Summary of evaluated options and proof of implementation

CETP CO2RR – Deliverable 4.2 [*interim*]

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Airfix

CARBON IMPACT

Logistics AG ChemOil

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Setting the scene

Purpose

- To summarise key evaluated risk-sharing and business model options
- To document initial implementation progress and early learnings

Scope

- First year iteration (2023–2024)
- Focus on feasibility testing, stakeholder engagement and model validation

Expected impact

- Laying the foundation for scalable CO2 transport and storage solutions
- Reducing uncertainties for emitters, logistics and financial stakeholders

Methodology and approach

Evaluation criteria

- ✓ Financial viability and cost effectiveness
- ✓ Risk distribution across the value chain
- ✓ Incentive alignment for emitter, transport and storage providers
- ✓ Scalability and replicability across regions

Stakeholder engagement

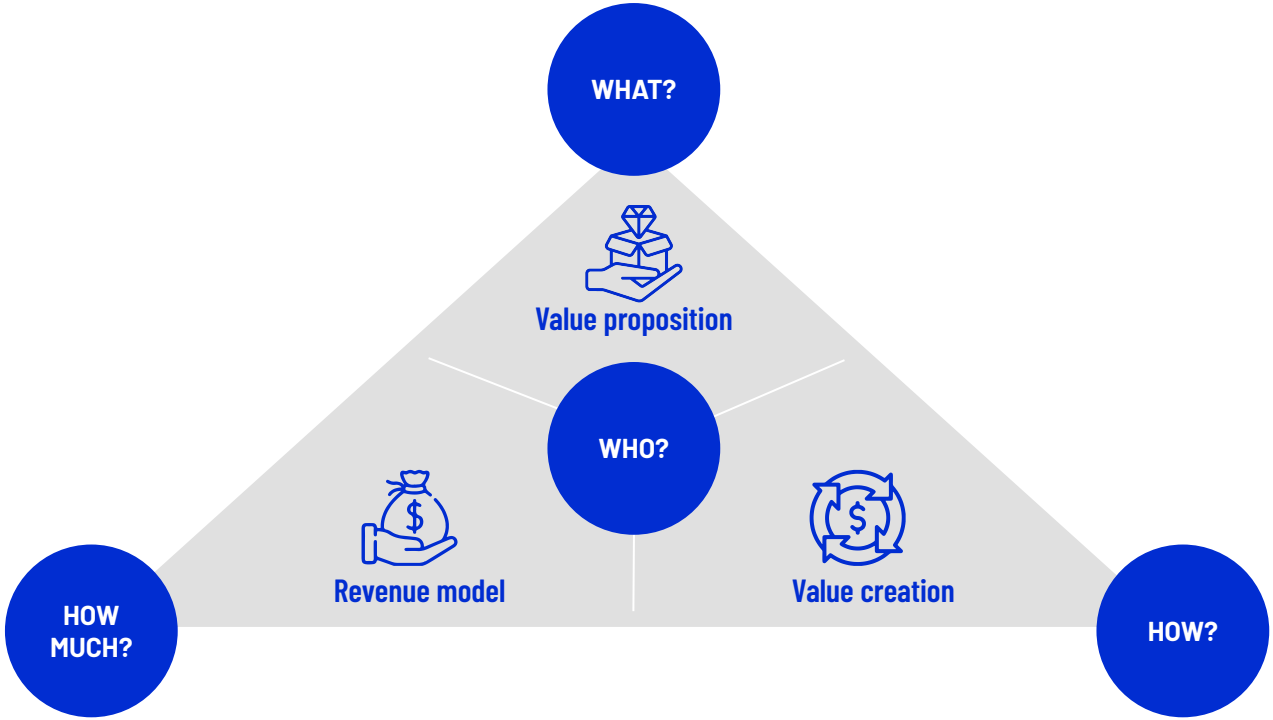
- Emitters of biogenic CO2
- Industrial partners
- Transport and storage providers
- Regulatory bodies, policymakers and financial institutions

Data sources

- Market research and policy analysis
- Stakeholder engagement
- Feasibility studies for pilot projects

