Promoting bio-CCS in the Nordic Region

Workshop paper

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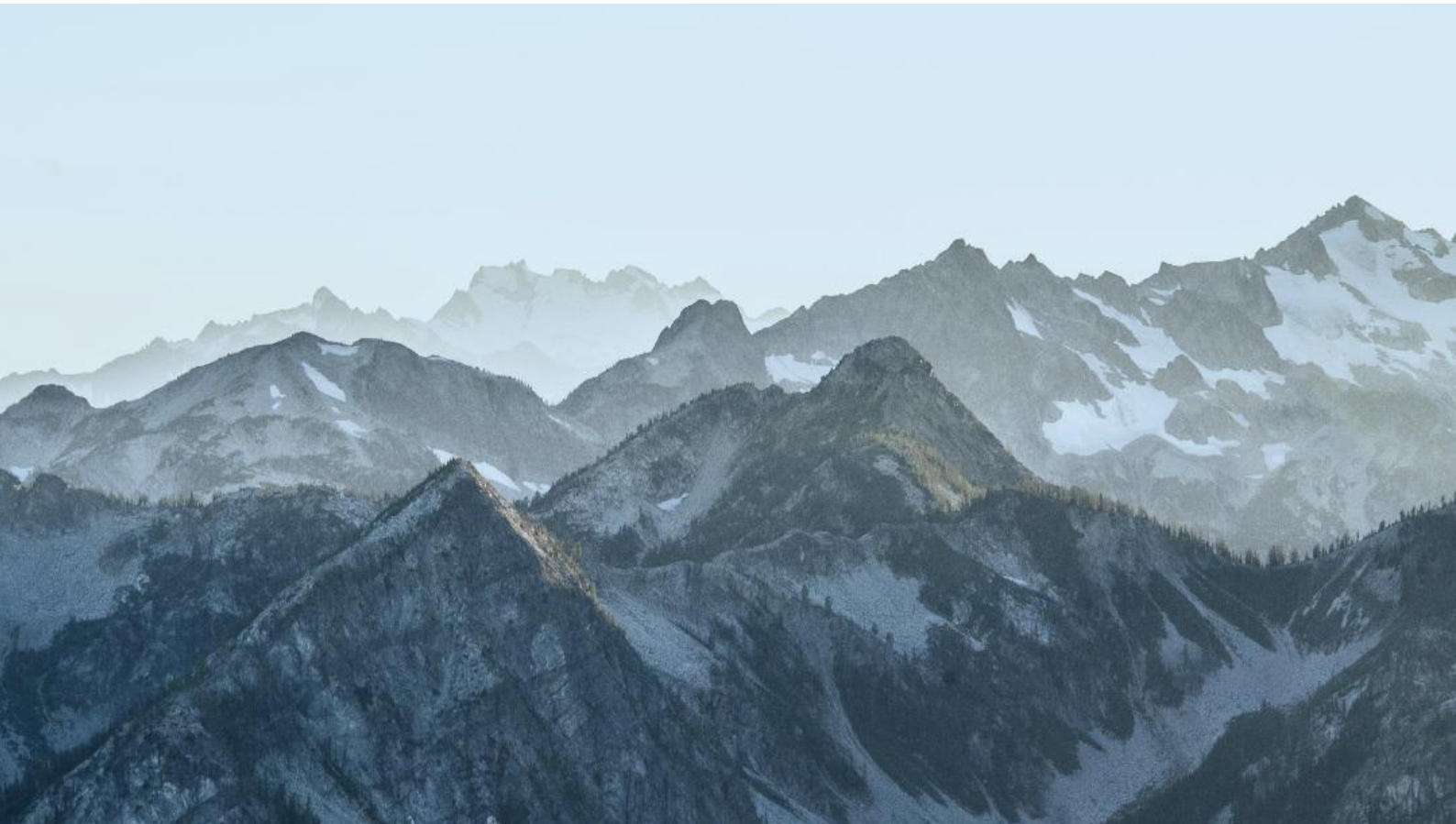

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Abbreviations

Bio-CCS	Biogenic carbon capture and storage
Bio-CCU	Biogenic carbon capture and utilisation
CCS	Carbon capture and storage
CCU	Carbon capture and utilisation
CO_2	Carbon dioxide
CO_2e	Carbon dioxide equivalent
CRCF	Carbon Removal and Carbon Farming
ETS	Emissions trading system
ITMO	Internationally transferred mitigation outcome
Mt	Million tonnes
PACM	Paris Agreement Crediting Mechanism

