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***OPTIMIZATION OF CO₂ CONVERSION
INTO CHEMICALS, ALSO THROUGH
ALGAE EXPLOITATION, IN HIGHLY
ENERGY INTENSIVE INDUSTRIES***

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CSM SpA was founded in 1963 by Italy's major steel manufacturers and end-users with the mission of developing Steel Technologies and its application.

From 2013 belongs to RINA Group.

CSM SpA is a leading company in the field of process and product innovation. It is operating worldwide in the steel and metal alloys as well as ceramics industrial production for different sectors such as oil&gas, aerospace, engineering, energy&environment. At present CSM SpA research activities are mainly related to the modelling and design of materials and products, development of innovative pilot plants and, reduction of environmental impact. CSM operates in six sites, with specialized labs and pilot plants.

More infos at: <http://www.c-s-m.it/>

Optimization of CO₂ conversion into chemicals, also through algae exploitation, in highly energy intensive industries

Introduction

CO₂ emissions reduction is an actual challenge in highly energy intensive industries (Power generation plants, Steel works, etc.). On the other hand, the CO₂ can be captured from the off-gas of industrial processes and used: 1) as a direct feedstock for chemicals production and 2) through algal bio-refinery concepts. The conversion of CO₂ into valuable chemicals is possible by several technologies, such as (photo) catalytic or biochemical/enzymatic or other novel process ways (i.e. by microbial electro synthesis, by photosystems from plants outside the plant cells, etc.).

Since the '70s algae (e.g. *Dunaliella*) were used for energy large scale production of Glycerol, utilized for oil production. Very promising applications are under investigation for the production of chemicals used as building blocks from algae, fed by industrial process CO₂, with zero or even negative greenhouse gas emissions.

Ways and means

1. Direct conversion of processes and/or environmental CO₂ into chemicals: methanol and other fuels, carbonates and urethanes, carboxylic acids.
2. Determine the most efficient processes of algae cultivation and operating condition (e.g. temperature, light intensity, CO₂ content, etc.) that allow to maximize the cellular lipid and carbohydrate algae content.
3. Indirect conversion of processes CO₂ by algae (e.g. stripper solvents by ammonia, steam, pyrolysis, etc.) into chemicals (protein, biofuels, chlorophyll, lipids).
4. Individuate the recovery treatments (e.g. gasification) in order to valorize the energy content of the algae residue (50% organic matter).
5. LCA of the whole conversion process.
6. Process modelling simulation to scale up the tested technologies in order to transfer the results to an industrial application.

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*The proposal addresses the **SPIRE 03-2018** call: Energy and resource efficiency in highly energy intensive industries.*

- **Novel advanced energy systems (also including new combustion and gasification techniques)**
- **Re-use and recycling of by-products**
- **Process modelling simulation, improving energy and waste streams efficiency, and minimising the global impact on the environment.**

EXPECTED IMPACT

1. CO₂ emission reduction (more than 5 %) and reduction of the environmental impact and greenhouse gas emissions.

- *Reduction of energy and raw materials (i.e. carbon, gasoline) consumptions*
- *Increasing of the production process efficiency*
- *Reduction of the environmental impact*
- *By-products (off-gas) reduction/valorization*

Results will be fully proved and tested at TRL7 through real scenarios in the target industries.

2. Dissemination of new methodologies and technologies for CO₂ conversion of a new vision to the optimization of the whole production chain chain

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Looking for partners (energy, steel, chemicals, algae....)

- *Partner 1: power generation plants/ Steel works/ (CO₂ sources)*
- *Partner 2: Petrochemical companies for chemicals production (direct and indirect approach)*
- *Partner 3: Partner 5 (could be a SME): Expert in algae cultivation*

CSM activity:

- *Thermodynamic characterization of algae by thermo-gravimetry (TGA) tests*
- *Study of an innovative CO₂ diffusor in the growing up water of algae.*
- *Study for removal and recovery of stripper solvents (ammonia, etc).*
- *Process modelling simulation, improving energy and waste streams efficiency*
- *gasification of organic algae residues for recovery of energy content (50% organic matter).*

CONTACT DETAILS

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