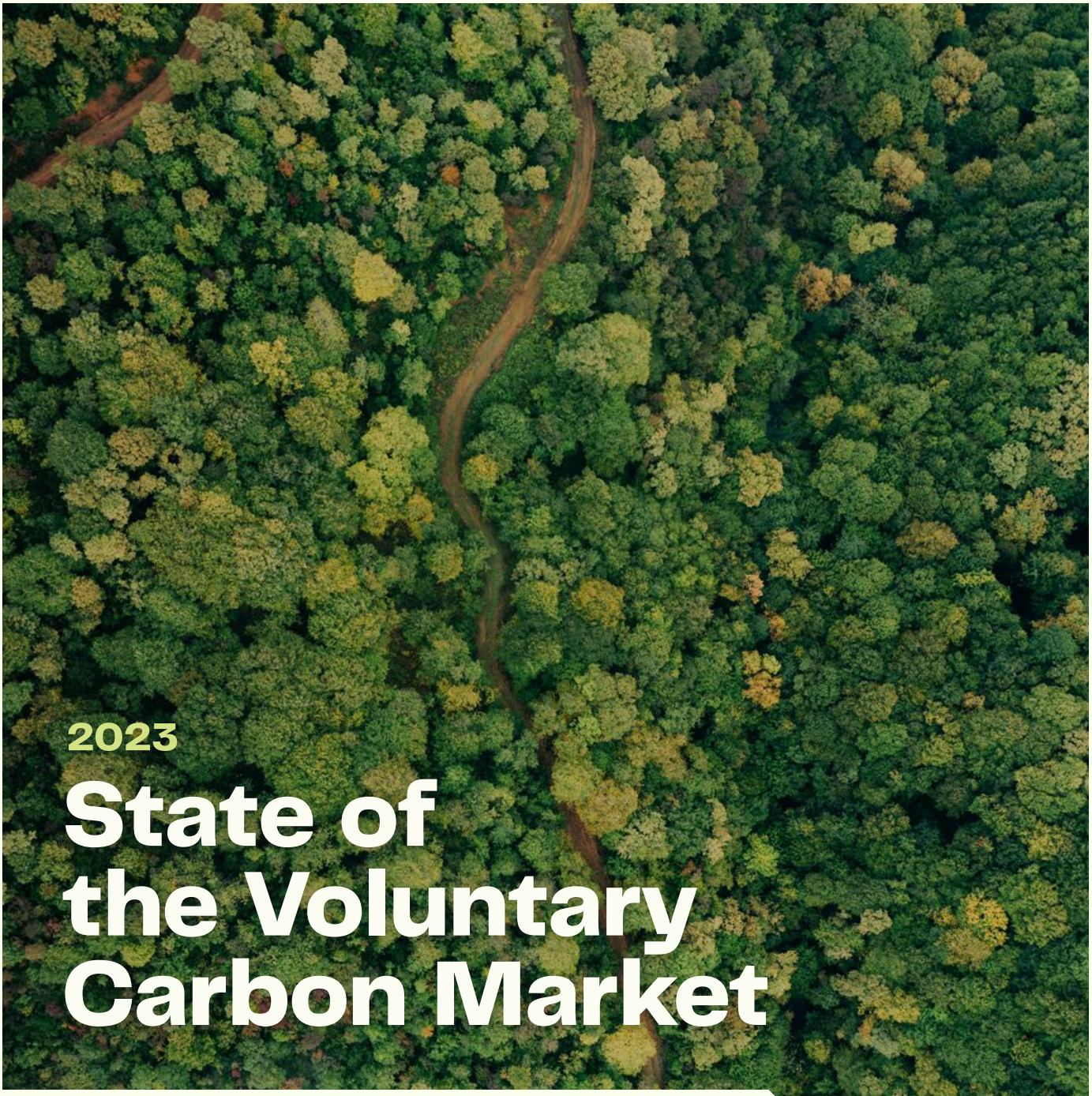

2023

State of the Voluntary Carbon Market

Carbon Direct

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Executive Summary

The Carbon Direct State of the Voluntary Carbon Market report provides carbon credit purchasers, project developers, and policymakers with a snapshot of key trends and market developments. The market has grown significantly over the past decade, with issuances reaching nearly 300 million tonnes per annum (tpa) in 2021.

This year's report includes insights from an analysis of the four major registries on the Voluntary Registry Offsets Database (VROD), the developing high-durability registries, and anonymized data from Carbon Direct's in-depth diligence evaluations on hundreds of carbon removal projects. See Appendix for more information on our data sources and methodology.

Based on these analyses, there are four key trends for the voluntary carbon market for 2022 and the first three quarters of 2023:

1. **Quality remains a key challenge across the market.**
   Within the hundreds of projects that Carbon Direct has analyzed for procurements across all project types, fewer than 10% of projects meet or exceed our standards for high quality.

2. **Though still dominant, the volume of credits from REDD+ and RE projects has declined.**
   With the inclusion of REDD+ and RE credits, reduction and avoidance credits account for 90% of all credits on the VCM[1]. REDD+ and renewable energy credits have fallen nearly 20% as a share of total issuances from 72% in 2021 to 53% in 2023. Both REDD+ and RE saw lower issuances in 2022 and H1 2023 than in 2021, while REDD+ also saw a decline in retirements. This decline coincides with buyer skepticism[2] and scrutiny of these categories.[3,4]

[1] *REDD+ is classified as "mixed" within the Voluntary Registry Offsets database because a small fraction of carbon benefits generated may be derived from removals. However, the majority of these credits fall into the reduction and avoidance categories. For the purposes of this report, we have classified REDD+ as a reduction and avoidance credit and it is referred to as such throughout this analysis.*

[2] *Holger, D. 2023. Many Companies Are Shying Away from Carbon Credits. Wall Street Journal.*

[3] *West, T. P., Borner, J., Sills, E. O., and Kontoleon, A. 2020. Overstated carbon emission reductions from voluntary REDD+ projects in the Brazilian Amazon, Proceedings of the National Academy of Sciences.*

[4] *Cames, M., Harthan, R. O., Füssler, J., Lazarus, M., Lee, C. M., Erickson, P., & Spalding-Fecher, R. 2016. How additional is the Clean Development Mechanism? Stockholm Environmental Institute.*

3. **Emerging quality-focused purchasing is increasing.**
   Though it remains a minority of credit buying, we estimate that quality-focused, removals-focused procurement[5] has grown 5X from 3.1 million tonnes in 2021 to 15.1 million tonnes through Q3 2023.

