Bioenergy with Carbon Capture and Storage (BECCS)

IETA Carbon Management Business Brief Series

EXECUTIVE SUMMARY

This brief provides a carbon market brief for Bioenergy with Carbon Capture and Storage (BECCS), covering technical aspects, crediting mechanisms, market activity and emerging policy developments. As a CDR pathway capable of delivering durable removals alongside energy production, BECCS is gaining attention across voluntary carbon markets, government policy frameworks and long-term decarbonisation discussions.

WHAT IS BECCS?

DEFINITION

Bioenergy with Carbon Capture and Storage (BECCS) is defined as a carbon dioxide removal pathway that combines the use of biogenic feedstocks for electricity and heat or fuel generation with the capture and durable storage of process-emitted CO_2 in geological formations. The defining characteristic of BECCS is the integration of natural carbon uptake through sustainable biomass growth coupled to engineered carbon capture and storage, that results in net-negative emissions over the project lifecycle.

BECCS should be clearly distinguished from traditional Carbon Capture and Storage (CCS). Conventional CCS captures CO_2 from fossil-based or industrial sources, thereby reducing emissions. In contrast, BECCS captures CO_2 of biogenic origin that has already been removed from the atmosphere through photosynthesis, and this permanently transfers it from the shorter, biological carbon cycle to the longer geological carbon cycle resulting in atmospheric CO_2 removal rather than CO_2 emissions reduction. BECCS systems can be understood as a two-stage process: biomass conversion, followed by CO_2 capture and permanent storage.

COMMON FORMS OF BECCS

Biofuel BECCS
Fermentation-based liquid fuel production

Biomethane BECCS
Anaerobic digestion and gas upgrading

Power and Heat BECCS
Biomass combustion with CO_2 capture

Waste-to-Energy BECCS
Waste combustion with carbon removal

Industrial BECCS
Biomass-integrated industrial decarbonisation

Gasification and Hydrogen BECCS
Syngas and hydrogen with CCS

POLICY AND REGULATORY OUTLOOK

Despite rapid growth in contracted demand, the BECCS market remains structurally early-stage and largely forward-looking. Verified issuance and retirement volumes remain modest, reflecting the fact that most projects are still pre-delivery and financed through long-term offtake agreements rather than spot credit trading. Contracted BECCS volume has scaled sharply from ~2 $MtCO_2e$ in 2022 to more than 36 $MtCO_2e$ cumulatively by Q1-2026, highlighting accelerating buyer confidence in durable removals. However, demand remains highly concentrated, with Microsoft alone accounting for ~32 $MtCO_2e$ of contracted volume across multiple suppliers, underscoring both the central role of large technology buyers in market formation and the continued concentration risk within the current BECCS demand landscape. Operational deployment also remains geographically concentrated, led by North America, while issuance growth indicates that the market is beginning to transition from pilot-scale validation toward early commercial-scale delivery.

THE CARBON CREDITING PROCESS

HOW BECCS CREDITS ARE GENERATED

- ***Biomass growth:*** *Biomass absorbs CO_2 from the atmosphere.*
- ***Energy conversion:*** *The biomass (such as agricultural residues, forestry residues, energy crops, wood pellets, municipal solid waste, or anaerobic digestate) are converted into energy carriers, including electricity, heat, biofuels, or biomethane, through processes such as combustion, gasification, or fermentation.*
- ***CO_2 capture:*** *CO_2 generated during conversion is captured using technologies such as post-combustion amine absorption or direct fermentation off-gas capture*
- ***Transport and permanent storage:*** *CO_2 is then dehydrated, compressed, and transported via pipelines or cryogenic trucking to appropriately selected and managed storage sites (e.g. deep saline aquifers, or basalt formations for mineralisation).*
- ***Net removal calculation:*** *Lifecycle emissions associated with biomass cultivation (if applicable), processing, transport, energy use, CO_2 capture, transport, and storage are deducted from the gross captured volume.*
- ***Leakage and risk adjustments:*** *Additional deductions may be applied for potential emissions leakage, uncertainty factors, or reversal risks depending on the methodology and storage assurance framework.*
- ***Verification and credit issuance:*** *Removal credits are generally issued only if biomass is sustainably sourced and CO_2 is durably stored, both of which are subject to monitoring, reporting, and third-party verification.*

BECCS MARKET OUTLOOK

VOLUNTARY CARBON MARKETS

Issuing bodies include Puro.earth (GSC), Verra (VMD0049), Gold Standard (Biomass fermentation with carbon capture and geologic storage), ACR (Carbon capture and storage projects), Isometric (Biogenic Carbon Capture and Storage). So far only Puro has issued credits from its registry.

