

Assessing the Scalability of Clean Innovations for Net Zero: Strategic Interventions to Enhance the Economic Viability of Direct Air Capture Technologies

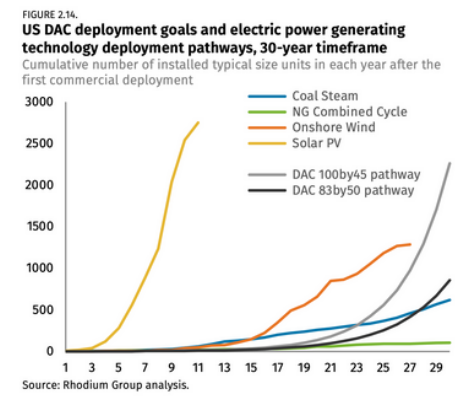
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This paper investigates the critical role of Direct Air Capture (DAC) technology in achieving global climate goals and emphasizes the need to scale its implementation. We explore various strategies and interventions to support DAC expansion, including market-based mechanisms, market-shaping tools, and green finance initiatives. By analyzing different implementations across countries, the paper assesses the effectiveness of these approaches in attracting investments and scaling deployment of DAC.

01 INTRODUCTION

Despite efforts to mitigate emissions, large amounts of CO₂ continue to accumulate. An estimated 20 billion tons still need to be removed each year. DAC has emerged as the most promising solution for removing carbon. While DAC offers flexibility in location and lower land usage compared to its alternatives, its expansion is limited by high costs and equipment constraints. As deployment climbs, cost per plant will fall and exponential growth will follow.

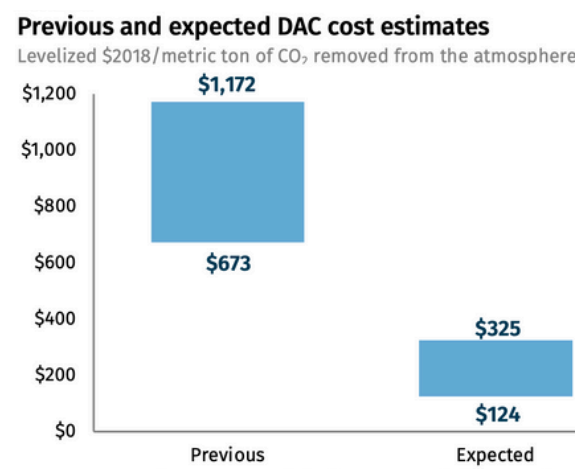


02 OBJECTIVES

1. Elaborate on the current sentiments, progress, investments and outlook of direct air capture technology
2. Identify financial interventions and government policies that can be used to scale direct air capture
3. Analyse and evaluate the different interventions and how effective they have been when implemented in different situations and countries
4. Recommend the best course of action for the United Kingdom to achieve target of net zero

03 CURRENT OUTLOOK

DAC costs must fall from \$600-\$1000 per ton to \$100-\$200 to scale effectively and meet the IPCC's goal of removing up to 10 billion tons of CO₂ annually. BCG's analysis of DAC developers suggests this is achievable, but requires significant investment, government support, and innovative market mechanisms.



04 IDENTIFYING INTERVENTIONS

- **Market-Based Mechanisms:**
 - Carbon Taxes
 - Cap and Trade Systems / Emissions Trading Systems (ETS)
 - Carbon Offsets
 - Sale of CO₂ Sourced Carbon
 - Voluntary Carbon Markets
 - Contract for Difference
 - Feed-in Tariffs
- Subsidies and Tax Incentives
- Concessional / Grant Payments
- **Market-Shaping Mechanisms:**
 - Public Procurement
 - Advanced Market Commitments
 - Direct Investments
- **Green Finance Mechanisms:**
 - Green Bonds
 - Sustainable Investment Funds

05 ANALYSIS

Market Based Mechanisms

Carbon Pricing: This includes carbon taxes and cap-and-trade systems, which show varying outcomes. Sweden's carbon tax has led to a 25% reduction in greenhouse gas emissions, with stable pricing attracting investments and funding for clean energy. In contrast, Australia's experience highlights the need to address socioeconomic factors, like energy affordability, to prevent public backlash. A tiered carbon tax could provide a gradual adjustment for businesses, supported by subsidies for renewable energy investments.