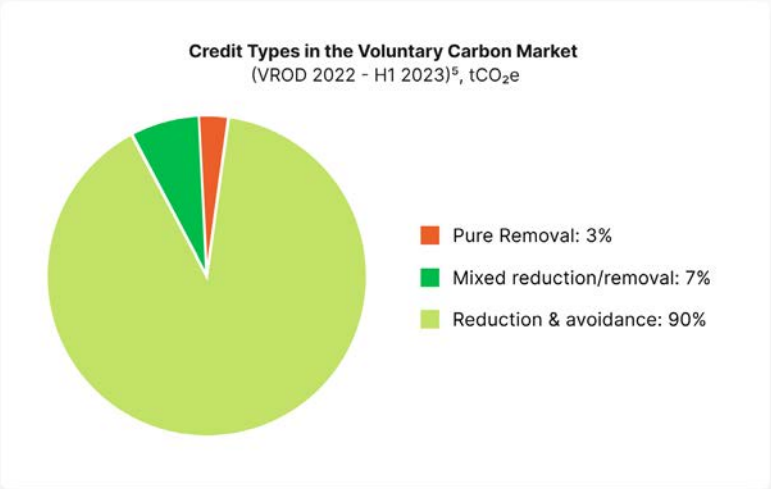
4. **A small group of market leaders are driving catalytic growth.**
   Two high-volume transactions from Microsoft[6] and Airbus[7] represent over 80% of high-durability carbon removal purchases across 2022 and 2023.

[5] *Carbon Direct tracked a set of buyers that have public carbon credit purchase strategies with clearly established quality criteria as well as intention to steer long-term credit mix towards removals purchases. This analysis reflects the summation of publicly tracked purchases from this set of buyers.*

[6] *Mathis, W. 2023. Microsoft Inks Deal to Pay for CO2 Stored Below the Sea. Bloomberg.*

[7] *Moses, E. 2023. 1PointFive announces agreement with Airbus for the purchase of 400,000 tonnes of carbon removal credits. 1PointFive. Note: Carbon Direct has not independently verified this purchase.*

Key Stats: VCM at a Glance

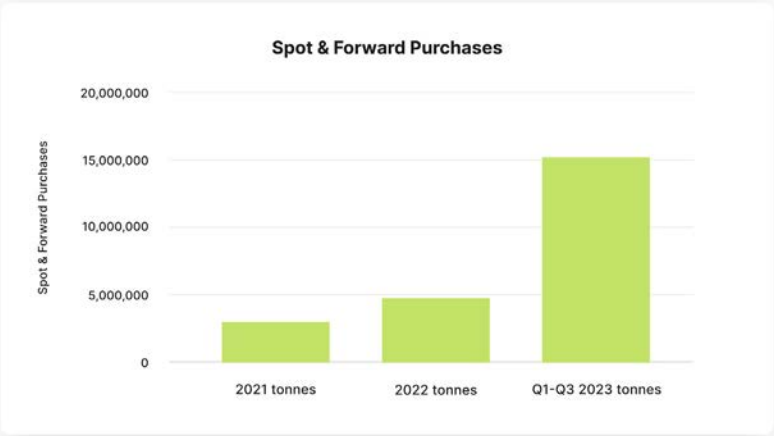


Just 3% of credits in the voluntary carbon market are from pure carbon removal projects.

YoY VROD Issuances & Retirements

	2021 tonnes	2022 tonnes	2023 tonnes
VROD Issuances	282,668,299	278,170,349	**H1** 94,620,903 **Annual Est.** ~263,000,000
VROD Retirements	160,641,548	145,357,720	**H1** 45,489,897 **Annual Est.** ~121,000,000

From 2021 to EOY 2022, overall retirements have decreased by approximately 10%, driven by decreases in REDD+ retirements.



Quality-oriented and removals-focused purchasing is estimated to have grown by 5X from 2021 to Q3 2023[8].

[8] *Carbon Direct tracked a set of buyers that have public carbon credit purchase strategies with clearly established quality criteria as well as intention to steer long-term credit mix towards removals purchases. This analysis reflects the summation of tracked purchases from this set of buyers.*

Introduction

The International Panel on Climate Change (IPCC) has made the requirement for emissions reductions and carbon dioxide removal extremely clear. Limiting global warming to 1.5 degrees C above pre-industrial levels requires significant carbon reductions and 6 to 10 billion tonnes of carbon dioxide removal per year by 2050. The voluntary carbon market (VCM) is a key mechanism to scale those solutions.

The VCM allows for the transaction of carbon credits between carbon project developers and buyers. Each carbon credit should represent an equivalent tonne of CO2 reduced, avoided, or removed. Organizations use these credits to compensate for emissions resulting from their operations, products, and investments.

Learn more about the carbon market basics here →

From 2022 to H1 2023, over 372 million credits were issued and over 190 million credits were retired to compensate for carbon emissions[9]. Unfortunately, few of these credits deliver the full climate benefits that they represent. In evaluating hundreds of projects over the past four years, Carbon Direct found that fewer than 10% met or exceeded our high-quality criteria without reservations.

The issue of quality undermines meaningful climate action both by failing to achieve climate goals and by increasing the reputational risks of participating in the market. Coinciding with these concerns, fewer credits were issued and retired in 2022 and 2023 than in 2021.

[9] *Analysis of the four major registries within the Voluntary Registry Offsets Database (VROD). The addition of the higher durability registries, Puro and Carbon Standards International, add 72k to issuances and 78k retirements.*

The majority of issuances and retirements in the voluntary market derive from reduced and avoided emissions classes with documented risks: Reduced Emissions from Deforestation and Degradation (REDD+)[10] and Renewable Energy (RE)[11].

Over the same period, quality-oriented, removals-focused purchasing has grown. Removals-focused buyers with dedicated quality standards for procurement have grown their spot market and forward purchasing (offtake) approximately fivefold from 3.1 million tonnes in 2021 to 15.1 million tonnes through the third quarter of 2023. However, these buyers are highly concentrated. For example, two purchases by Microsoft and Airbus represented over 80% of the publicly announced high-durability removals purchases between 2022 and H1 2023. While in-year removals retirements have remained relatively steady at approximately 8 million tpa in 2021 and 2022, the significant forward purchases made by these buyers signal a growing demand for high-quality removals.

Two distinct markets are emerging in the VCM:

1. The reduction and avoidance market, which has the ability to deliver good projects, but is also driving the majority of quality concerns in the VCM; and
2. The quality-focused removals market with a minority of issuances and strong growth.

While smaller in notional volumes, the removals market has positive tailwinds. Growing interest among large buyers and major legislation like the Inflation Reduction Act and the Bipartisan Infrastructure Law have set the stage for more growth.

