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Energy Harvesting from Carbon Dioxide Capture through an Ionic Liquid Based Supercapacitor / Molino, Davide; Zaccagnini, Pietro; Martellone, Simone; Pedico, Alessandro; Ferraro, Giuseppe; Bocchini, Sergio; Lamberti, Andrea. - (2023). ( 244th ECS Meeting Gothenburg (SE) October 8-12, 2023) [10.1149/MA2023-02482444mtgabs].

*Availability:*
This version is available at: 11583/2989083 since: 2024-05-29T08:41:21Z

*Publisher:*
IOP Publishing

*Published*
DOI:10.1149/MA2023-02482444mtgabs

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13 May 2026

# Energy harvesting from carbon dioxide capture through an ionic liquid based supercapacitor

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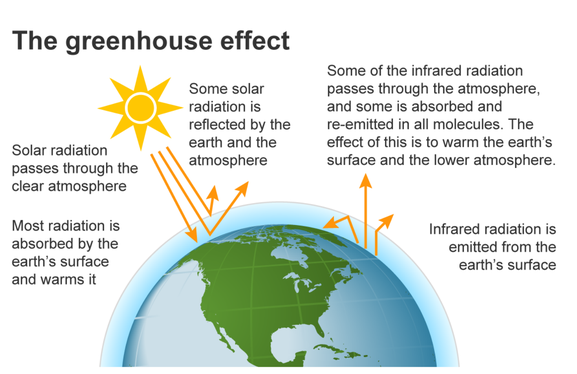
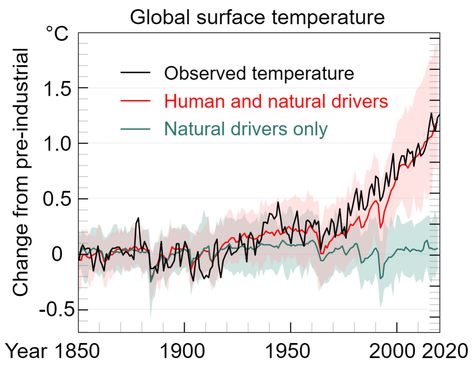
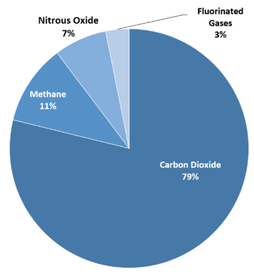
I06-2444
11 October, 2023

## Research context and motivation

- Starting from 1900 **global temperature started to increase**, mainly because of human influence: emission of greenhouse gases (g.h.g.) and deforestation



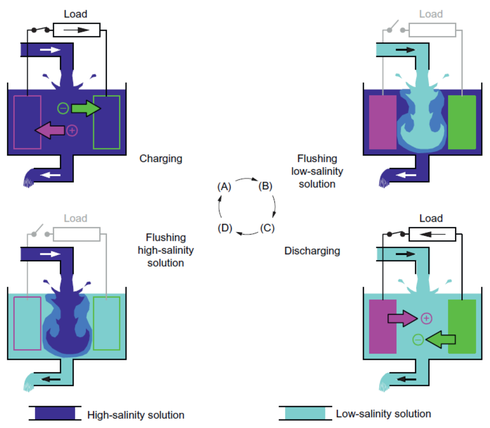

- Greenhouse gas composition: the most abundant gas among g.h.g. is **Carbon dioxide ($CO_2$)**, coming mainly from oil and coal.
- $CO_2$ is **responsible for 60% of global warming** due to human activity

## Addressed research questions/problems

- The goal is to **harvest energy from $CO_2$ capture** adapting the Capmix technique, but the mechanism is totally different.

