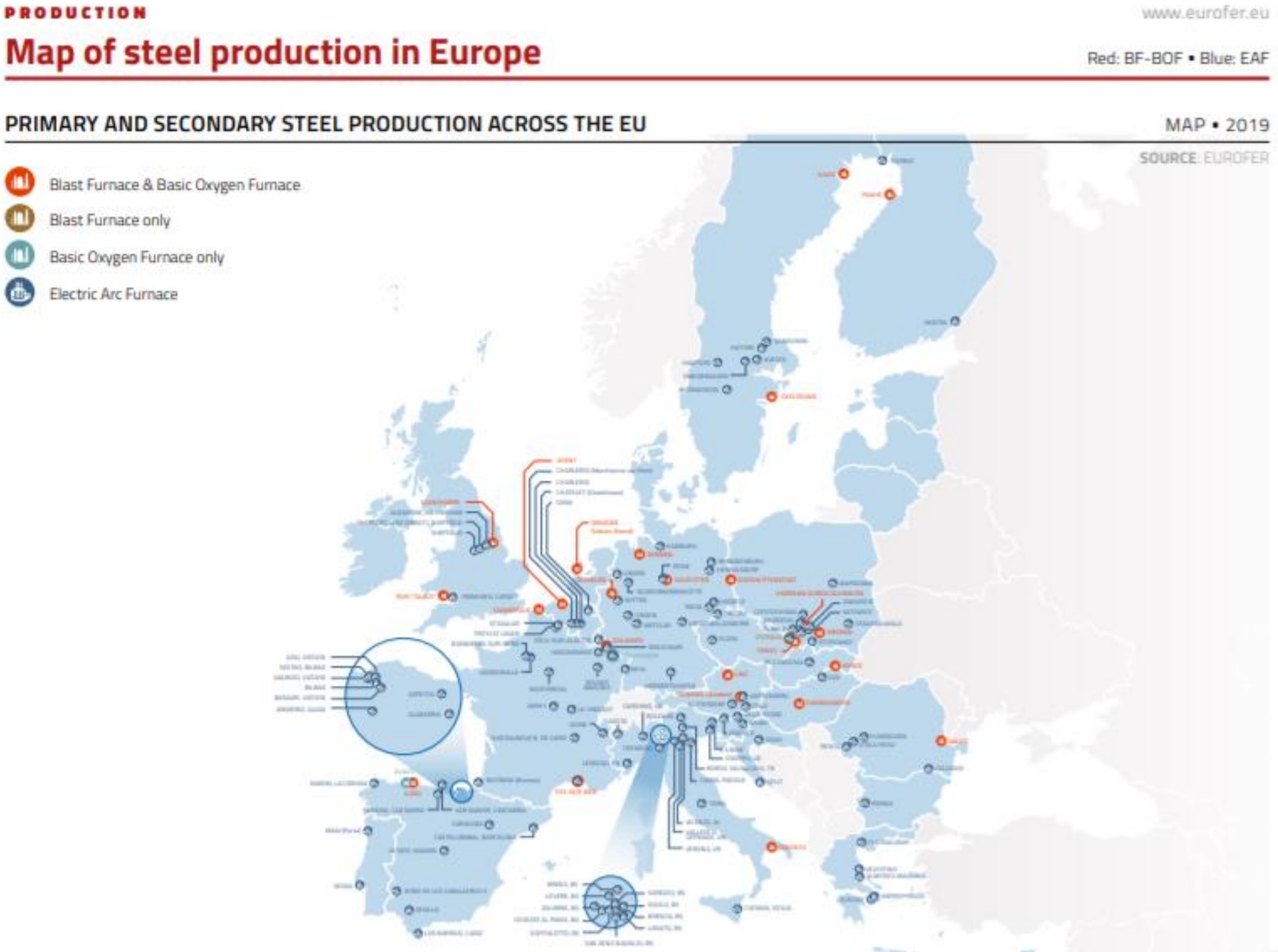
Hot front end for reforming of natural gas to syngas ($CO + H_2$). Net CO_2 emissions.