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[10] *West, T. P., Bomfim, B., and Haya, B. 2023. Methodological Problems Underlying Voluntary REDD+ Project Baselines Compromise the Environmental Integrity of Carbon Offsets.*

Mertz, O., Grogan K., Pflugmacher, D., Lestrelin, G. 2017. Uncertainty in establishing forest reference levels and predicting future forest-based carbon stocks for REDD+. Journal of Land Use Sciences.

[11] *Cames, M., Harthan, R. O., Füssler, J., Lazarus, M., Lee, C. M., Erickson, P., & Spalding-Fecher, R. (2016). How additional is the Clean Development Mechanism? Stockholm Environmental Institute.*

Fearnside, P. M. (2013); Credit for climate mitigation by Amazonian dams: Loopholes and impacts illustrated by Brazil's Jirau Hydroelectric Project. Carbon Management, 4(6), 681–696.

Haya, B., & Parekh, P. (2011). Hydropower in the CDM: Examining Additionality and Criteria for Sustainability. Energy and Resources Group Working Paper, ER-11-001. University of California, Berkeley.

He, G., & Morse, R. (2014). Addressing Carbon Offsetters' Paradox: Lessons from Chinese Wind CDM. Energy Policy, 63, 1051–1055.

Market Contracts Amid Quality Concerns

Credit Issuances and Retirements Across All Categories

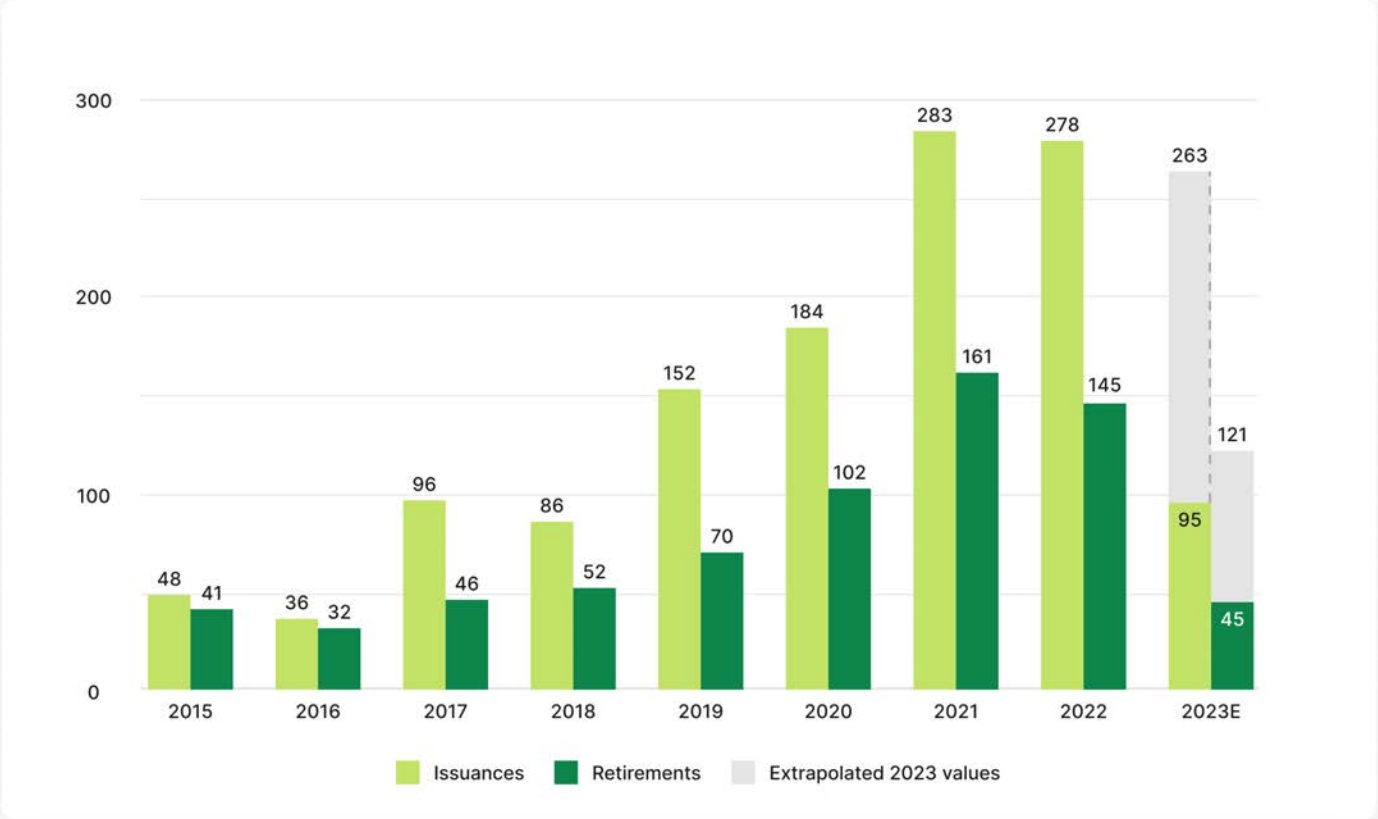

Figure 1: *Issuances and retirements in the VROD, MtCO2e*

According to our analysis of the VROD, the voluntary carbon market grew rapidly from 2016 to 2021. Growth through 2021 was fueled by the acceleration of corporate climate goals and market speculation that followed that demand. Over the last year and a half,[12] however, both issuances and retirements have declined overall.

[12] *2023 values based on historic analysis of trends in the month-to-month variation in volume of retirements and issuances.*

Retirements

Retirements in particular have slowed. This is notable as an indicator for demand. Reasons for this decline may include:

- Reputational backlash experienced by some buyers of low-quality credits;[13,14]
- Highly public failures on carbon trading platforms that sourced indiscriminately from the major registries; and
- Global macroeconomic headwinds and uncertainty that caused some businesses to take a conservative approach to spending.

Other reports on the VCM have framed these slowdowns as temporary setbacks[15] caused by verification slowdowns and/or short-term trading from crypto[16] platforms. We view the decrease in issuances and retirements as an indication of a broader trend: a fundamental downshift in the demand for riskier credits that make up the majority of the market.

Issuances

While issuances have also declined, they continue to outpace retirements. This is notable as an indication of supplier activity. Reasons for this may include:

- Carbon project developers are betting on sustained growth in the market and are producing today for future demand; and
- Secondary markets for trading and speculation have driven an increase in purchases without retirement, i.e., purchasing and exchanging credits versus exercising those credits to compensate for emissions in a reporting year.