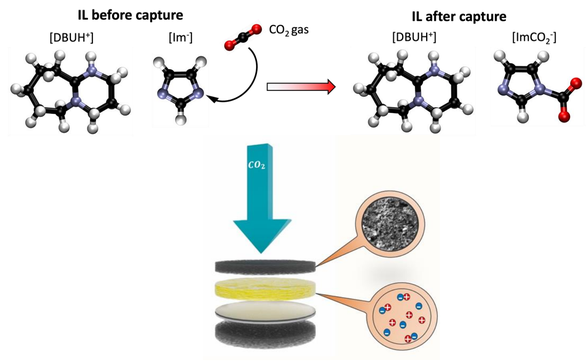
**Working principle**

**Capmix**




Technology exploited in blue energy field, based on **EDL enlargement**

**CO2Cap**

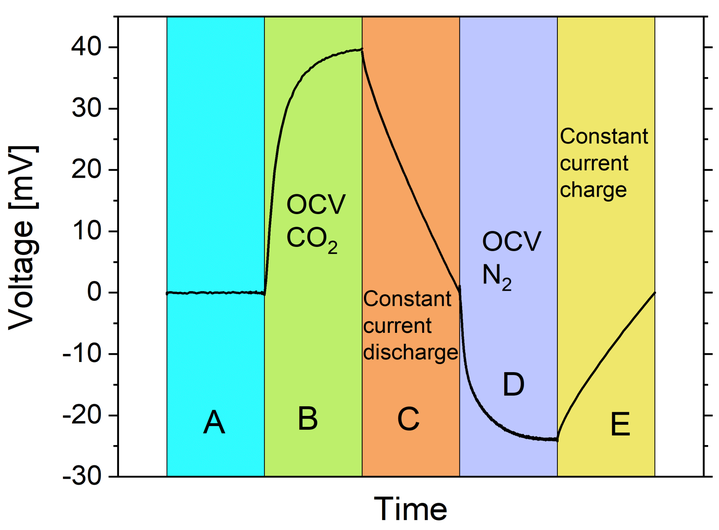



The reaction between the ionic liquid and $CO_2$ **happens only on one electrode**, producing a junction across which a voltage difference is created

## Adopted methodology

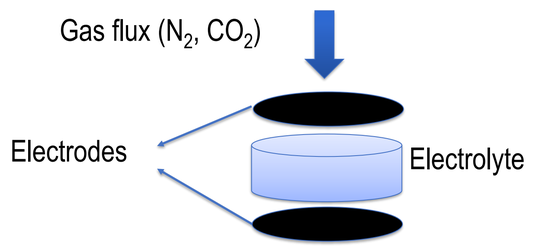
**Procedure:** inspired from Capmix, but avoiding the polarization of the device used to store charges at the electrodes interfaces.

- A: 5' short circuit
- B: OCV + $CO_2$ flush (50 ml/min)
- C: Constant current discharge (energy recovery)
- D: 15' OCV + $N_2$ flush (50 ml/min) (regeneration of the electrolyte)
- E: Constant current charge (energy recovery)



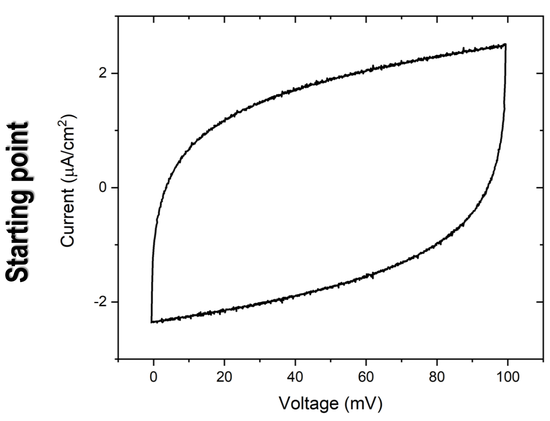

## Results

- Idea to **improve CO2Cap performances** is to exploit **Ionic liquids** as electrolyte inside the harvesting device. As in Capmix technology, we substitute high and low concentration solutions with fluxes of $CO_2$ and $N_2$.

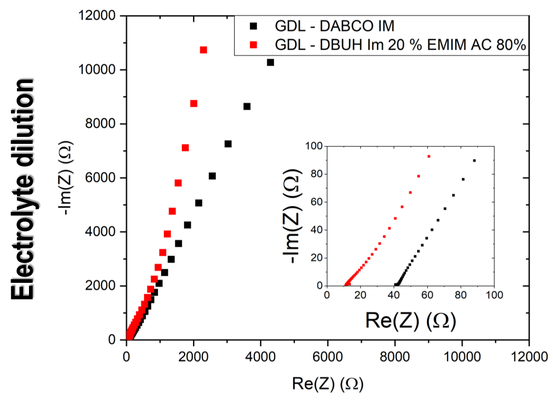



| 3 tested configurations | | |
|---|---|---|
| **Electrodes:** GDL **Electrolyte:** Dabco Imidazolide | **Electrodes:** GDL **Electrolyte:** 20% Dabco Im 80% Emim AC | **Electrodes:** Act. Carbons **Electrolyte:** 20% Dabco Im 80% Emim AC |