COMPLIANCE / REGULATORY MARKETS OUTLOOK

BECCS inclusion remains limited but is gradually emerging across select ETS, carbon tax, and Article 6-linked systems. Switzerland currently provides the clearest operational example, where biogenic CO_2 storage can generate compliance-use attestations under its fuel offsetting regime. The UK ETS is the most advanced ETS pathway under development, with plans to integrate engineered removals, including BECCS, by 2029. Japan's JCM under Article 6.2 also provides a potential future route, with removals recognised in principle and possible future linkage to the GX-ETS framework. Programs such as the EU ETS, California cap-and-invest, Quebec cap-and-trade, China ETS/CCER, New Zealand ETS, Canada Greenhouse Gas Offset Credit System and Australia's ACCU/Safeguard framework do not yet operationally credit BECCS removals but are exploring engineered removals integration. The EU CRCF's BioCCS methodology was recently adopted.

For more information, please contact rubin@ieta.org

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MARKET SNAPSHOT — KEY STATS

~596 thousand tCO_2
CREDITS ISSUED TO DATE (MAR'26)

~335 thousand tCO_2
CREDITS RETIRED TO DATE (MAR'26)

$150–$430
PRICE RANGE PER TCO_2E

348%
YOY ISSUANCE VOLUME GROWTH

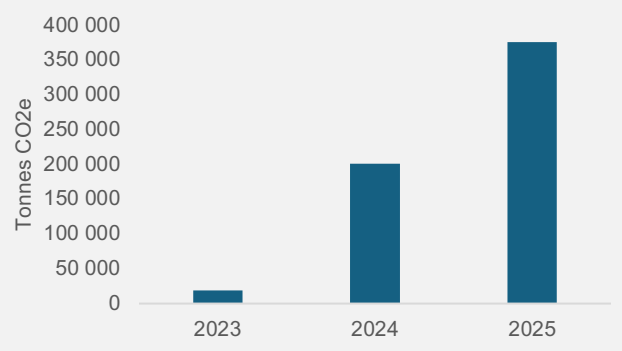
GEOGRAPHIC DISTRIBUTION OF PROJECTS

BECCS Operational Projects Distribution by Geography

Country	Region	#Projects	Capacity (Mt CO_2/yr)
United States	North America	10	2.695
Japan	Asia Pacific	1	0.18
Netherlands	Europe	1	0.1

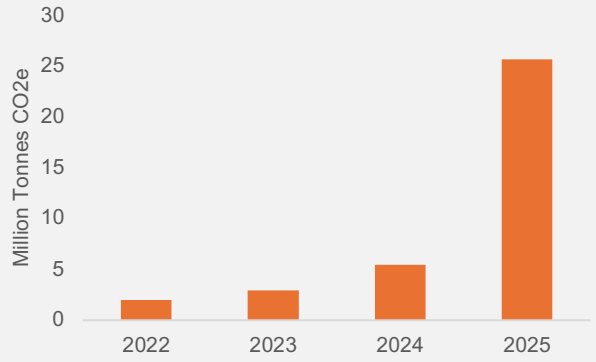
CREDIT ISSUANCE OVER TIME

Annual BECCS credit issuance volume (tCO_2e) by year.



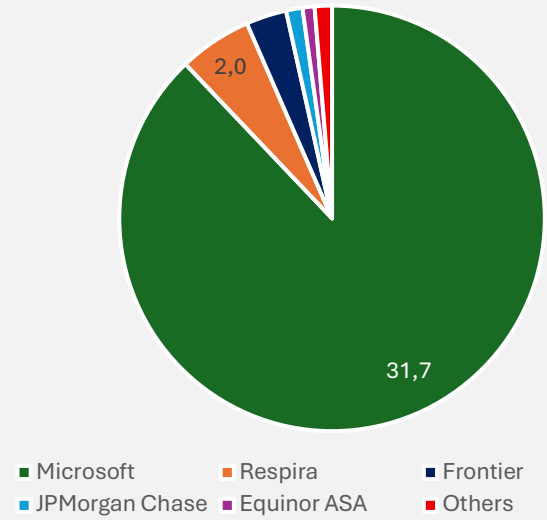
OFFTAKES DEALS OVER TIME

Annual BECCS offtake volume ($MtCO_2e$) by year



OFFTAKES BUYER BREAKDOWN

Offtakes ($MtCO_2e$) breakdown by Top Buyers (Data till Q1-2026)



IETA CARBON MANAGEMENT BUSINESS BRIEF SERIES

PURPOSE & OVERVIEW

This IETA Carbon Management Business Brief Series aims to provide market clarity on CCUS and engineered CDR pathways from market participants and stakeholders. IETA's suite of business briefs, covering nearly all compliance carbon markets, is publicly available.

REFERENCES

[1] cCarbon research - CROM (Carbon Removals and Offsets Monitor)
[2] IEA, CCUS project database, March 2026

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