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[13] *Holger, D. 2023. Many Companies Are Shying Away from Carbon Credits. Wall Street Journal.*
White, N. 2023. Carbon Offset Gatekeepers Are Failing to Stop Junk Credits. Bloomberg.
Newburger, E. 2023. Major registries in the carbon offset market are allowing dubious credits, report says. CNBC.
White, N. 2023. Carbon-credit traders find their CO2 offsets may be worth nothing. Los Angeles Times.
De Haldevang, M. 2022. BP paid rural Mexicans a 'pittance' for Wall Street's favorite climate solution. Bloomberg.
Song, L. 2019. Why Carbon Credits For Forest Preservation May Be Worse Than Nothing. ProPublica.
Dillon, K. 2023. We Wish Buying Carbon Offsets for Your Flight Helped. It Doesn't. New York Times.

[14] *Calel, R., Colmer, J., Dechezlepretre, A., Glachant, M. 2021. Do Carbon Offsets Offset Carbon?*

[15] *Sylvera. 2023. 10 Trends Carbon Market Experts are Talking About Right Now. Sylvera.*

[16] *South Pole. 2023. The Voluntary Carbon Market | 2022–2023. South Pole.*

Market Composition by Credit Category

90% of all credits issued on the VCM for 2022 and H1 2023 are from emissions reduction and avoidance projects, 7% are from mixed reductions and removals projects, and only 3% are from pure carbon removal projects. These figures are derived from combined analysis of nature-based credits reported in the four major VROD registries and Carbon Direct's proprietary analysis of hybrid and engineered projects affiliated with newer registries.

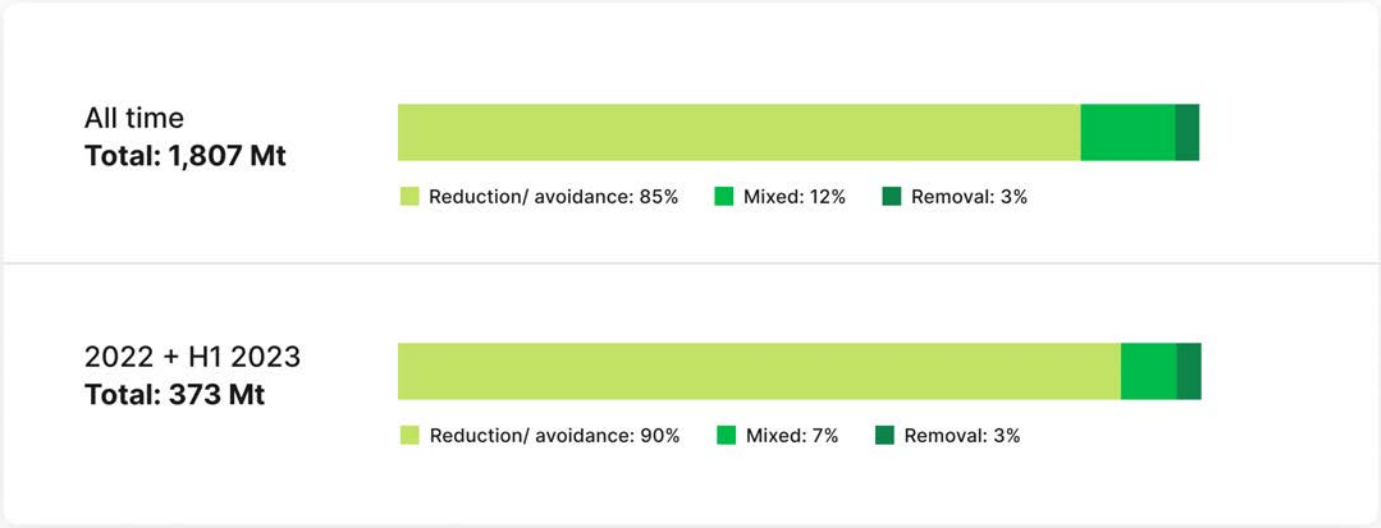

Figure 2: *Credits issued by project category. Note: Removals here include both high-durability and nature-based removals.*

Credits that represent emissions reduction and avoidance derive predominantly from REDD+ and RE projects. Removal credits derive predominantly from afforestation, reforestation, and revegetation (ARR).

REDD+ and RE Credits

According to the analysis, issuances of REDD+ and RE credits are estimated to have dropped from approximately 200 million tonnes in 2021 to approximately 160 million tonnes in 2022. That trend is the primary driver for the drop in issuances in the VCM and appears set to continue in 2023.

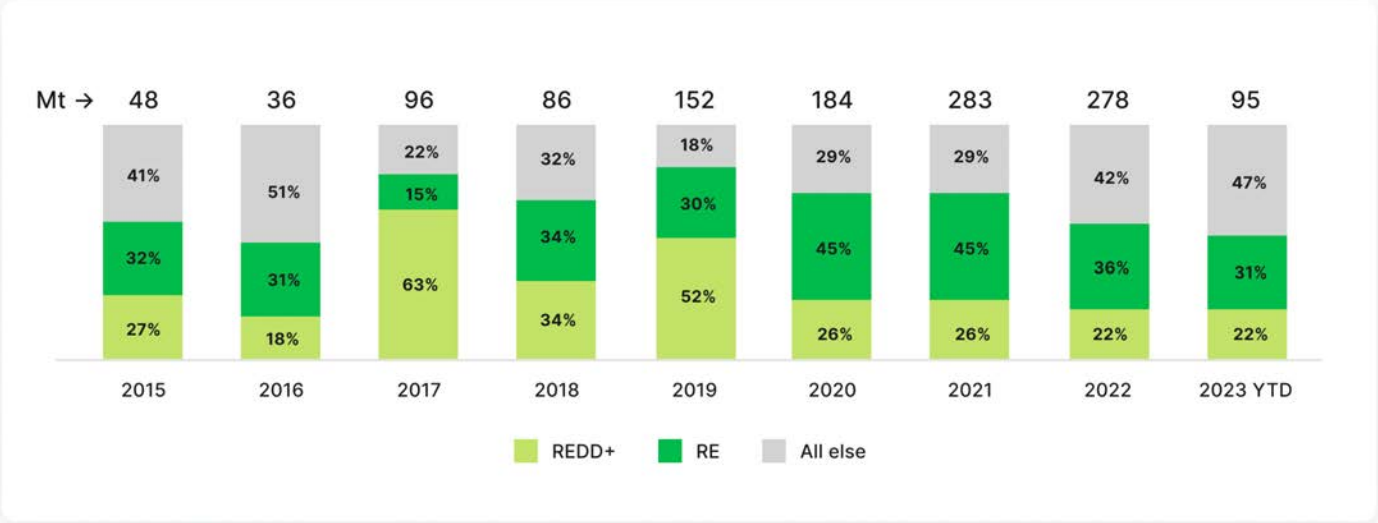

Figure 3: *Issuances by credit category %.*

REDD+ credits experienced a downward trend in retirements, falling from 61 million tonnes (36% of the market) in 2021 to 29 million tonnes (20% of the market) in 2022. RE credits slowed down in issuances but they have increased in retirements, growing from 58 million tonnes (36% of the market) in 2021 to 64 million tonnes (44% of the market) in 2022.