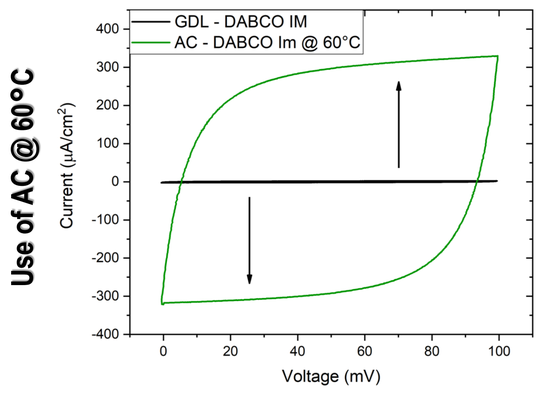
**EC characterization**




C= 0.3 mF/cm² η= 91.3% ESR= 40 Ω

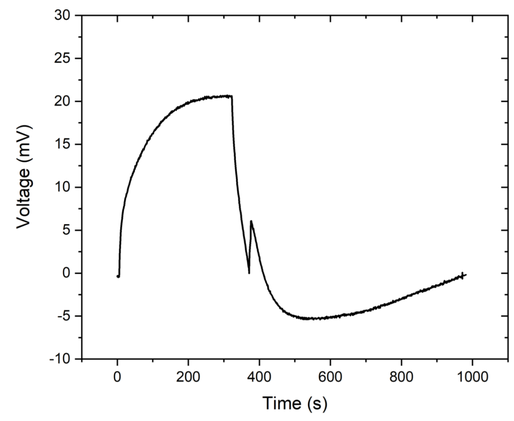



C= 0.4 mF/cm² **η= 96% ESR= 12 Ω**

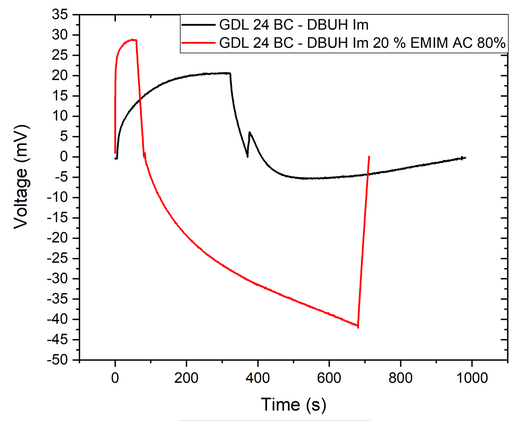



**C= 50 mF/cm² η= 98% ESR= 3 Ω**

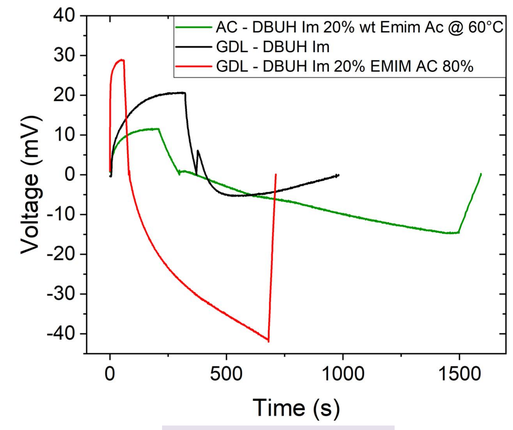
**Capmix performances**




E=0.1 µWh/m²




**E= 2.4 µWh/m²**




**E=30.4 µWh/m²**

## Future work

- **Use of new ionic liquids** more selective for $CO_2$ capture
- Improve ionic mobility, reducing ion pairing by **polar aprotic solvent**, such as Propylene carbonate
- Enhance conducibility of the electrolyte by inserting a **supporting salt**
- Increase the voltage rise due to the adsorption of $CO_2$ by exploiting **functionalized electrodes**, able to autonomously accumulate specific charges at their surface

**ACKNOWLEDGEMENT:** This result is part of a project that has received funding from the European Research Council (ERC) under the European Union's ERC Starting Grant. Grant agreement "CO2CAP" No. 949916

EARN&ST Energy Harvesting & Storage devices

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