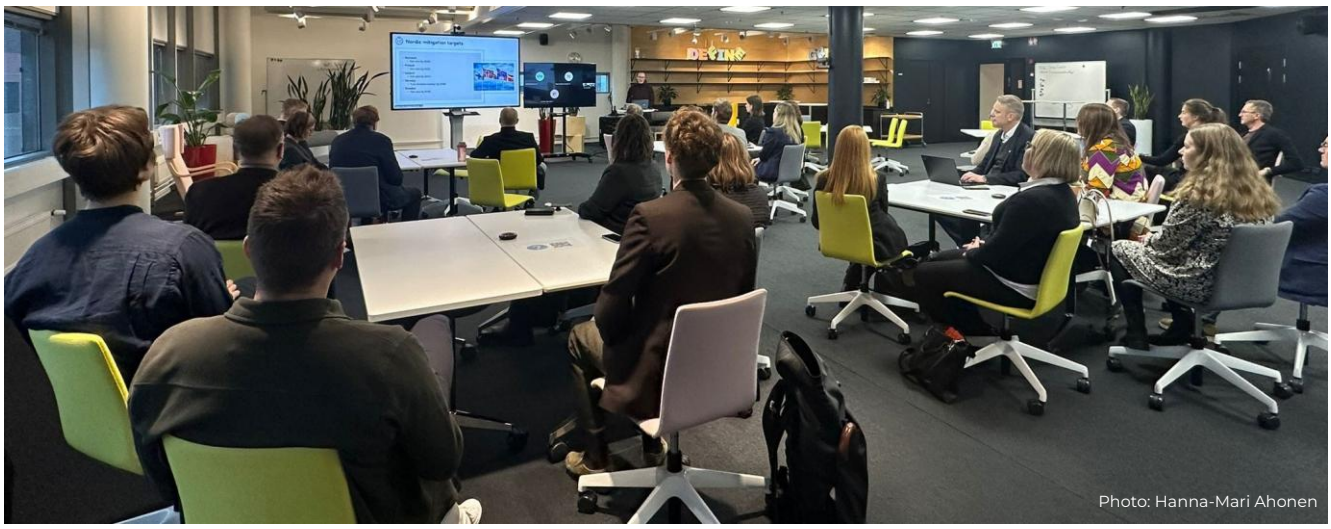
Photo: Hanna-Mari Ahonen

This paper summarises the key take-aways from a workshop on promoting bio-CCS in the Nordic region, held in Helsinki on 5 December 2025. The workshop brought together around 40 Finnish public and private stakeholders and international experts to exchange views and experiences on policy options and case studies for funding bio-CCS through state support and/or carbon credits. Presentations covered Article 6, the voluntary carbon market and the EU context, as well as relevant Nordic experiences, including insights from the Swedish and Danish state support schemes for bio-CCS, and early bio-CCS/CCU activities in Finland.

The workshop was organised under a research project on Nordic bio-CCS cooperation. This project examines the conditions for promoting the capture and durable storage of biogenic carbon dioxide in the Nordic region through carbon market cooperation under Article 6 of the Paris Agreement. The project is funded by the Swedish Energy Agency, led and coordinated by KTH Royal Institute of Technology and supported by IVL Swedish Environmental Research Institute and Perspectives Climate Research.


Photo: Malin Dufour

Photo: Hanna-Mari Ahonen

Background

The capture and durable storage of biogenic carbon dioxide (bio-CCS) is an emerging solution that can contribute to achieving our global climate change mitigation goals by removing carbon dioxide (CO_2) from the atmosphere.

The Nordic region has significant potential for bio-CCS – Finland, Denmark and Sweden have considerable point sources of biogenic CO_2, and Denmark, Norway and Iceland offer durable storage opportunities for captured CO_2. Cooperation between Nordic policymakers and the private sector is needed to untap this potential through effective national policies and a well-functioning bio-CCS infrastructure and value chain.

To be financially viable, removals from bio-CCS need to be monetised, for example through state support and/or the sale of carbon credits in carbon markets. Denmark, Norway and Sweden are already providing state support for bio-CCS, and Finland also intends to do so. Finland is also exploring options for biogenic carbon capture and utilisation (bio-CCU). Article 6 of the Paris Agreement provides for market-based climate cooperation through internationally transferred mitigation outcomes (ITMOs). Sweden intends to pilot the transfer of ITMOs from bio-CCS with Switzerland.