Revenue options and business models

A ‘magic triangle’ helps structure business model needs



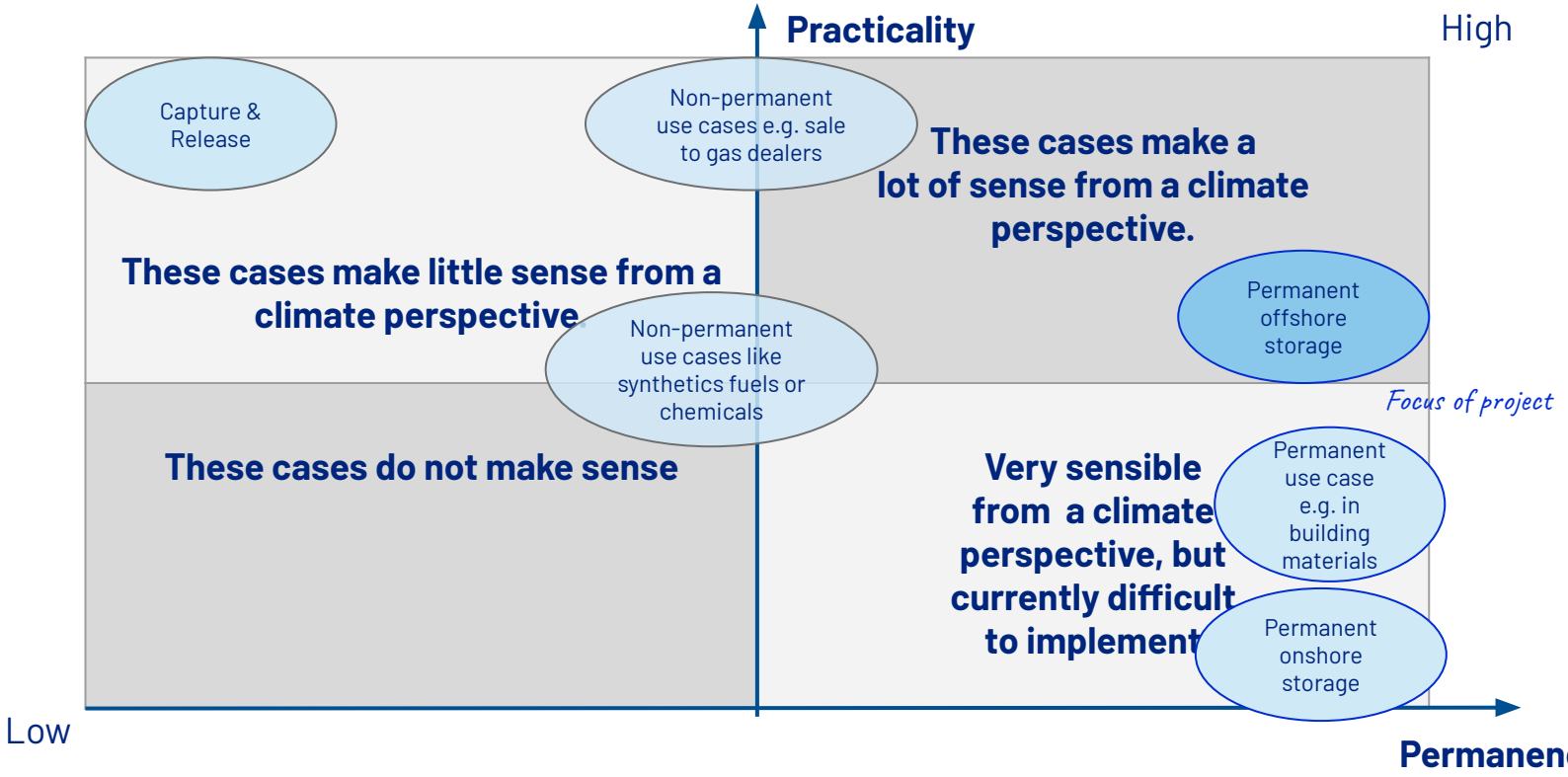
Source: “Developing business models, 55 innovative concepts with the St. Gallen Business Model Navigator”, 2013

What is the value proposition?

- To be established on case-by-case basis.

- Generally: For biogenic emitters to: i) establish appropriate facilities to capture, process, transport and store CO2 permanently; ii) contribute to national and international climate and net-zero targets; iii) to advance knowledge building in the topics of CDR and CCS. All the while it is important that projects to do not negatively impacts emitters' supply mandates.

How do we create added value for capture CO2?



How much revenue can be expected?

