JULIAN SMART

SUPERVISOR: DR NIALL MAC DOWELL

"Optimizing Carbon Dioxide Removal and Carbon Markets to Stimulate Policy Towards Climate Resilience"

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IMPERIAL

UKRI Natural Environment Research Council

01. Background

Global Carbon Dioxide Removal (CDR)

- CDR refers to methods of removing atmospheric CO2 (separate from the reduction of emissions)[1]
- There is a need for CDR to reach 1.5/2.0C warming targets according to most Integrated Assessment Models (IAMs) by the United Nations Framework Convention on Climate Change (UNFCCC)[2]
- Methods are plentiful and categorized according to (i) the method used to remove emissions (ii) the method used to store carbon

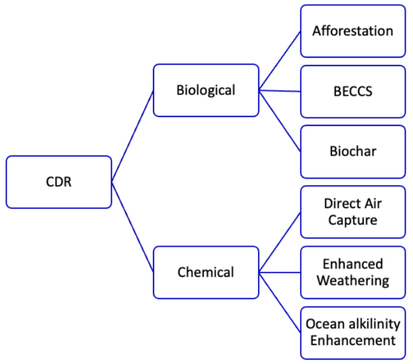


Figure 1: *Classification of CDR by removal mechanism*

The UK position on CDR

- The maximum technical potential of BECCS in the UK is 100-160MtCO2/year[3]
- HMG in the UK is amongst the most progressive on CDR, with teams working to include CDR within the UK Emissions Trading System (UK ETS)[4]

02. Research Questions

There remains a wealth of questions that need to be explored in the paradigm of Carbon Dioxide Removal:

1. What are the bottlenecks/risks for scaling carbon dioxide removal technologies?
2. What financial tools can support CDR deployment?
3. What is the potential for securitisation for CDR?

03. Aims, objectives and research stages

Aim 1: Understand the key risks in the CDR value chains.

Objective 1: Identify and compare the risks in the CDR value chains. Create **heat maps** showing the risks (initial findings in the graphs on the right), **quantify** the impact of risks through VaR metrics, and suggest methods of controlling risks.

Research Method 1: Use **exploratory mixed methods** to analyze CDR risks

Aim 2: Understand the existing mechanisms in the UK, such as UK ETS, and their role in scaling CDR

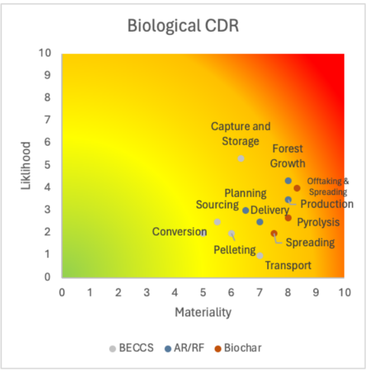
Objective 2: Develop a thorough understanding of all the **existing financial/market mechanisms in the UK** and how they can be leveraged to achieve the required levels of CDR in different scenarios.

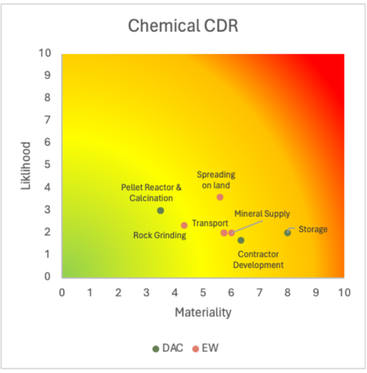
Research Method 2: Create **case studies** and a **model** of the CDR impact on carbon pricing, including how it affects demand/supply of CDR and allowances

Aim 3: Understand how securitisation can be applied to CDR.

Objective 3: Study the **optimal CDR portfolios** in the UK and beyond, and develop policy recommendations that can facilitate the deployment of **securitised** CDR portfolios.

Research Method 3: Use **optimization** methods to quantify CDR portfolios and suggest policy recommendations.