- *Hot front end to make syngas*
- *Steam drum*
- *Flue gas stack*
- *2-step distillation system*
- *No flexibility to load*
- *Conventional reactor (e.g. BWR)*

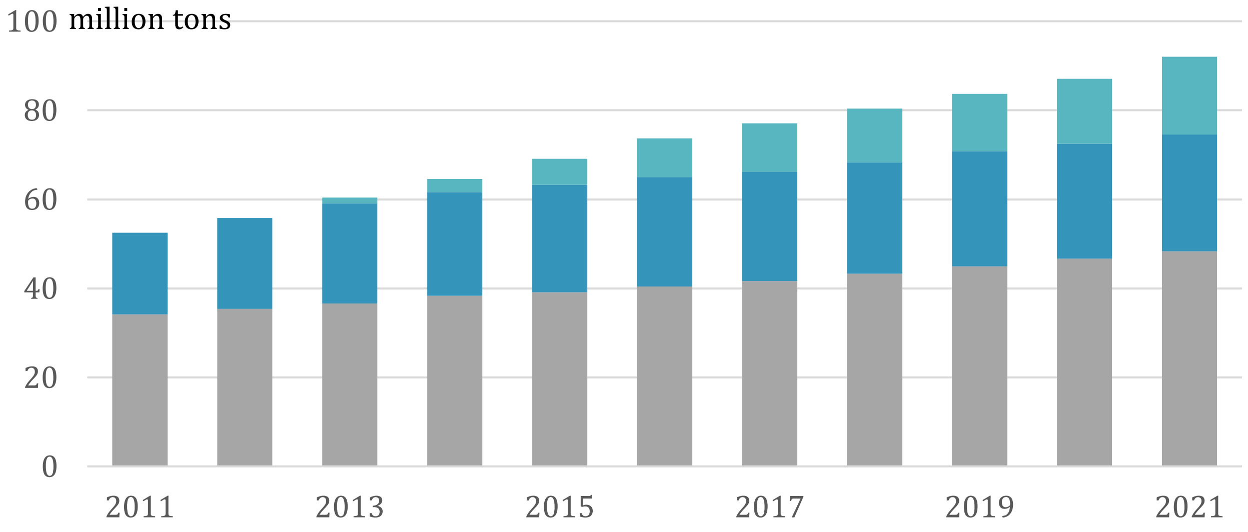
Addressable market size and locations in Europe

1. Stepwise SEWGS process is primarily applicable to the **BOFG and BFG gas emissions** of iron and steel manufacturing
2. The addressable market for the technology can be estimated at approximately **230 million tonnes of CO_2** emissions from existing production facilities in Europe alone.
3. In addition, the total volume of emissions in the **ferro-alloy and silicon sector** (EU + EEA) in 2015 was **4,6 million tonnes of CO2** according to Euroalliages.



Methanol: global chemical feedstock and growing fuel source

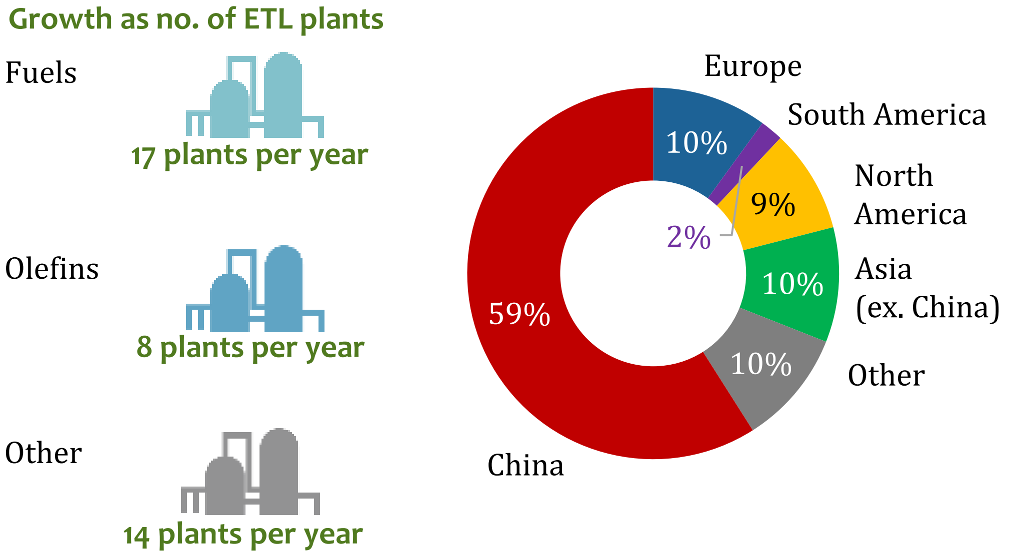
Total market size 2021: >90 million tons