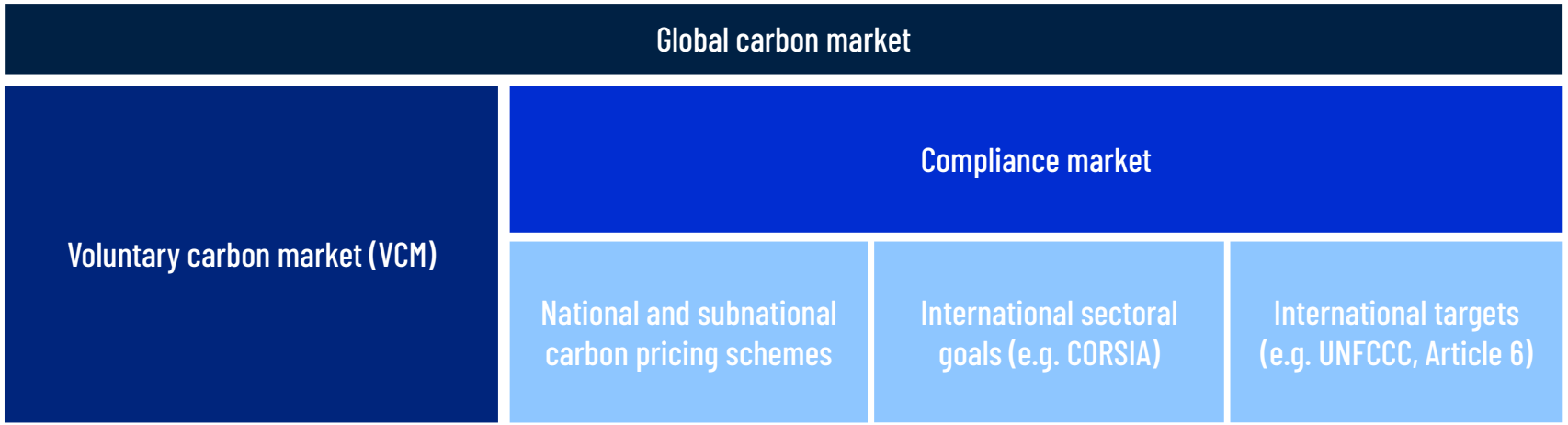
Monetisation option	CO2 source	Potential revenue	Market size	Complexity	Climate impact	Notes
Permanent storage						
Sale of biogenic share via CDR certificates on VCM	Biogenic	High	Strong growth	High	Very positive	- Revenues usually follow a 'cost plus' approach - Certification via standard/ methodology required - Double counting to be avoided - Volumes uncertain
Sale of biogenic share to public entities with net-zero target	Biogenic	High	Small – growing	High	Very positive	- Revenues usually follow a 'cost plus' approach - Certification via standard/ methodology required - Double counting to be avoided
Sales on emissions trading systems	Fossil	Low	Stable	High	Very positive	- Only fossil emissions are currently part of the ETS - Current CO2 prices in the EU ETS do not cover costs
Non-permanent storage						
Use in commercial products e.g. gas dealers, greenhouses	Fossil and biogenic	Moderate	Stable	High	Low - moderate	- Not permanent - Revenue are highly variable
Use in commercial products e.g. synfuels	Fossil and biogenic	Moderate – high	Growing	High	Moderate	- Volumes dependent on national markets - Not clear how market will evolve

Note: the above options are based on high-level market insights but are indicative only. Specific feasibility will depend on certification standards and methods, as well as evolving legislative landscape.

Market overview and regulatory framework conditions

Voluntary and compliance carbon markets

- In compliance markets, legal obligations create market demand. In the voluntary market, corporate voluntary targets form the basis for demand and thus determine the value of CO2.



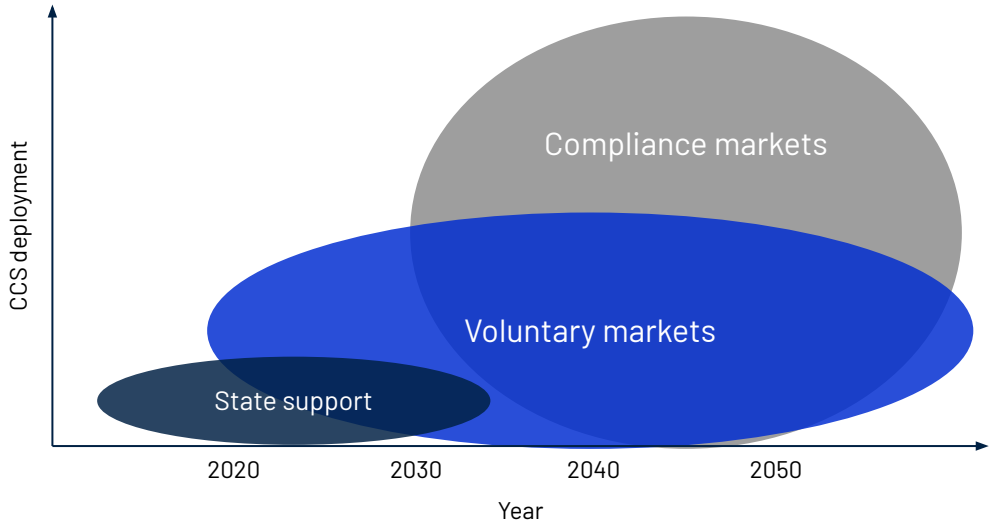
CCS/ CDR will increasingly be financed through compliance markets

State support
Entrepreneurial policies, often reflected in state incentives, provide early support for CCS (including CDR and BECCS).

Voluntary markets
Voluntary carbon markets may drive CCS adoption at a large scale sooner than compliance markets.

Compliance markets
Compliance markets likely represent the largest market potential in the long term.The incentives pathway for CCS and CDR (including BECCS) follow a similar trends. However, given the prioritisation of emission reductions over removals, CCS for reductions is ahead in this pathway.

Illustrative timing and scale of incentives for BECCS



Based on Fig. 1 from Zetterberg et al., 2021

The main drivers for carbon pricing

The Paris Agreement: Article 6
If article 6 can be agreed it will allow carbon credits created under compliance schemes to be internationally traded.