Photo: Malin Dufour

Key take-aways

All Nordic countries have ambitious mitigation targets that can drive substantial demand for removals from bio-CCS, and the Nordic region also has significant potential for supplying removals from bio-CCS. Due to differences in the sectoral scope coverage of Nordic countries' mitigation targets, they are challenging to compare. Net zero target years range from 2035 to 2045 in Denmark, Finland, Iceland and Sweden, while Norway has a "low emission society"-target for 2050. The projected need for counterbalancing national emissions in the target years range from 4.5 to 33 million tonnes of CO_2 equivalent ($MtCO_2e$). This counterbalancing of emissions requires different removal methods and/or ITMOs, with regional preconditions and preferences determining the most suitable option(s). Significant potential for capturing biogenic carbon from point sources exists across the Nordic region, especially in Finland and Sweden. Fully realising the Nordic bio-CCS potential might fulfil up to half of the entire need for EU "industrial removals", depending on the estimate. For more information, see Dufour & Möllersten (2025): Nordic net-zero: counterbalancing residual emissions in the context of unevenly distributed BECCS potentials.

Carbon credits can help to finance bio-CCS activities. Several carbon crediting programmes offer methodologies for generating carbon credits from bio-CCS activities, with further methodologies expected in the future, e.g., under the EU Carbon Removal and Carbon Farming (CRCF) certification framework and the Paris Agreement Crediting Mechanism (PACM). Voluntary buyers are the main source of current demand, and compliance buyers are a potential source of future demand. Carbon credits are suitable for different voluntary and compliance uses, depending on, for example, which crediting programme has issued them and whether they have been authorised as ITMOs under Article 6.2 of the Paris Agreement. Combining carbon credit revenue with state support could lead to more removals, more profit or less state support, depending on the case. For more information, see Ahonen et al. (2025): Promoting biogenic carbon capture and storage in the Nordic region through carbon markets (Discussion Paper & Policy Brief).

The EU is exploring various policy options for supporting bio-CCS. Dedicated policies are crucial, with the appropriate policies depending on the scale, maturity, and characteristics of the removal method. Currently, the CCS Directive regulates CO_2 storage, the Net-Zero Industry Act sets injection targets for industrial carbon management, the Innovation Fund can be used to finance bio-CCS, and the integration of permanent removals into the EU Emissions Trading System (ETS) is under discussion. ETS integration would create demand for bio-CCS credits, as the ETS cap will approach (and even surpasses) net zero in the future. However, ETS integration is no panacea – caveats include fairness, competitiveness, and „emission reduction deterrence". Sustainability of demand, could become questionable if industrial decarbonization advanced substantially, leaving but a few remaining emitting ETS sectors to demand bio-CCS credits. The CRCF methodology for bio-CCS is expected to be adopted in 2026. While the CRCF does not create a demand for CRCF units per se, potential use cases include voluntary use, inclusion into the EU

ETS, and a flexibility mechanism for the effort-sharing sector. For more information, see Winkler et al. (2025): Exploring key dimensions of policy instruments for carbon dioxide removal.

Denmark's experience shows that competitive tenders may not be cost-effective for an immature (bio-)CCS market. Denmark has pioneered funding for (fossil and biogenic) CCS, with the first deliveries of removals from bio-CCS expected in 2026. Under the first two tenders, the state is paying around 135 EUR/tCO_2. Typically, the state support covers only part (e.g. 50%) of the costs and successful bids include co-funding from the voluntary carbon market (mainly Microsoft). Under the ongoing tender, the state is expecting 2.3 Mt/year from 2030 at an average cost of 90 EUR/t in subsidies (bid cap of 140 EUR/t). However, of the ten pre-selected entities, only two opted to bid under the tender. Key lessons include that the technical capture and storage potential is not equal to the realistic or economic potential. Many high-level assessments do not take into account how operating hours will affect the cost per ton of CO_2. Unrealistic requirements for implementation and delivery timelines may exclude potential bidders. Furthermore, when state support covers only part of the costs, the bidder's ability to secure co-funding from the voluntary carbon market becomes key for success. For more information, see Sørensen & Capion (2025): Higher costs may reduce the impact of the Danish CCS tender.

