From CO_2 capture and storage to its conversion in sustainable fuels

Margherita Cavallo[1], Melodj Dosa[2], Natale G. Porcaro[1], Marco Piumetti[2], Silvia Bordiga[1], Valentina Crocellà[1], Francesca Bonino[1]

[1]Department of Chemistry, NIS and INSTM Reference Centre, University of Turin, Via G. Quarello 15, I-10135 and Via P. Giuria 7, I-10125, Turin, Italy
[2]Department of Applied Science and Technology, Politecnico di Torino, Corso Duca degli Abruzzi 24, 10129 Torino, Italy.
e-mail: margherita.cavallo@unito.it

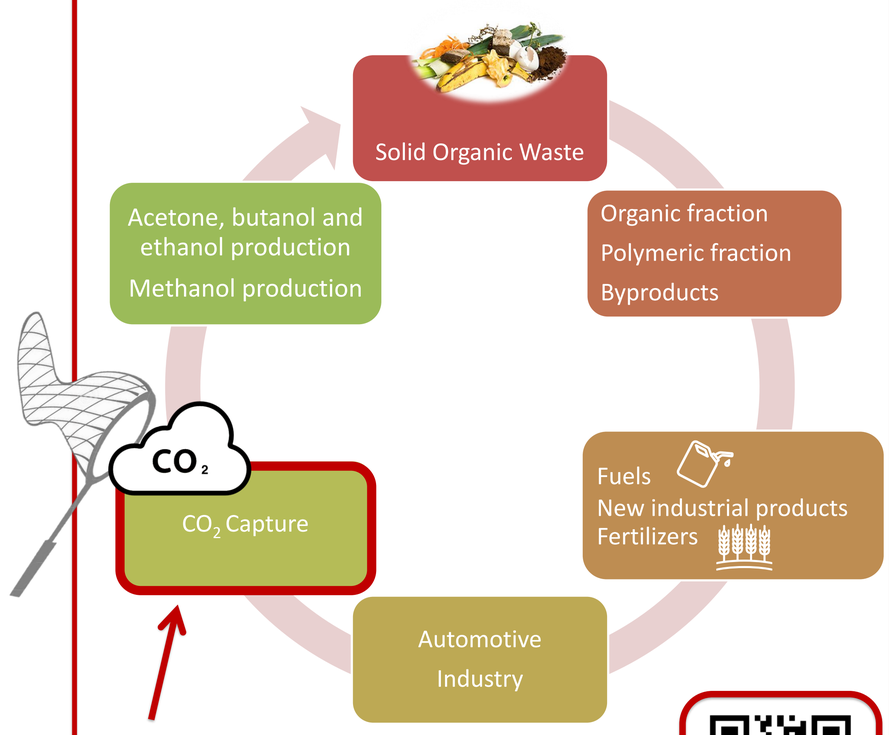
BACKGROUND

In the last 50 years a constant increase of **CO_2 emissions** due to anthropogenic activities has been registered. Among the different strategies applied to contrast this trend, **Carbon Capture Utilization and Storage (CCUS)** technologies are expected to play an important role.[1]
In this work **two examples** of **CCS** and **CCU** strategies coming from **two different projects were examined**.

From Carbon Capture and Storage…

An example of **circular economy…[2]**

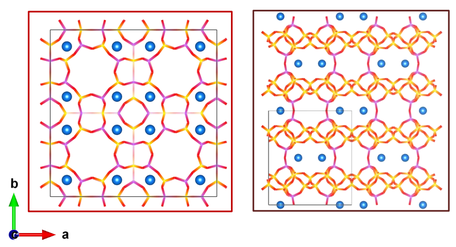
SATURNO



Materials and methods

Two materials for CO_2 capture at different temperature were studied:

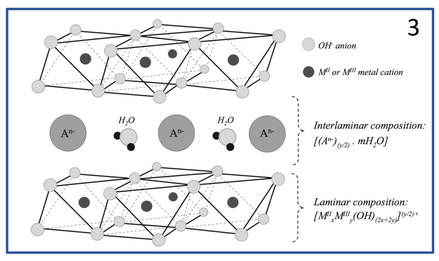
- **LTA** and **Clinoptilolite** (pristine and ion-exchanged) zeolites for medium-low temperatures (T= 25- 150°C)



Shaped Materials

- **Hydrotalcite (LDH)** for medium-high (T= 150-300°C)

Materials in powder form

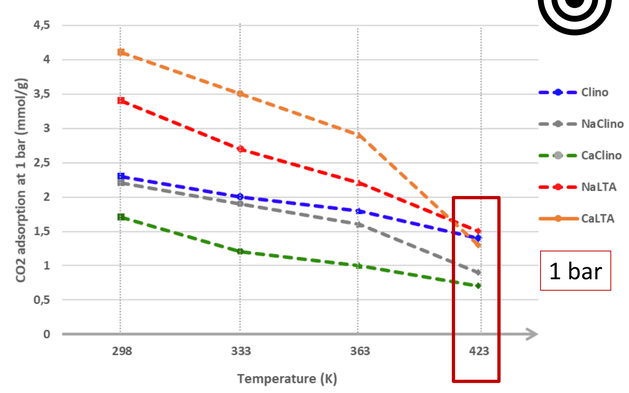


1A. Basic characterization: (IR CO 77 K , EDX, XRD and SSA)
1B. Pure CO_2 adsorption/desorption isotherm at 293, 333, 363, 423 K
1C. Breakthrough measurements