Voluntary carbon market growth
An additional source of demand for carbon credits comes from the voluntary carbon market.

CORSIA
CORSIA will affect prices in carbon pricing schemes that allow for carbon credits certified by standards eligible under CORSIA.

Carbon standards' restrictions of carbon credit project types
Leading carbon standards are increasingly phasing out the certification of select project types, increasing costs.

Compliance carbon market growth
More compliance schemes, or increased ambition, will increase the demand for carbon offsets.

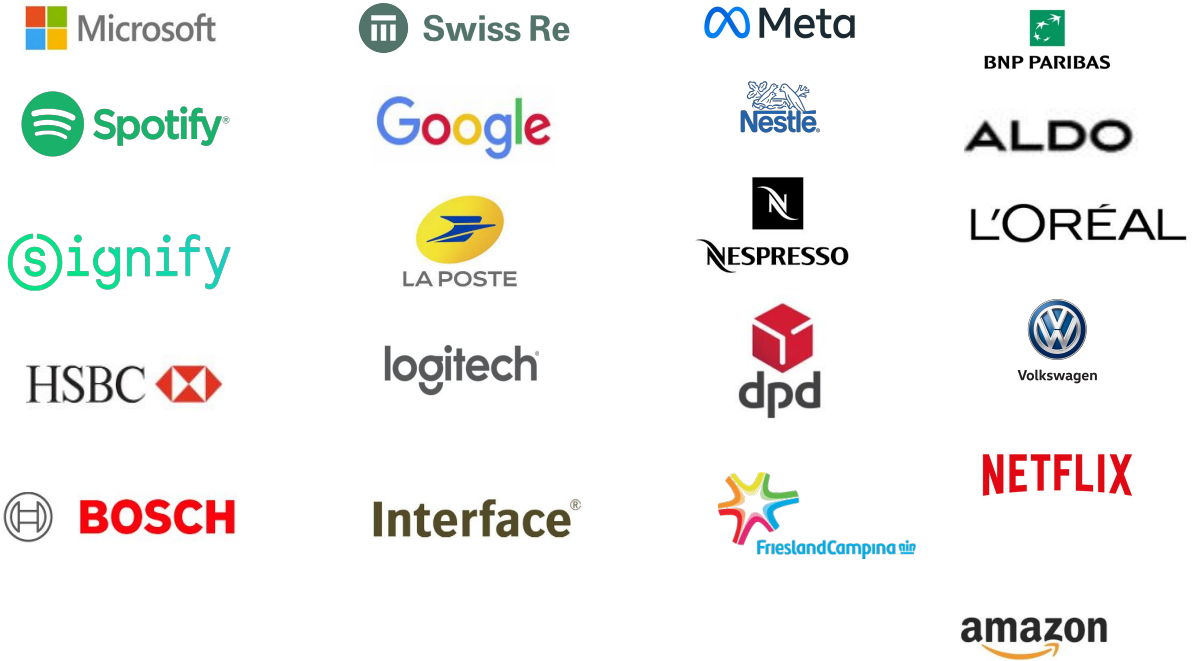
Global economic situation
A drop in economic activity – which generally leads to an initial decline in GHG emissions – could curb demand for carbon credits.

Focus: Voluntary Carbon Market (VCM)

Companies participate in a voluntary carbon market as a result of:

- Corporate social responsibility efforts to reduce their carbon footprint; or
- Preparatory initiatives for future compliance with a mandatory system

Over 53% of all Fortune 500 companies made carbon neutral, net zero and/or SBT targets*. These companies are using carbon credits within their climate strategies.



* Public commitments as of 2024

Focus: Voluntary Carbon Market (VCM)

The VCM enables corporates to offset residual emissions towards their sustainability targets.

- The VCM is a key enabler of climate action, facilitating the offsetting of residual emissions for various organizations, beyond just corporates. It supports the achievement of targets set through initiatives such as SBTi and PRI.

- Key factors that will influence future VCM prices and market growth include:
  - Best practice changes, including claims guidance, quality initiatives (e.g. Integrity Council for VCM), SBTi's guidance on Beyond Value Chain Mitigation;
  - Macroeconomic conditions;
  - National climate policy changes.

- The VCM is expected to be 3–7 times larger by 2030, generating 0.1–1.4 $GtCO_2$ of reductions and removals.

- In the VCM for carbon removals, the top three deals that have been closed so far are BECCS projects. Out of the largest 10 deals, 86% (of volume) are BECCS.

- Deal duration varies from unique annual purchases to purchases up to 17 years, with a strongly heterogeneous quality of commitments. Almost no CDRs have been delivered so far (to be delivered in future). Prices of most deals are undisclosed.

Source: South Pole (2024), Destination Zero: the state of corporate climate action; Trove Research (November 2022), 'The projected supply-demand gap to 2050 in the voluntary carbon market'

The VCM will be a key driver for CCS/ CDR in coming years

Voluntary corporate commitment

Background

- Fortune 500 making Carbon Neutral, Net Zero or SBTi commitments
- 543 companies have set Net Zero targets with 1.5°C trajectory (among them 363 have committed to offset residual emissions in their supply chain).