Cap-and-Trade Systems: The EU Emissions Trading System (ETS) achieved a 47% emissions reduction since 2005, due to a gradually declining cap on emissions that allows for trading allowances. However, a recurring issue was the oversupply of permits. Adjusting the cap has helped restore market effectiveness, suggesting that sector-specific caps could be beneficial for the UK, targeting industries like transportation and energy.

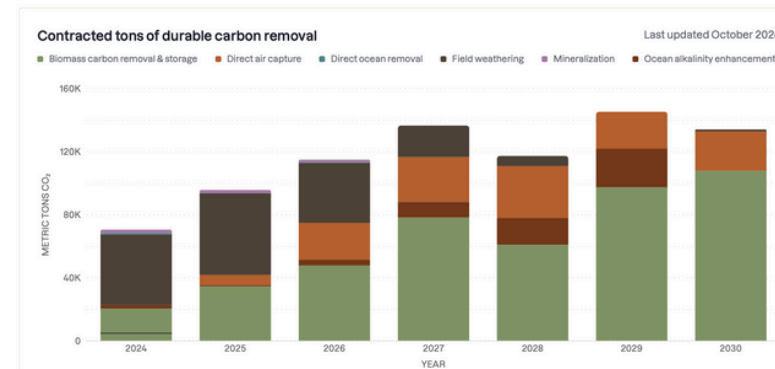
Low Carbon Fuel Standard (LCFS): In California, the LCFS reduces emissions from transportation fuels by incentivising low-carbon options. This system's adaptability relies on carefully adjusted caps, making it a potential model for the UK.

Voluntary Carbon Markets: Expected to grow significantly, these markets allow companies to invest in carbon dioxide removal projects. However, challenges include unclear definitions, verification difficulties, and risks of over-crediting. Improving standards and accountability is essential to prevent companies from relying solely on offsets instead of reducing emissions directly.

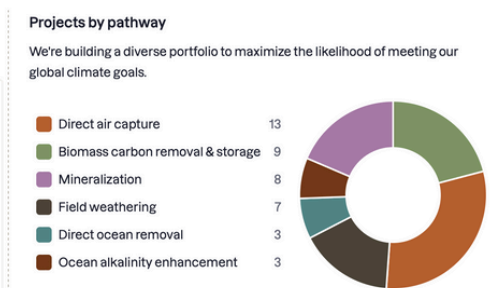
Market Shaping Mechanisms

Frontier's Progress

Dollars contracted	Tons contracted	Tons delivered
\$346M	635,199	4,463
↳ \$25M since Oct 2023	↳ 435K since Oct 2023	↳ 443 since Oct 2023



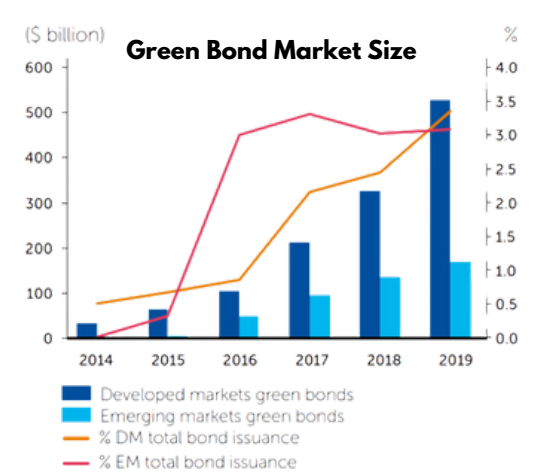
Frontier's investment portfolio



An example of market-shaping mechanisms is **Advanced Market Commitments (AMCs)**, which are used to address market failures when commercial incentives fail. AMCs encourage private investment by guaranteeing future demand and reducing uncertainty. They involve a binding promise to purchase a product once developed, often with firms agreeing to sell at near-cost prices in exchange for large-volume purchase commitments. A notable example is the **Frontier AMC**, which has pledged over a billion dollars for initial carbon removal before 2030, backed by major companies like Stripe, Alphabet, and Meta.