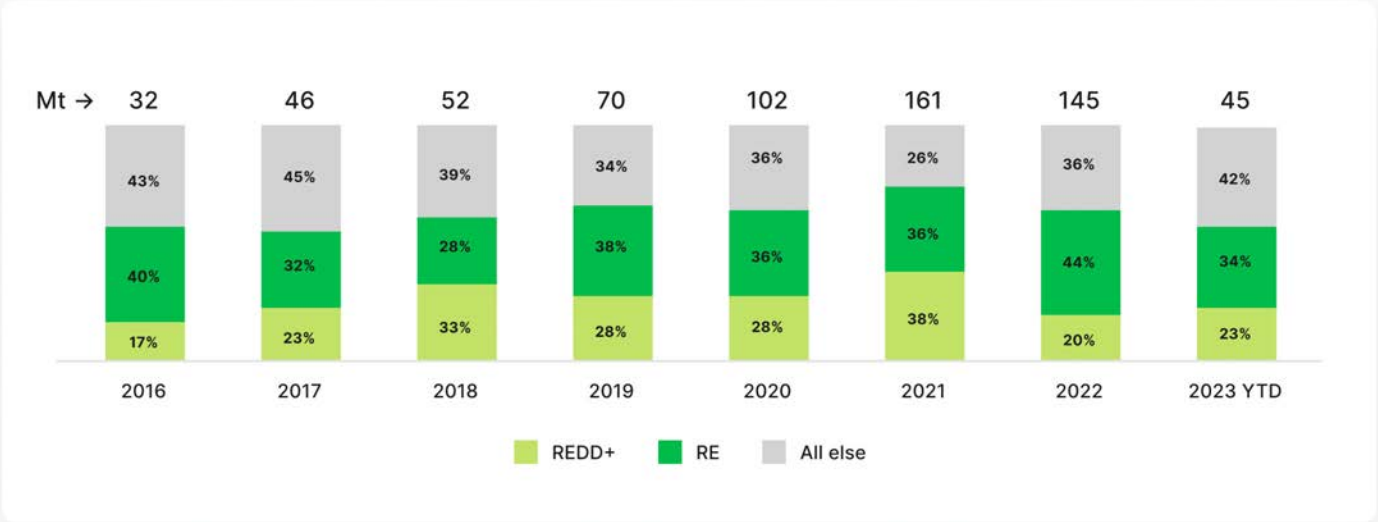

Figure 4: *Retirements by credit category %.*

REDD+

For REDD+ credits, market trends around quality concerns[17], reputational backlash, and wary buyers[18] may have contributed to the decreases in issuances and retirements, alongside uncertainty associated with the transition to Verra's new Consolidated REDD Methodology. In addition, some REDD+ demand may be being displaced to future years due to purchase commitments like the LEAF coalition which has built a coalition of buyers to commit capital for future deliveries of jurisdictional REDD+.[19] Similarly, data for new jurisdictional REDD+ issuances and retirements through the Architecture for REDD+ Transactions (ART) are not yet aggregated in the VROD, including recent large offtake agreements.[20] Ideally, these credits will be lower risk than other avoided emissions credits.

Renewable energy (RE)

For RE credits, increases in retirements may reflect the lack of highly publicized criticism. It is possible that as some price-conscious buyers pause spending on REDD+ credits but continue market participation, RE credits present a low-cost alternative. Looking ahead, we expect that the sustained criticism around many reduction and avoidance credits will extend to RE credits and continue to shift buyer demand away from these categories until new methodologies are shown to sufficiently reduce existing risks.

Removals Credits

Removal credits remain a minority in the voluntary carbon market (approximately 3% of credits to date) and issuances have fluctuated in growth over time. The uneven trajectory for these credits is driven by the small cohort of active developers and the gap from project initiation to issuance (often 2 to 6 years).

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[17] *West, T.A.P. et al., "Action Needed to Make Carbon Offsets from Forest Conservation Work for Climate Change Mitigation," Science 381, no. 6660: 873–77, https://doi.org/10.1126/science.ade3535.*

[18] *Greenfield, P. Revealed: more than 90% of rainforest carbon offsets by biggest certifier are worthless, analysis shows. The Guardian.*

[19] *Favasuli, S. 2022. Jurisdictional REDD+, high-impact carbon projects fighting to bloom. S&P Global.*

[20] *Jennifer, L. 2022. Hess Signs $750M REDD+ Carbon Credits Deal with Guyana. CarbonCredits.com.*

In addition, ARR credit developers, which comprise the majority of this category, often issue credits in multi-year tranches that certify multiple years of growth in a single verification event. This may contribute to the jump in issuances from 2 million tonnes in 2019 to 13 million tonnes in 2020. The total of 8 million issuances in 2022 may also reflect developers relying on credits generated in 2020 and 2021 to support sales.