Forecasts

SBTi framework is likely to increase the carbon removal credits demand

Expansion of compulsory market for fossil fuel emissions

Background

- Climate commitments of oil and gas companies
- Push towards purchasing credits within supply chain
- Combination of efficiency improvements, switch to low carbon products, and offsets

Forecasts

Increased investments in CCS projects or purchasing of CCS credits

Availability and clarity of CCS/ CDR certification

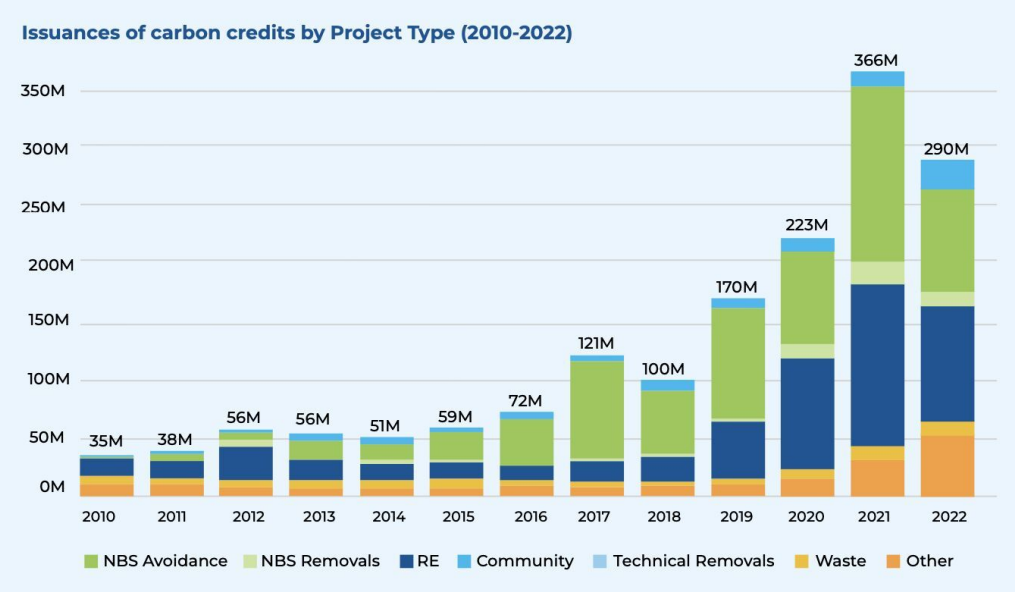
Background

- International Emissions Trading Associated has developed high-level criteria for CCS
- VCS, GS, ACR, Puro.earth and GCC have either develop or are developing CCS methodologies

Forecasts

Increased investments in CCS projects or purchasing of CCS credits

Removals are a nascent but growing segment



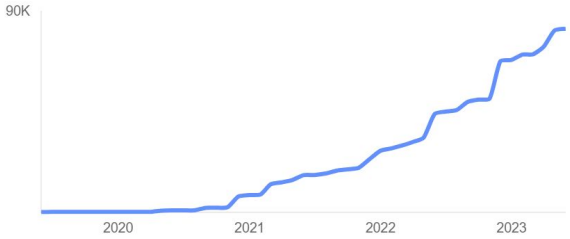
Source: The Voluntary Carbon Market 2022–2023, South Pole (based on data from carbon standards)

The VCM overview on the left shows that technical removals are still a nascent market. Methodologies for CDR are increasingly emerging, which helps build trust and drive adoption.

While this is confirmed by the volumes of delivered technical CDR in the graph below, the upward trend demonstrates that the technical CDR market is on a growth track.

Furthermore, removals are essential to neutralize residual for companies' net zero plans under the SBTi.

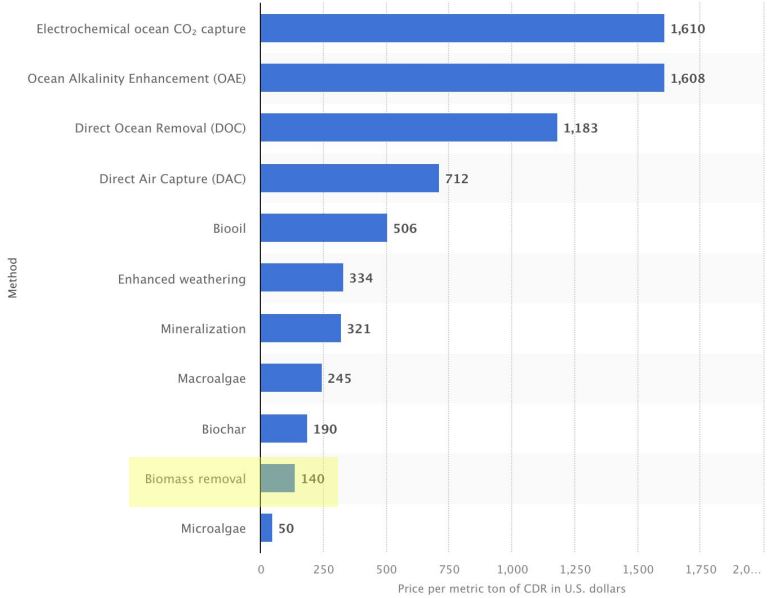
Total deliveries of technical CDR (cumulated)