2A. Basic characterization: XRD
2B. Pure CO_2 adsorption/desorption isotherm at 573 K

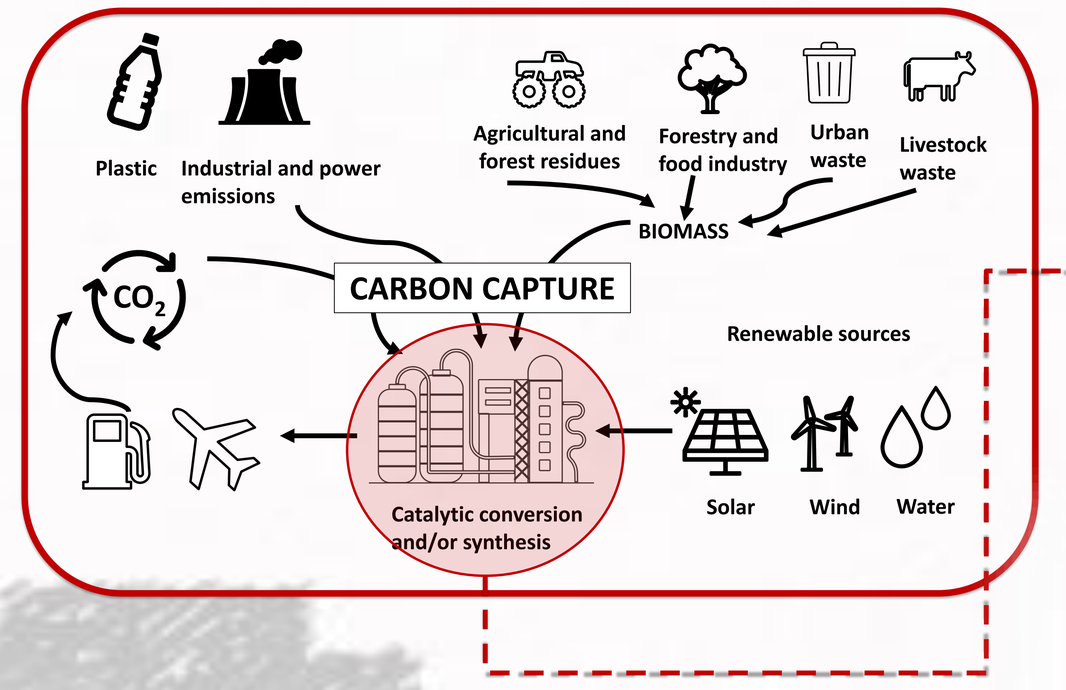
Results

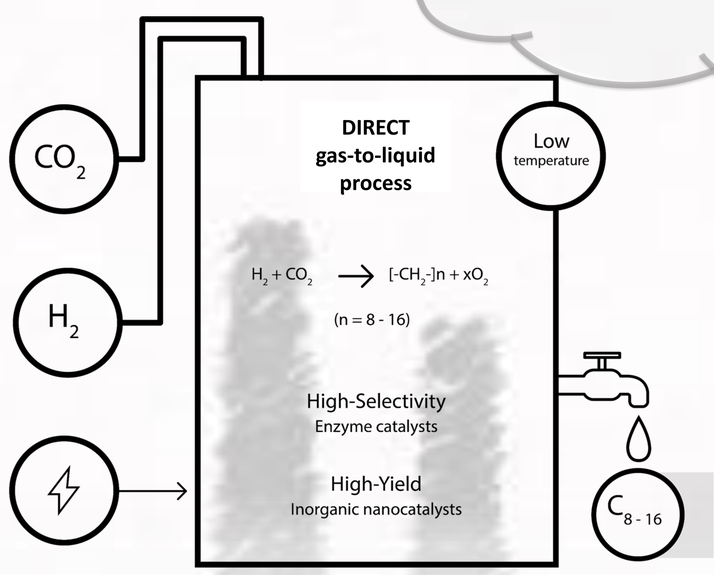
1A. Basic characterization proved the success of ion exchange procedure
1B & 1C. At low temperature **CaLTA** and **NaLTA** has the highest CO_2 capture capacity while increasing the temperature **Clinoptilolite** is the best adsorption material
2A & 2B. $Mg_3Al_1CO_3$ LDH CO_2 uptake reached 1 mmol/g at 573 K
BUT a further characterization is ongoing also concerning materials in 3D form



…to Carbon Capture and Utilization

4AirCRAFT project proposes the conversion of **captured CO_2 into C_8-C_{16}** liquid jet fuels into a **single cascade reactor** at mild temperature and pressures conditions.[4]





4AirCRAFT

- Synthesis and characterization of electro-,bio and chemo-catalysts (involving materials such as zeolites or MOFs and hierarchical solid oxide scaffolds)
- Structural and mechanical investigations
- Proof of concept cascade reactor

ACKNOWLEDGMENTS & REFERENCES

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[1]Cuéllar-Franca, R.M. et al, *J. CO2 Util.* **9**, 82–102 *(2015)*
[2]SATURNO https://saturnobioeconomia.it
[3]Salomão, R. et al, *Ceram. Int.* **37**, 3063–3070 (2011).
[4]Air Carbon Recycling for Aviation Fuel Technology, https://cordis.europa.eu/project/id/101022633/it (2021).