What economic incentives for Bioenergy with Carbon Capture and Storage? An overview of pricing mechanisms for Carbon Dioxide Removal (CDR)

Emma Jagu Schippers*[1], Injy Johnstone[2], Coline Seralta[1], Romain Presty[3], Antigoni Theocharidou[4], and Flore Verbist[5]

[1]Laboratoire Génie Industriel, CentraleSupélec, Université Paris-Saclay – CentraleSupélec, Université Paris-Saclay, 3 rue Joliot Curie, 91190 Gif-sur-Yvette, France – France
[2]Oxford Smith School – United Kingdom
[3]IFP School – IFPEN, IFP Energies nouvelles, 1 et 4 avenue de Bois-Préau, 92852 Rueil-Malmaison, France. – France
[4]Center for Environmental Policy, Imperial College London – United Kingdom
[5]Divison of Applied Mechanics and Energy Conversion, KU Leuven – Belgium

Abstract

Carbon Dioxide Removal (CDR) technologies, including Bioenergy with Carbon Capture and Storage (BECCS), have evolved from being met with skepticism to being recognized as essential for achieving net-zero emissions targets globally (IPCC, 2022). Integrated Assessment Models (IAM) have incorporated BECCS since the late 2000s (van Vuuren et al., 2013), and mitigation pathways compatible with the Paris Agreement objectives are increasingly relying on BECCS.
In that context, the rationales for considering CDR in public policy are multifaceted: balancing residual emissions from hard-to-decarbonize sectors, enabling net-zero emissions targets, and even moral obligations for historical emitters to drive down CDR costs for others (Honegger et al., 2021). However, despite its critical role, CDR is characterized by a public goods dilemma, where few actors bear the costs, but the benefits are global, necessitating systematic long-term public intervention.

This paper provides a comprehensive overview of existing and proposed economic incentives aimed at fostering the deployment of BECCS to meet national Net-Zero objectives. We examine a range of mechanisms, including carbon crediting mechanisms (Schenuit et al., 2023), voluntary carbon markets (Fuss et al., 2024), UNFCCC carbon markets (UNFCCC, 2021), taxes, and Emissions Trading Systems (ETS) (Kalkuhl et al., 2022; Rickels et al., 2022, 2021), to understand how they can be designed and implemented to promote the uptake of BECCS.

By synthesizing the current state of knowledge in the economics literature, this study aims to inform policymakers and stakeholders on the most effective strategies to overcome the economic barriers to CDR deployment, ultimately supporting the transition to a net-zero economy.

*Speaker

References

Fuss, S., Johnstone, I., Hoglund, R., Walsh, N., 2024. Chapter 4: The Voluntary Carbon Market, The State of Carbon Dioxide Removal - 2nd Edition. https://doi.org/10.17605/OSF.IO/MG3CY

Honegger, M., Poralla, M., Michaelowa, A., Ahonen, H.-M., 2021. Who is paying for carbon dioxide removal? Designing policy instruments for mobilizing negative emissions technologies. Frontiers in climate 3, 672996–672996.

IPCC, 2022. Climate Change 2022: Mitigation of Climate Change. Contribution of Working Group III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, UK and New York, NY, USA. https://doi.org/10.1017/9781009157926

Kalkuhl, M., Franks, M., Gruner, F., Lessmann, K., Edenhofer, O., 2022. Pigou's Advice and Sisyphus' Warning: Carbon Pricing with Non-Permanent Carbon-Dioxide Removal. SSRN Journal. https://doi.org/10.2139/ssrn.4315996

Rickels, W., Proelß, A., Geden, O., Burhenne, J., Fridahl, M., 2021. Integrating Carbon Dioxide Removal Into European Emissions Trading. Frontiers in Climate 3, 1–10. https://doi.org/10.3389/fclim.2021.690023

Rickels, W., Rothenstein, R., Schenuit, F., Fridahl, M., 2022. Procure, Bank, Release: Carbon Removal Certificate Reserves to Manage Carbon Prices on the Path to Net-Zero. Energy Research & Social Science 94, 102858–102858. https://doi.org/10.1016/j.erss.2022.102858

Schenuit, F., Gidden, M.J., Boettcher, M., Brutschin, E., Fyson, C., Gasser, T., Geden, O., Lamb, W.F., Mace, M., Minx, J., 2023. Secure robust carbon dioxide removal policy through credible certification. Communications Earth & Environment 4, 349.

UNFCCC, 2021. Decision -/CMA.3 Guidance on cooperative approaches referred to in Article 6, paragraph 2, of the Paris Agreement.

van Vuuren, D.P., Deetman, S., van Vliet, J., van den Berg, M., van Ruijven, B.J., Koelbl, B., 2013. The role of negative CO 2 emissions for reaching 2 C-insights from integrated assessment modelling. Climatic Change 118, 15–27.

Keywords: BECCS (Bioenergy with Carbon Capture and Storage), economic incentives, carbon dioxide removal, negative emissions, carbon markets