Source: cdr.fyi, 2023 (left axis is volume of CDR delivered)

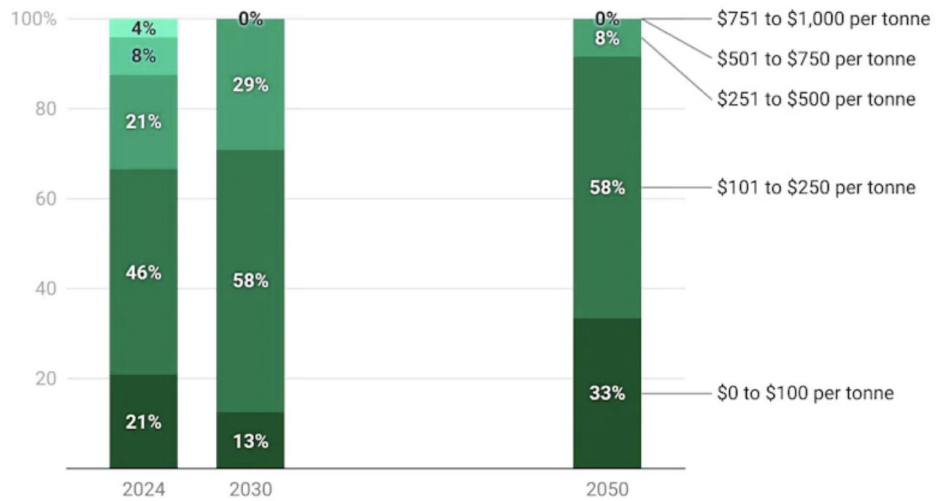
There are differences in price and maturity between CDR methods

Average selling price for CDR worldwide in 2023



Source: Statista 2024: Average selling price of carbon dioxide removals (CDR) worldwide as of 2023, by method *(in U.S. dollars per metric ton of CO_2 removal)*

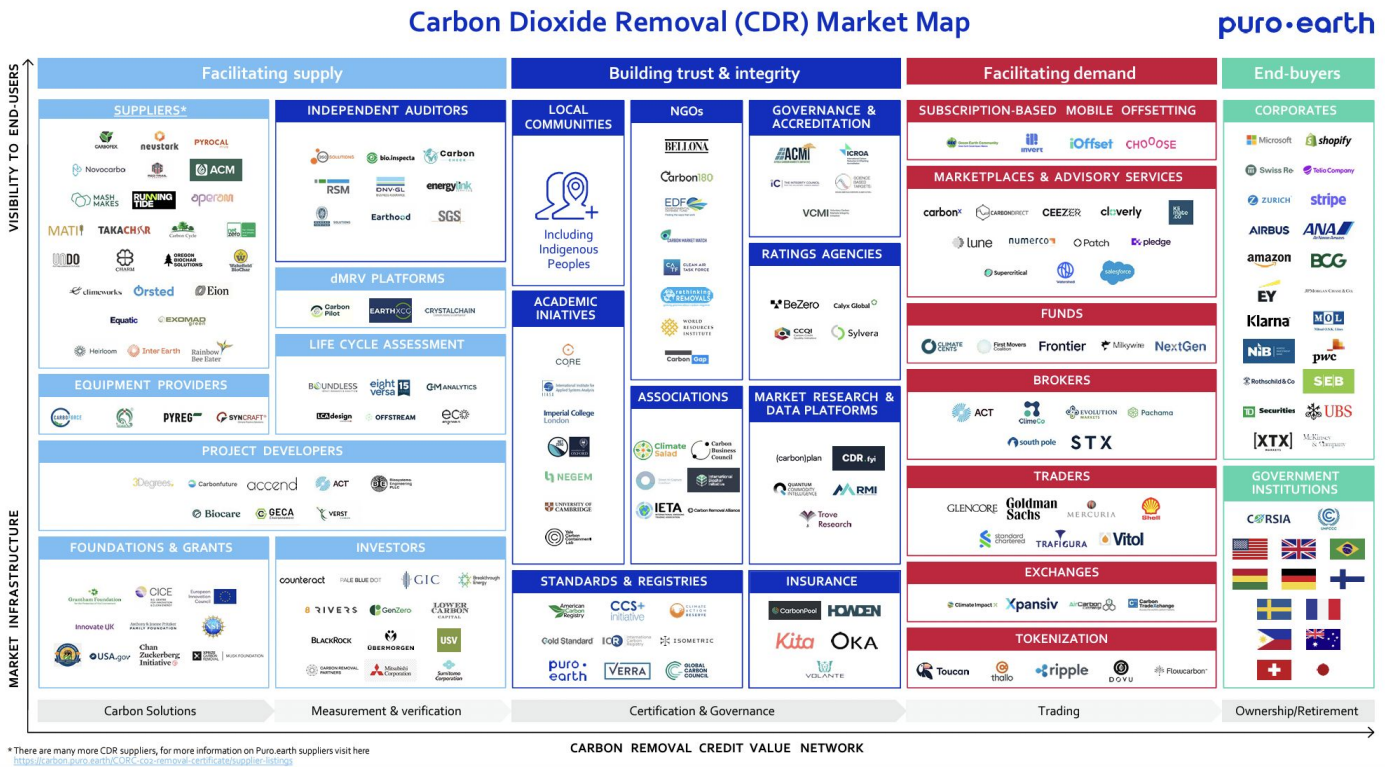
Average price that buyers plan to pay for a tonne of durable CDR