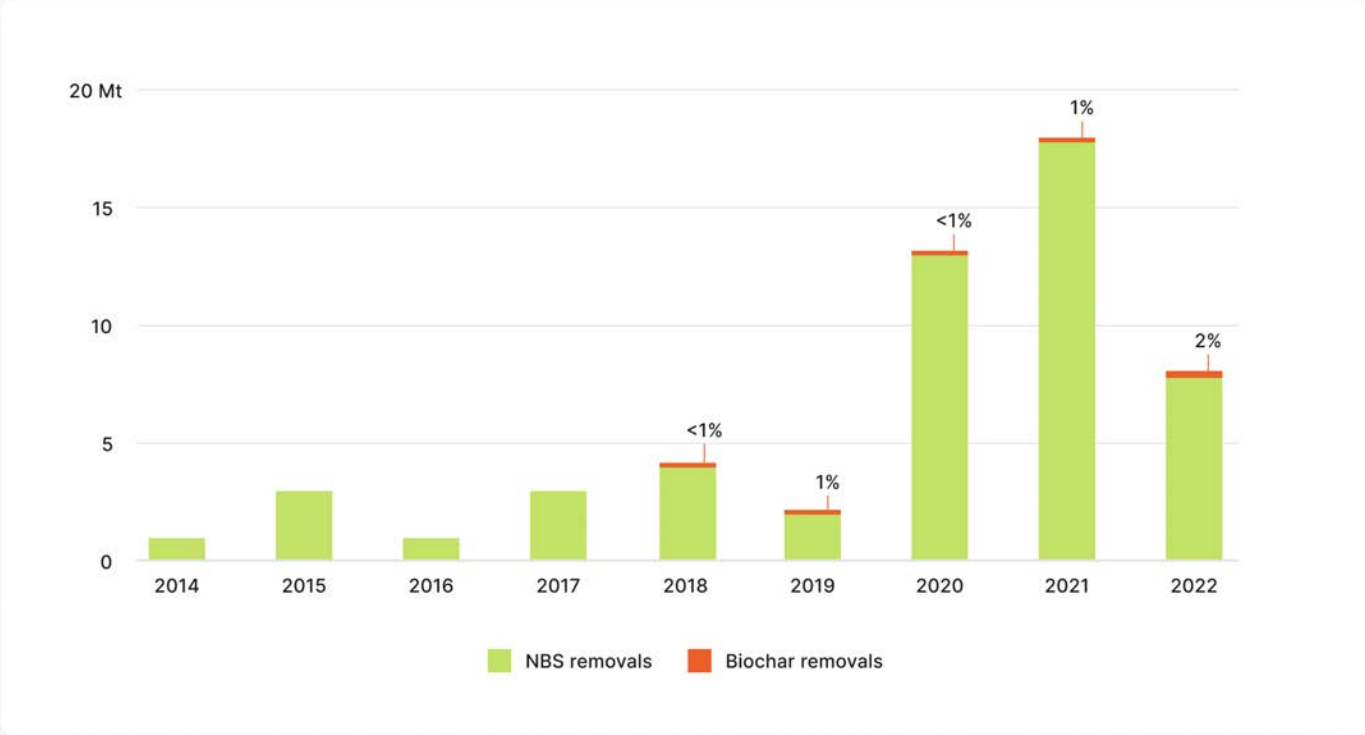

Figure 5: *Removals issuances and their sources, MtCO2. Note: As tracked on VROD registries, puro.earth, and Carbon Standards International.*

Retirements data reveal a more consistent trend in demand with an eightfold increase from 2018 to 2021 (from 1 million tonnes to 8 million tonnes) and sustained demand at 8 million tonnes in 2022. Because retirements reflect buyer activity, this represents one of the key measures of demand.

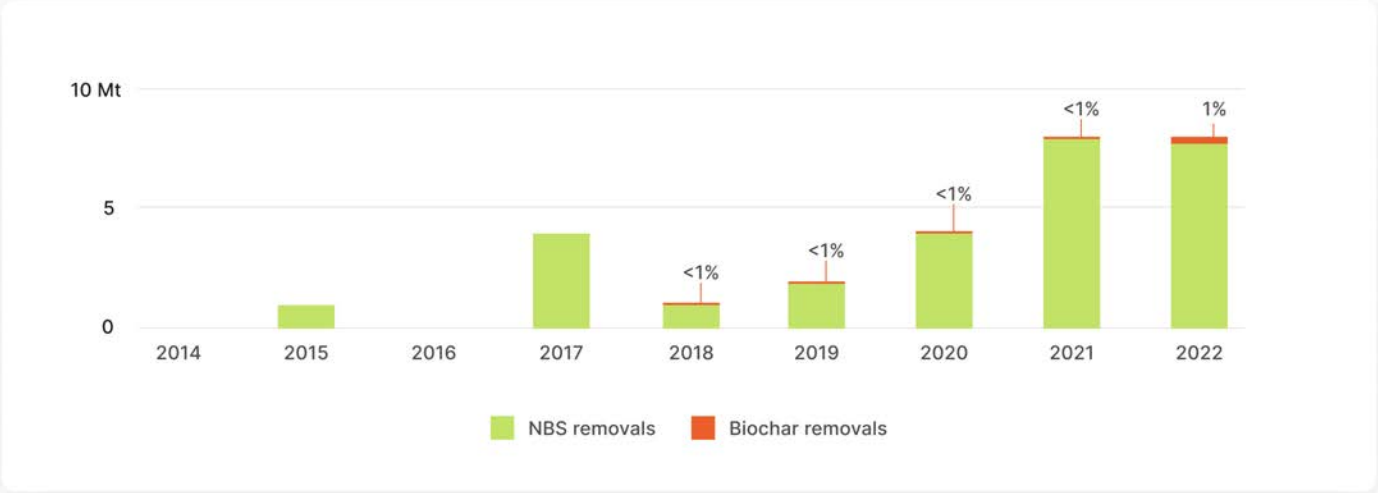

Figure 6: *Removals retirements and their sources, MtCO2e*

Within removals, higher-durability tonnes—defined here as tonnes with a project length greater than 100 years—are a small minority (1-2% of removals issuances and retirements). However, they saw a steep increase in media attention from 2020 to 2021 and have sustained higher issuances and retirements since then.

Biochar has emerged as the most prominent entrant in higher-durability tonnes and has experienced continuous growth, going from 1,000 tonnes in 2020 to 40,000+ tonnes in 2022. While the overall trend is growth, that growth is uneven.

The issuances of higher-durability removals had a spike in 2021, a drop in 2022, and are on track for a growth trajectory in 2023. The issuances spike in 2021 can likely be explained by registries clearing a backlog of biochar generation that completed issuance in 2021. The largest issuers in that year have audit statements with start dates of biochar that range as far back as December 1, 2019.