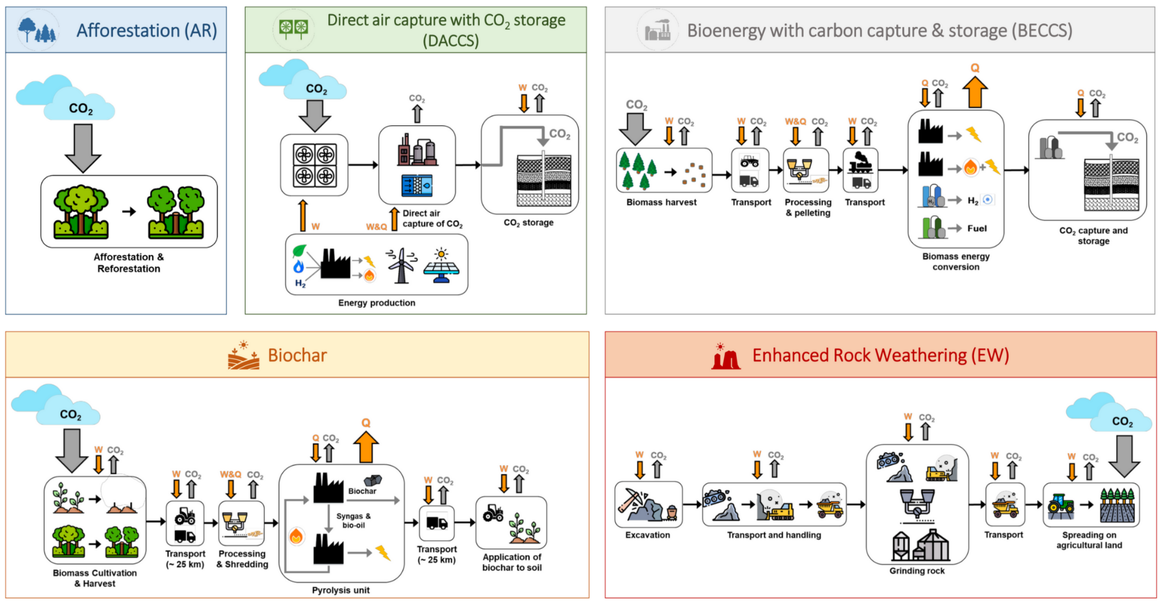


Figure 2: *The principal CDR types and their respective value chains[5]*

04. Project relevance and implications

This project is multidisciplinary and serves the purpose of expanding our understanding of (i) carbon dioxide removal technologies, (engineered and nature-based) and (2) how different actors can come together to scale the technologies and close the emissions gap, expected at 10-20% of hard-to-abate emissions[6]. As such, this research has specific relevance for:

1. **Policy-makers**, by providing insight into the key areas of CDR that can be supported to establish a robust transition to net-zero (and negative) emissions
2. **Financial Institutions**, by facilitating insight into novel tradable instruments that can support the development of CDR
3. **CDR providers**, by offering an understanding of the inherent risks and opportunities
4. **Academia**, due to novel research in CDR and the multidisciplinarity between the engineering, political, and financial elements of CDR

References: 1. Bird et al., (2024) Carbon dioxide removal, Grantham Institute - Climate Change and the Environment **2.** Pozo et al., (2020) Equity in allocating carbon dioxide removal quotas; Lomax et al., (2015) Investing in negative emissions **3.** Daggash, M.A., & Fajardy, M. (2019) Bioenergy with CCS and Direct air CCS, UK Energy Research Council **4.** Coutinho, C. & Callanan, M., (2023) Carbon Capture, Usage and Storage: A vision to establish a competitive market **5.** Bui, M., (2024) Carbon dioxide removal (CDR) technologies: Challenges and opportunities **6.** United Nations Environment Programme (2023) Broken Record - Temperatures hit new highs, yet world fails to cut emissions (again)

Contact: jhs21@ic.ac.uk