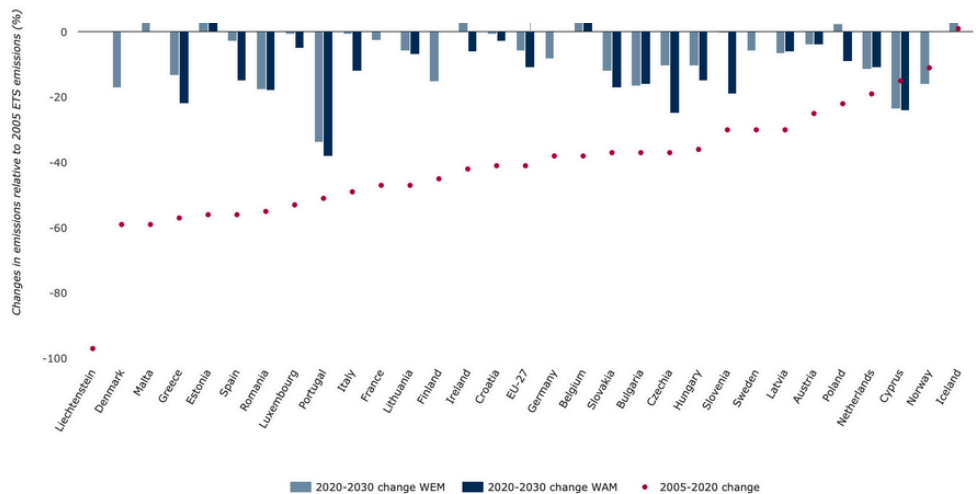
Green Finance Mechanisms

Green bonds are a type of fixed-income security issued to finance projects with environmental or climate-related benefits. They appeal to investors who are seeking both profit and environmental outcomes. The green bonds market saw a notable surge in 2021 when the European Union issued \$14 billion in green bonds, the largest issuance of its kind at the time.

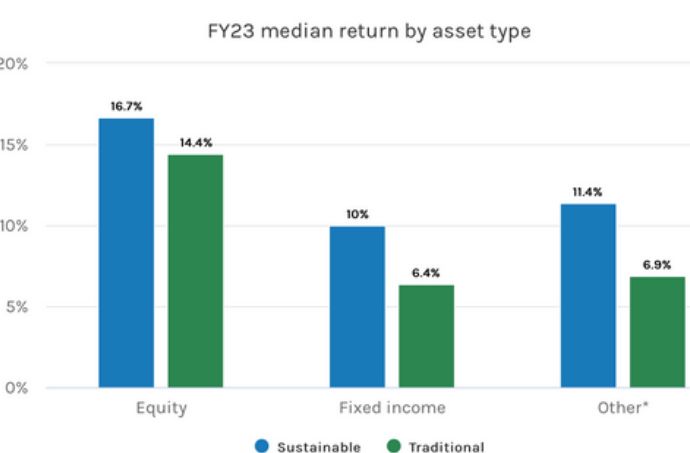


Sustainable investment funds have recently outperformed traditional funds across all asset classes. According to Morgan Stanley, sustainable funds generated median returns of 12.6%, significantly higher than the 8.6% returns of traditional funds. Sustainable funds now account for 7.2% of global assets under management, reflecting their growing appeal to investors seeking both profit and positive social or environmental impact.

Figure 2 Historical and projected changes in ETS emissions relative to 2005 levels



Sustainable Funds Outperformed Across Asset Classes



06 CONCLUSION

In conclusion, there is not one intervention or mechanism that is capable of helping scale DAC to the level that we need it to be to achieve net zero emissions. Drawing from successful implementations in other countries, the UK's most effective approach would involve a combination of key strategies:

1. Refining the UK ETS with industry-specific caps while ensuring market liquidity
2. Implementing a progressive carbon tax
3. Creating an AMC for DAC technologies or working with an existing AMC to drive investment and innovation for a risky, emerging technology
4. Issuance of more green bonds that are targeted for carbon removal and encouraging private investment through sustainable investment funds