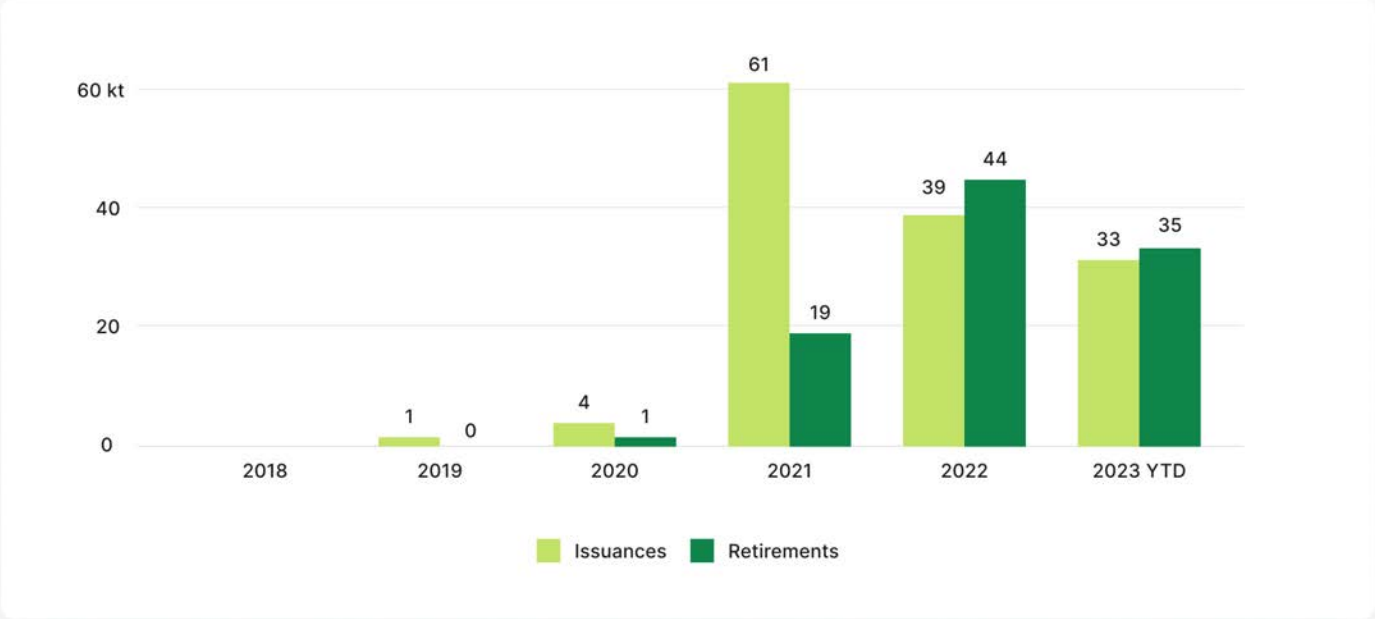

Figure 7: *Biochar-based removals issuances and retirements, ktCO2e*

In the coming years, large-scale removals in biomass with carbon removal and storage (BiCRs) and direct air capture (DAC)[21] are expected to launch. The planned annual capacities of many of these facilities are 10 to 50 times the size of current biochar projects. We expect this to drive a significant shift in market composition and new high-durability price competition.

[21] *Moses, E. 2022. 1PointFive to Begin Construction of World's Largest Direct Air Capture Plant in the Texas Permian Basin. 1PointFive.*
Birkeland Kjær, C. 2023. Ørsted awarded contract – will capture and store 430,000 tonnes of biogenic CO2. Ørsted.
Bates, Andrew. 2023. Navigator CO2 Partners with Puro.earth to Generate CDR Credits from Heartland Greenway CCUS Project. Navigator.

Increase in Removals-Focused Demand

As further set forth in the Appendix, Carbon Direct has tracked a set of buyers that have carbon credit purchase strategies with clearly established quality criteria as well as intention to steer long-term credit mix towards removals purchases. This analysis reflects the summation of tracked purchases from annualized data for these buyers.

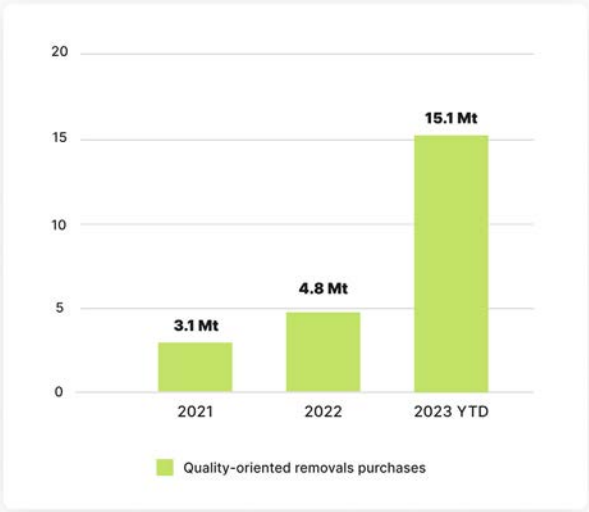

Figure 8: *Quality-oriented, removals-focused purchases, MtCO2e*

The demand for high-quality, durable carbon removal credits has increased alongside global climate commitments. The majority of these credits are still in development and are limited in number. Due to this limited demand, organizations that are working to reach net zero by 2030 or 2050 increasingly recognize that they need to secure the necessary volumes of carbon dioxide removal in advance—alongside large-scale emissions reductions.

Because organizations are contracting for retirement in the future, these purchases are not reported in this year's VCM databases. Analyzing available market data on purchases from high-quality, removals oriented buyers[22] from 2021 through Q3 2023, forward purchasing has resulted in a fivefold increase in demand for high-quality tonnes, from 3.1 million tonnes to 15.1 million tonnes.

[22] *Carbon Direct tracked a set of buyers that have public carbon credit purchase strategies with clearly established quality criteria as well as intention to steer long-term credit mix towards removals purchases. This analysis reflects the summation of publicly tracked purchases from this set of buyers.*

Market Leadership and Buyer Concentration

To scale CDR solutions to reach the IPCC requirement of 6 to 10 gigatonnes of CO2e annually, trillions of capital investment is required—and that investment is needed long before 2050. Today, select market leaders are investing in these earlier-stage solutions in order to catalyze development, bring new high-quality credits online, and demonstrate to other buyers how to engage in this nascent market. This group must grow rapidly to get the market to scale.

For example, Microsoft's Ørsted forward purchase agreement to procure 2.76 million tonnes over 11 years represents more than 80% of all high-durability tonnes contracted for in 2023[23]. Similarly, AirBus' forward agreement for 400K tonnes of direct air capture made up over 60% of high durability tonnes contracted for in 2022[24]. Together, these two agreements make up over 80% of tracked high-durability tonnes contracted for across 2022 and 2023.

