

Advanced MOF-based materials towards dual carbon dioxide capture and conversion



Simone Coelho Fernandes

up201603496@fc.up.pt

Supervisors: Luís Cunha-Silva¹, Salette S. Balula¹

¹: LAQV/REQUIMTE, Faculdade de Ciências da Universidade do Porto, 4169-007, Porto, Portugal

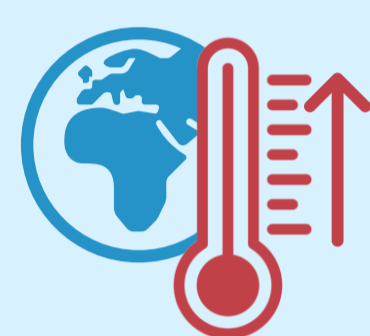
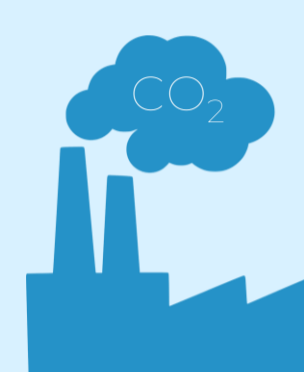
MIT Portugal 2023 Annual Conference

PROBLEM:



Increasing global energy consumption:
85 % of total energy is still supported in fossil fuels

Excessive release of CO₂ to atmosphere



Increasing average global temperature

SOLUTION:



Climate neutrality by 2050

Economy with net-zero greenhouse gas emissions, especially CO₂



decarbonization



STRATEGIES:

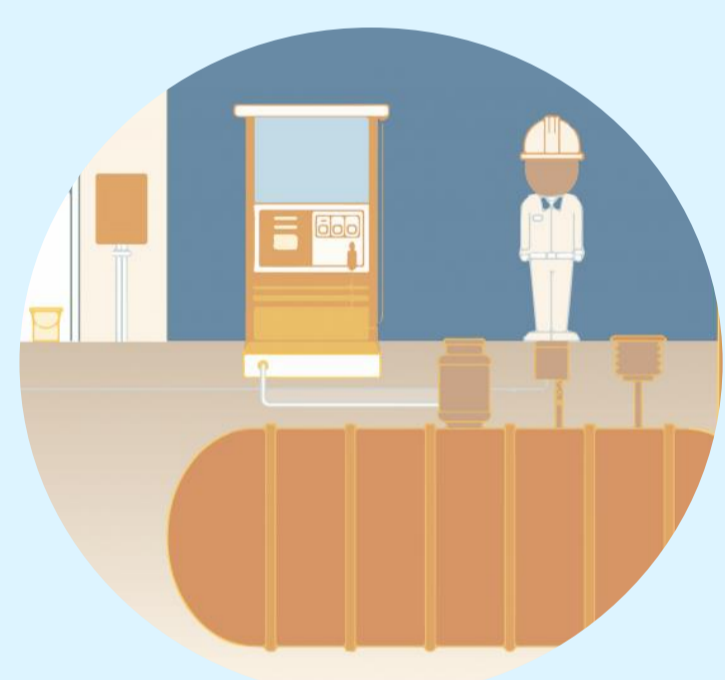


Capture

CO₂ capture and storage (CCS) in underground reservoirs is already being implemented

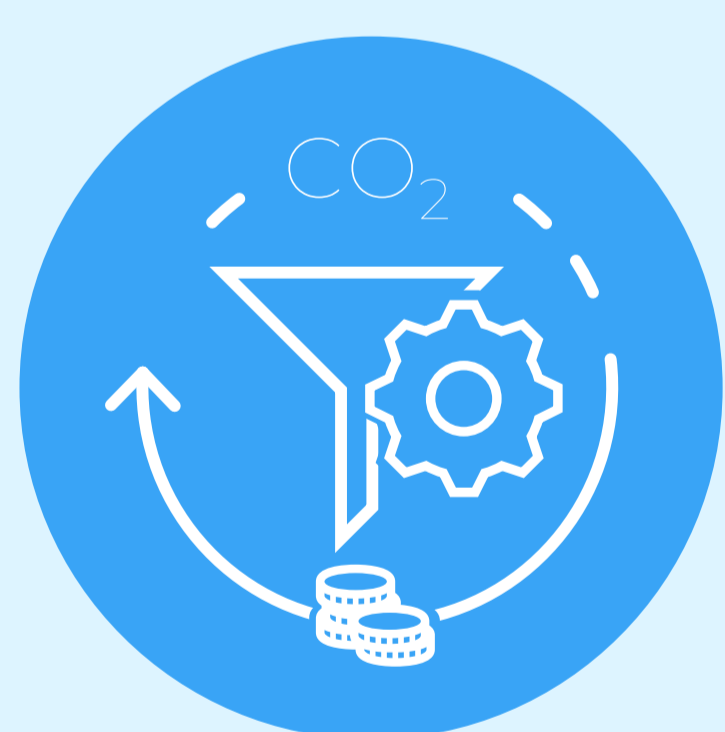


waste of abundant feedstock for valuable products



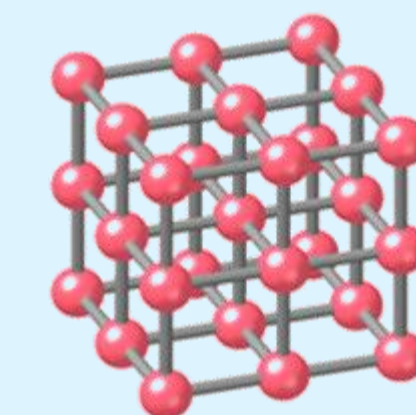
Conversion

CO₂ can be converted to value-added products without by-products, through an 100% atom economical route



One example of products with industrial interest are cyclic carbonates

Metal-Organic Frameworks (MOFs)



- Permanent and ordered porosity
- Crystallinity
- Robust and recyclable catalysts in several applications

MOF-based Materials

Activation of MOFs by:



Defect engineering MOFs crystalline structures (DeMOFs)

Supporting metallic nanoparticles in MOFs: materials (MNPs@MOFs)

Preparing porous MOF-silica hybrid composites (MOF/SiO₂)

MAIN OBJECTIVE:



Design of MOF-based materials with dual function: CO₂ capture and conversion into useful products, under ambient conditions (temperature and pressure).



REFERENCES:

1. Haszeldine, R. S. (2009). "Carbon Capture and Storage: How Green Can Black Be?" *Science* 325(5948): 1647-1652.
2. Gür, T. M. (2022). "Carbon Dioxide Emissions, Capture, Storage and Utilization: Review of Materials, Processes and Technologies." *Progress in Energy and Combustion Science* 89: 100965.
3. Pal, T. K., D. De and P. K. Bharadwaj (2020). "Metal-organic frameworks for the chemical fixation of CO₂ into cyclic carbonates." *Coordination Chemistry Reviews* 408: 213173.

Funded by:



This work received financial support from Portuguese national funds (FCT/MCTES) through the strategic project UIDB/50006/2020 and UIDP/50006/2020 (for LAQV-REQUIMTE) and was also funded by the European Union (FEDER funds through COMPETE POCI-01-0145-FEDER-031983). LCS and SSB thank FCT/MCTES for funding the Individual Call to Scientific Employment Stimulus (CEECIND/00793/2018 and EECIND/03877/2018, respectively). SF thanks FCT/MCTES for the PhD Grant 2022 MPP2030-FCT.



under the Doctoral Grant 2022 MPP2030-FCT | MPP Climate Science & Climate Change