Source: IHS

Fuels Olefins Other

Market growth and share of total demand

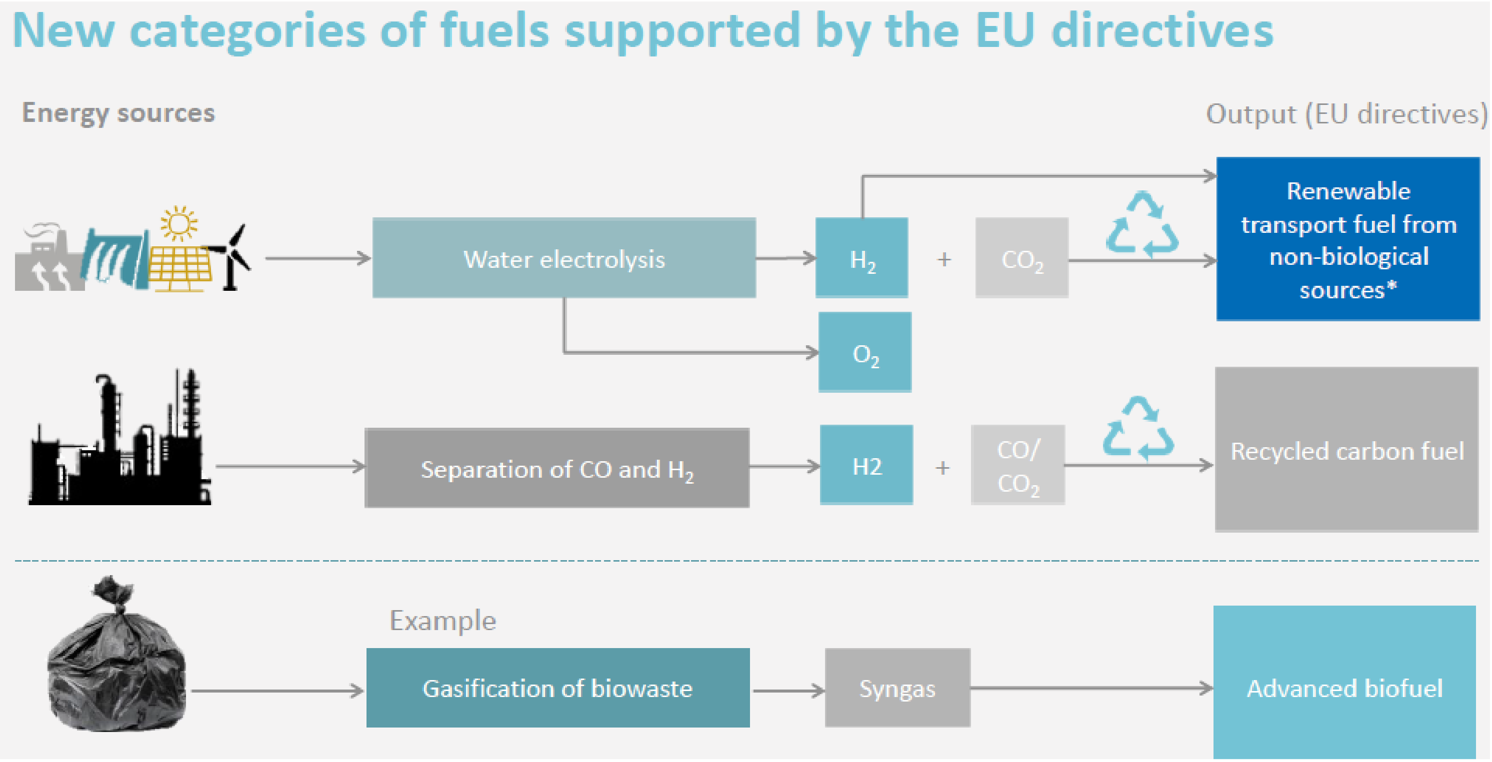


1 standard ETL plant per year = 100,000 tons methanol

EU regulatory framework

Complicated classifications and missing LCA rules

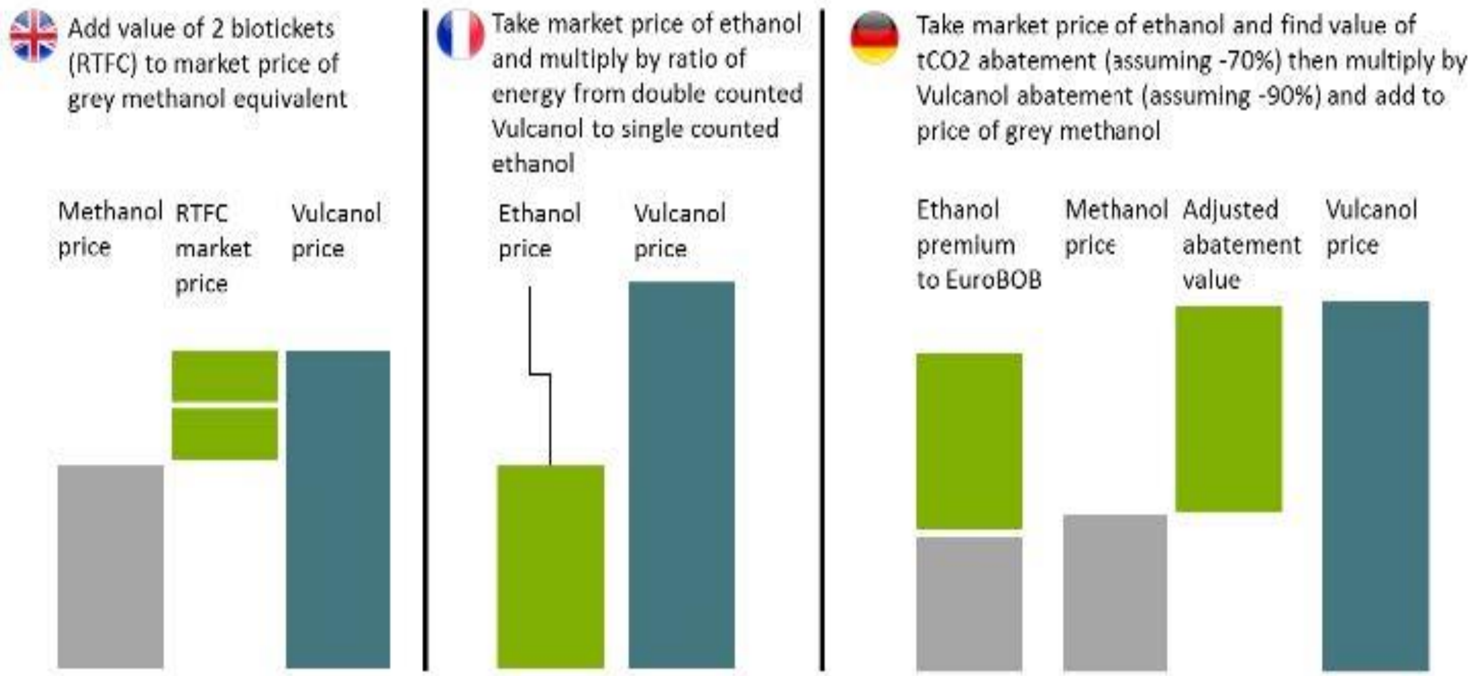
1. A handful of countries implemented a revision to REDI in 2015, which included RFNBO. These include UK, Italy and France.
2. With REDII a definition of a new fuel category Recycled Carbon Fuel (RCF) was introduced.
3. Adoption of RCF into member state laws is optional.
4. Methanol made in FReSMe is a hybrid between RFNBO and RCF.
5. LCA methodology to be defined in a delegated act by end of 2021.



Value of ‚green‘

Examples of pricing methodologies in the fuel market

1. European countries have adopted **different schemes** to incentivize the use of **renewable fuels**.
2. Renewable energy content vs. volumes vs. CO2 abatement values.
3. These markets are currently **dominated by biofuels**.
4. The “**willingness to pay**” varies between countries and applications.
5. **Legal classifications** and **GHG certifications** can be important factors in pricing.



Addressable EU market for Sustainable Methanol

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Deriving an estimate for the near term and long term addressable markets

Estimates are based on:

1. Known pathways and applications of methanol
2. Current regulation and market
3. Voluntary switching
4. Analysis of future demand drivers
5. Assumptions on possible market share
6. Further listed in D6.4

Market	EU Addressable market 2020-2030 in tons methanol equivalent.	EU Addressable market 2030-2050 in tons methanol equivalent.	Main demand drivers
Road fuels	6 million	136 million	Compliance with 14% REDII target and 6% reduction of GHG emissions. Cap on biofuels at current levels.
Marine fuels	1 million	67 million	IMO target of at least 40% reduction of CO_2 emissions per transport work by 2030 (70% reduction target in 2050) and a total annual GHG emission reduction of at least 50% by 2050 compared with 2008. Expected EU mandates through REDIII or ETS
Other energy applications	100,000	48 million	Demand for green alternative to LNG or LPG used for heat in industry to reduce CO_2 footprint. Requirements for sustainable aviation fuels (SAF).
Chemicals & plastics	1 million	68 million	Demand for increased sustainability and circular economy with reduced fossil fuel dependence. Voluntary initiatives initially followed by regulatory requirements.
Total	8.1 million	319 million	

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THANK YOU!

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