Carbon capture, utilization and storage (CCUS)

The concept of CCUS:

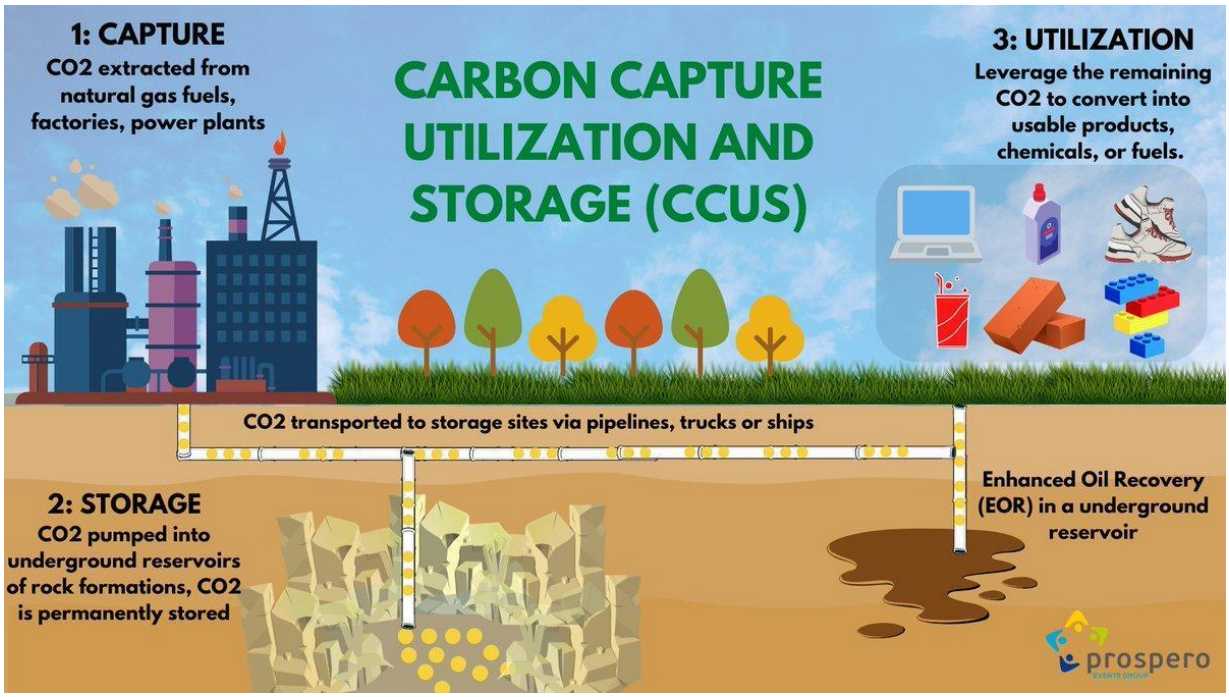


Figure taken from https://www.nextias.com/current-affairs/30-11-2022/carbon-capture-utilisation-and-storage-ccus-policy-framework/ I suggest to elaborate a similar one

CCUS has been identified as a needed technology for **carbon emissions reduction** in the short-medium term. Additionally, CCUS can allow the **continued use of fossil fuels**, and the deployment of **blue hydrogen**, while meeting the required energy and fuels demand and simultaneously protecting the environment. This attractiveness has caused CCUS technologies to be an area of deep interest to researchers from industry and academia globally.

Activities at the RICH Center (in blue from the webpage currently published – in process of being updated as it is from 2019!)

1. **CO_2 CAPTURE**

ADVANCED SORBENT DEVELOPMENT AND EVALUATION FOR CO2 CAPTURE HYBRID SYSTEMS

The objective of this project is to develop novel sorbent for carbon dioxide capture applications using hybrid systems. This includes steps such as synthesis of solid adsorbent, characterization of solid adsorbent, surface functionalization of solid adsorbent, selection, synthesis, and evaluation of liquid absorbent, evaluation of the CO2 capture hybrid system using major process performance indicators such as absorption capacity, selectivity, sorbent stability, energy requirement and mass transfer efficiency. In addition, the experimental evaluation and selection of the different sorbent materials will be supported by molecular modelling and mass transfer/diffusion modelling.