Sweden's first reverse auction for bio-CCS also faced participation challenges. Sweden has established a state support system using reverse auctions to facilitate the deployment of bio-CCS. To date, roughly SEK 30 billion has been allocated to this program. The first reverse auction, held in late 2024, attracted relatively few bidders. The requirement to commence geological CO_2 storage within three years discouraged many developers, while the restriction of support eligibility exclusively to biogenic CO_2 further reduced the interest in participating from facilities with mixed emissions streams. No actors from the pulp and paper industry participated in the auction. The winning bidder from the first auction – a biomass combined heat and power plant in the district heating sector - will receive just over SEK 20 billion, disbursed as results-based payments over a maximum of 15 years, starting from the commencement of geological storage, which is scheduled for 2028. The support level, around SEK 1,700 per tonne, covers approximately one third of the abatement cost, with the remainder of revenues deriving from carbon removal credit sales and the EU Innovation Fund. Approximately SEK 10 billion has been allocated for the second round of reverse auctions in 2026. For more information, see Swedish Energy Agency (2025): Den första omvända auktionen för bio-CSS-stöd och den svenska bio-CCS-sektorn - från aktörernas perspektiv (in Swedish).

Finland's national net-zero target for 2035 could be achieved with strategic use of removals from bio-CCS/CCU, and ITMOs. Emission reductions from bio-CCU could help to reduce emissions in 2035 to 14-17 Mt, while removals from bio-CCU could counterbalance some of these remaining emissions. Finnish pulp mills and district heating plants emit around 28 Mt of biogenic CO_2 per year. For capturing 20-90% of this potential, preliminary breakeven price estimates are around 100-135 EUR/t. In the first stage, government support is needed to incentivise bio-CCS/CCU. While

voluntary demand helps, compliance demand (EU ETS reform) will ultimately be needed. ITMOs could also play a significant role in achieving the national target. For more information, see Ollikainen & Honkatukia (2025): Kansantaloudellisesti tasapainoinen nielupolku Suomen hiilineutraaliustavoitteen saavuttamiseen (in Finnish).

Finnish pilots for bio-CCS/CCU highlight the role of infrastructure for transport and storage, partnerships across the CCS/CCU value chain, and co-funding from the voluntary carbon market. There are ongoing or planned pilots for capturing carbon from a waste-to-energy plant and pulp and paper mills, with plans for its storage and/or utilisation. Metsä Group's pilot unit in Rauma was launched in 2025 and Vantaa Energia's CCS project is planned to start construction in 2027 and be commissioned in 2030. Carbonaide has developed a technology for utilising biogenic carbon in the construction industry, enabling companies to durably store carbon in their products. There are also plans to utilise biogenic carbon in green hydrogen production, and Hydrogen Cluster Finland has developed a hydrogen roadmap. Key hurdles to scaling these solutions include the lack of infrastructure and incentives for biogenic CCS/CCU, and the immaturity and illiquidity of the global carbon removal market. Building a carbon removal industry could offer Finland a strategic opportunity to make its bio-industry net-negative and achieve its national targets on net-zero and net-negative emissions. Currently, the voluntary carbon market is a key source of funding for removals from bio-CCS activities. Government support and incentives would be needed to scale up these activities, also for setting up the transport and storage infrastructure. Finland has already signed bilateral agreements with Norway and Denmark on transporting and permanently storing CO_2 in their territories.

Further reading

- Ahonen & Möllersten (2025): Swedish participation in the voluntary carbon market - Guidance for potential buyers and sellers.
- Ahonen et al. (2025): Promoting biogenic carbon capture and storage in the Nordic region through carbon markets. Discussion paper & Policy brief
- Capion & Sørensen (2025): E-fuels or storage: How to make the most of clean electricity and captured CO_2.
- Dufour et al. (2025): Corporate net-zero: targets do not add up due to scope 2 and 3 emissions.
- Dufour & Möllersten (2024): Nordic net-zero: counterbalancing residual emissions in the context of unevenly distributed BECCS potentials.
- Dufour, Möllersten & Zetterberg (2024): How to maintain environmental integrity when using state support and the VCM to co-finance BECCS projects-a Swedish case study.
- Michaelowa et al. (2023): International carbon markets for carbon dioxide removal.
- Swedish Energy Agency (2025): Den första omvända auktionen för bio-CSS-stöd och den svenska bio-CCS-sektorn - från aktörernas perspektiv.
- Sørensen & Capion (2025): Higher costs may reduce the impact of the Danish CCS tender.

- Swedish Energy Agency (2021): Första, andra, tredje… Förslag på utformning av ett stödsystem för bio-CCS (in Swedish).
- Winkler et al. (2025): Exploring key dimensions of policy instruments for carbon dioxide removal.
- Zetterberg (2025): An EU Removals Target and Trading System (RTTS) for Carbon Dioxide – Concept paper for discussion.

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