Source: CDR.fyi: 2024+ Market Outlook Summary Report

The CDR market is small but unconsolidated

Large deals have been direct project-to-buyer transactions or pooled buyers



Source: Puro Market Map, Puro, 2024

Initiatives shaping the voluntary carbon market

Initiatives	Purpose and aims
Integrity Council for the Voluntary Carbon Market (ICVCM)	• The ICVCM is an independent governance body for the voluntary carbon market. • Developed with input from hundreds of stakeholders, the Core Carbon Principles (CCPs) and Assessment Framework (AF) will set new threshold standards for high-quality carbon credits.
Voluntary Carbon Markets Integrity Initiative (VCMI)	• The VCMI is a multi-stakeholder platform enabling high integrity VCMs through publication of guidance for market participants. • Works with the private sector to provide guidance on how to use carbon credits transparently and how to make credible climate claims.
Science Based Targets Initiative (SBTI)	• The SBTi defines and promotes best practice in science-based target setting. More than 5,000 companies have joined the initiative to set a science-based climate target. • While mainly certifying corporate reduction targets, the SBTI also influences what certificates corporates can use for different purposes (e.g. to claim reductions, net zero, or contributions to mitigation). • Allows companies to 'neutralize' some of their remaining emissions at net-zero through the permanent removal and storage of carbon from the atmosphere (i.e. CDR credits).

EU Carbon Removal and Carbon Farming Framework (1/2)

The European Commission has proposed the first EU-wide voluntary certification framework for the certification of high-quality CO2 storage projects. The certification framework builds on the EU Regulation adopted in 2024 and aims to facilitate and encourage the uptake of high-quality carbon removals and soil emission reductions.

The proposal covers the capture of CO2 from all types of CO2 emitters as well as all types of permanent geological storage of CO2. The proposal includes the following approaches:

- Four quality criteria: quantification, additionality, long-term storage and sustainability
  → These concepts are also examined by ICROA & ICVCM
- Rules for the independent verification of CO2 storage
  → A new standard with new methodologies is being developed
- Rules for the recognition of certification schemes that can be used as proof of compliance with the EU framework
  → Existing standards and methodologies can be approved for the EU framework

EU Carbon Removal and Carbon Farming Framework (2/2)

Current status:

- Based on the four quality criteria, the Commission is currently developing **tailor-made methodologies for the various types of CO2 capture and storage with the support of a group of experts.**
- As with the methodologies under Verra and Isometric, the CRCF is expected to rely on a modular structure, i.e. on individual sub-methodologies for the capture, transportation and storage of CO2.

Opportunities:

- **A high level of acceptance among certificate purchasers is expected.** This can help to strengthen confidence in the market and thus generate additional demand for BECCS in the short and medium term.
- A review of the ETS will be presented in 2026 primarily focusing on whether permanent removals should be included in the EU ETS.
- The CRCF could lead to a consolidation and harmonization of the voluntary CO2 market in Europe.

Risks:

- **High project requirements** are expected, which are only partially known so far.
- Possible slowdowns or changes in the political context at EU level may influence the adoption of the CRCF and thus the regulatory environment for storage projects.

EU Emission Trading System

The EU Emissions Trading System (EU ETS) is a market-based mechanism where industries are allocated a cap on their carbon emissions and can trade carbon allowances to incentivize reducing greenhouse gas emissions.

In 2023, the EU finalized a significant reform to align the EU ETS with the EU's long-term climate goals. Part of the ETS revenue finances the Innovation Fund.

Revenues: Record revenues in 2023 (EUR 18bn), prices currently between EUR 60 - 80 per tCO2eq (2023/2024) (*EEX 2024*).

Interface with CCS projects: The EU ETS includes CO2 capture, transport and geological storage in its scope of activities. **Fossil emissions captured, transported and stored are considered as not emitted** (*Annex 1 of the EU ETS Directive*).

Interface with the VCM: Projects on the voluntary carbon market (VCM), are not allowed to be implemented within the EU ETS, since this would lead to double counting. **Thus, emissions which are included in the EU ETS cannot be included in carbon projects on the VCM**.