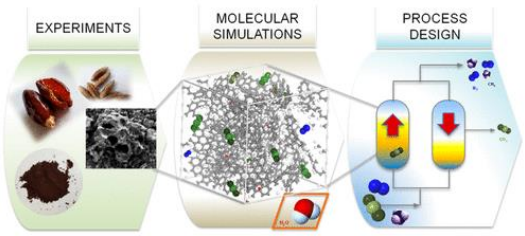
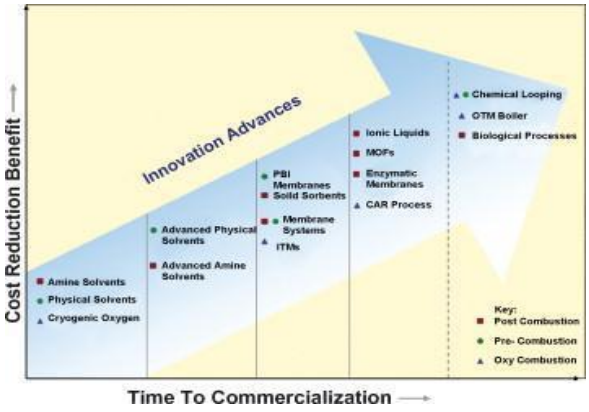


Figure: A combined modeling experimental approach for optimizing the process of CO2 capture by using activated carbons obtained from date seeds.

ADVANCED CO2 CAPTURE PROCESSES EVALUATION AND INTEGRATION

The objective of this project is to develop an integrated framework for the design and analyses of intensified and novel CO2 capture system with improved efficiency, lower energy requirement and reduced cost. Figure 2 exhibits the current status of CO2 capture technologies and its readiness to commercialization.



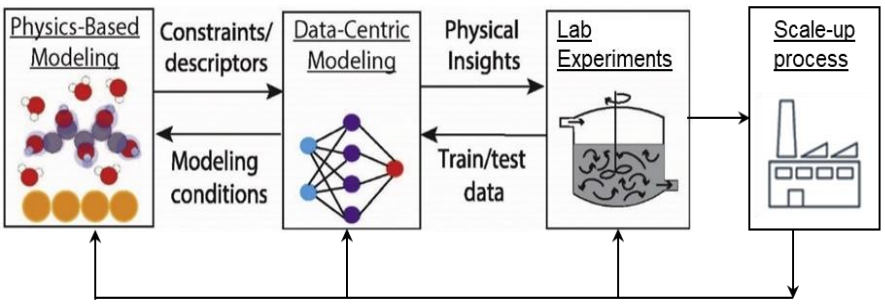


Figure: integrated approach for screening of sorbents and novel solvents for CO2 capture followed at the RICH Center

1. CO_2 UTILIZATION (FROM THE CURRENT RICH WEBPAGE)

SOLAR-DRIVEN CONVERSION OF CO2 AND H2S INTO FUEL PRODUCTION

The objective of this project is to develop and optimize solar-driven photochemical and thermochemical processes for the production of fuels and products (H2, CO, O2 and S) from

H2S/CO2 splitting, both very abundant in the UAE, using novel materials, demonstrating their technical feasibility.

MACHINE LEARNING APPROACH FOR NOVEL MATERIALS DEVELOPMENT

In this project, we make use of machine learning techniques to develop advanced molecular models of new materials for CO2 conversion and H2 production. We are using a computational design environment involving high-throughput as well as detailed theoretical studies along with data mining and the information from P2.1 and P3.1.

DIRECT CONVERSION OF CO2 INTO VALUABLE PRODUCTS: FROM WASTE TO MATERIALS

Firmly based in the concept of circular economy, in this project we are working on converting alkaline wastes to valuable materials for direct applications through carbonation process. The focus is on two types of wastes: Steel slag produced from the steelmaking industry and brine produced from water desalination, both of them abundant in the UAE and the region. Figure 3 shows the different pathways of CO2 usage and its conversion to different value-added products.

Additional current activities at the RICH center (to be added to the RICH webpage)

- **Integrated approaches to combine CO_2 capture with CO_2 utilization.**
- **Simultaneous CO_2-EOR (Enhanced Oil Recovery) and storage**

2. CO2 STORAGE/SEQUESTRATION (work carried out at RICH, still missing in the webpage)

Current activities at the RICH Center

- **Reservoir characterization, monitoring, measuring and verification for saline aquifers**
- **Artificial intelligence (AI) for characterization in the absence of data**
- **Mineralization:** conversion of CO_2 into stable carbonates through chemical reactions with suitable minerals, offering the potential for long-term CO_2 storage. Project in collaboration with ADNOC

Soil storage: Soil storage entails the storage of carbon as biochar or activated carbon, thereby increasing the carbon content of enriched soil. Project in progress using desertic soil is a **significant route for CO_2 storage in the UAE**