Interface with the EU CRCF: Carbon removal projects are currently not possible under the EU ETS. In 2026 the European Commission will **reassess the inclusion of permanent removals (incl. BECCS projects) under the CRCF in EU ETS**. This inclusion would mean that EU ETS participants will be able to purchase BECCS CDRs from CRCF endorsed standards instead of surrendering carbon allowances.

High-level assessment

Evaluated business model options

- Three primary models were explored for financial sustainability and risk sharing.
- The reality is that a hybrid approach is likely required.

Model	Description	Benefits	Limitations	Status
Offtake agreements for negative emissions (Voluntary Carbon Market)	Selling CO2 removal credits to voluntary buyers	Aligns with corporate climate commitments and offers high-quality projects	Market demand and price uncertainty	Ongoing discussions with corporate buyers; key approach used in market to date
Cost-pooling mechanisms for emitters	Clustering small to mid-sized emitters for shared transport and storage infrastructure	Lower cost per tonne and scalability	Requires alignment, legal frameworks and potentially regulatory approvals	Initial cluster developed in France (Azerailles biogas plants)
Government-backed risk-sharing funding	Public-private funding to de-risk infrastructure investments	Stability, can attract private sector participation	Requires regulatory buy-in, long lead time	Early discussions with Swiss and French governments

Offtake agreements for negative emissions

Concept

- CO2 removal credits sold to voluntary market buyers for their corporate climate commitments
- Revenue stream for emitters, supporting BECCS adoption

Current implementation

- Engaging carbon credit buyers (corporates and financial institutions)
- Exploring pre-purchase contracts to secure stable pricing

Key challenges

- High prices for BECCS are limiting adoption, compared to lower priced avoidance and reduction credits
- Market not yet mature for large-scale adoption, with limited demand

Next steps

- Continue engaging carbon credit buyer to secure early adopter buyers
- Align with EU regulatory developments on CDR certification

Cost-pooling mechanisms for emitters

Concept

- Clustered approach for small- and mid-sized emitters (**refer to WP1 deliverables**)
- Shared infrastructure for CO2 capture, transport and storage

Current implementation

- Ongoing work with the Azerailles biogas cluster in France
- Exploring frameworks for cost-sharing agreements

Key challenges

- Aligning emitter ambitions, timelines and expectations
- Balancing cost distributions

Next steps

- Finalise cluster concept in WP1
- Engage additional emitters in France, Switzerland and Germany

Government-backed risk-sharing funding

Concept

- Public-private partnerships to cover early-stage risks
- Government-backed financial guarantees for emitters & infrastructure investors

Current implementation

- Discussions with Swiss & French policymakers on potential incentives
- Exploration of Swiss Climate and Innovation Act (KiG) for funding applications, e.g. through the CCS / NET tender

Key challenges

- Long approval process
- Requires strong political support

Next steps

- Secure pilot funding for first test cases
- Advocate for policy inclusion in EU and national CDR and CCS frameworks

Evaluated risk-sharing mechanisms

- Two key risk-sharing models were explored to address cost uncertainties

Mechanisms	Description	Benefits	Limitations	Status
Scenario-based risk allocation	Contracts assigning financial risk per stage (capture, transport, storage)	Clear accountability, reduces first-mover hesitation	Complex to negotiate across multiple stakeholders	Tested in RWB Nesselnbach pilot
Dynamic pricing model for CO2 transport	Transport costs adjusted based on costs and volume commitments	Encourages upscaling, reduces long-term costs	Requires accurate and stable volume forecasts	Under discussion with transport partners

Proof of implementation: First-year milestones

Secured commitments from initial emitters

- RWB Nesselnbach (Switzerland)
- EZI Horgen (Switzerland)
- Azerailles biogas (France)

Established initial partnerships with transport and storage providers

- Including rail, storage and interim storage

First test case funded

- RWB Nesselnbach secured CHF 10M funding for negative emissions via Climate Cent Foundation

Framework for emitter clustering drafted

- Refer to WP1 deliverables

Early learning and adjustments

What worked well

- Early funding secured for first project
- Feasibility assessments confirming transport and storage viability
- Emitter interest in exploring BECCS activities

Challenges identified

- Voluntary carbon market not yet mature enough for full reliance
- Limited initial interest in emitter clustering
- Slow engagement with stakeholder, including long policy approval cycles

Adjustments

- Explore diversification of revenue streams beyond voluntary carbon credits
- Increase engagement with policymakers on regulatory frameworks

Next steps and roadmap (2025)

H1 2025

- Expand emitter pool beyond pilot projects
- Further explore risk-sharing mechanisms with industry partners
- Assess KiG applicability for emitters
- Establish legal structuring options for emitter cost-pooling

H2 2025

- Secure early buyer commitments for CO2 removal credits
- Further engage public entities on partnerships for risk-sharing mechanisms
- Finalise transport and storage agreements with providers