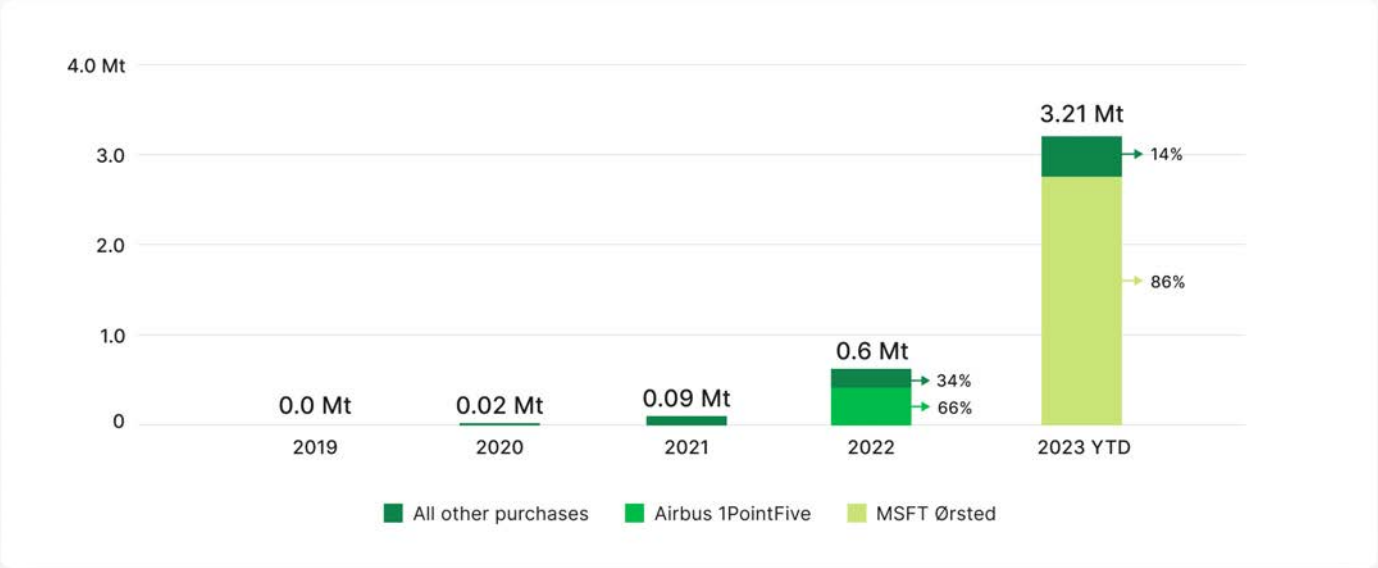

Figure 9: *Publicly announced hybrid and engineered carbon offtake agreements, MtCO2e. Note: As tracked by cdr.fyi.*

[23] *Mathis, W. 2023. Microsoft Inks Deal to Pay for CO2 Stored Below the Sea. Bloomberg.*

[24] *Moses, E. 2023. 1PointFive announces agreement with Airbus for the purchase of 400,000 tonnes of carbon removal credits. 1PointFive. Note: Carbon Direct has not independently verified this purchase.*

There is cause for optimism here. While the volumes of dedicated procurement remain concentrated, the overall number of buyers continues to grow. According to the cdr.fyi database, tracked high-durability removal purchasers have grown from 0 in 2018 to more than 90 in 2022. More broadly, the Science Based Targets Initiative has tracked thousands of companies with net-zero or science-based targets. As these companies seek to reach their targets, they will need to catalyze quality removals in the market by purchasing high-quality carbon removal solutions. This creates a base of hundreds of buyers with the size, capabilities, and need to engage in the VCM.

Carbon Direct Scientific Reviews Reinforce the Need to Focus on Quality

Between 2020 and July 2023, Carbon Direct has assessed more than 500 unique projects for their scientific quality and fit for quality-focused procurement. In conducting these assessments, we apply a "down-select" process that prioritizes client objectives like geography and project profiles as well as early quality indicators, like a project's potential to fulfill climate targets. Through this down-select process, we focus our deep diligence efforts on the projects most likely to meet our standards for quality.

For the projects that pass initial down select, we conduct a deep dive evaluation against the Criteria for High-Quality Carbon Dioxide Removal and similar criteria for reduction and avoidance projects. Using these criteria, Carbon Direct evaluates a project's approaches to harms and benefits, environmental justice, additionality and baselines, carbon accounting and MRV, durability, and leakage. Carbon Direct has evaluated hundreds of unique projects at this level of depth. Our team conducts evaluations against these criteria using a deep bench of scientific expertise and related project experience to analyze project data.

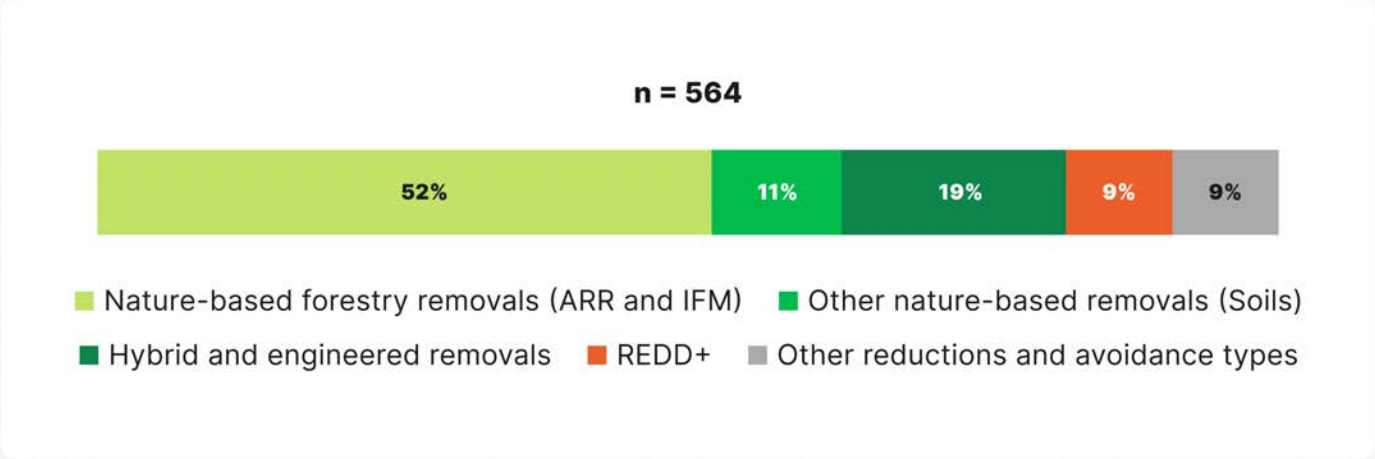

Figure 10: *Projects assessed by Carbon Direct (n=564)*

Because of our focus, the proportions of these assessments are heavily weighted towards removals.

- 52% were on nature-based forestry projects (afforestation, reforestation and revegetation, and improved forest management)
- 11% from other nature-based projects (soils)
- 19% were hybrid or engineered removals projects
- 18% were reduction and avoidance projects (by client request)

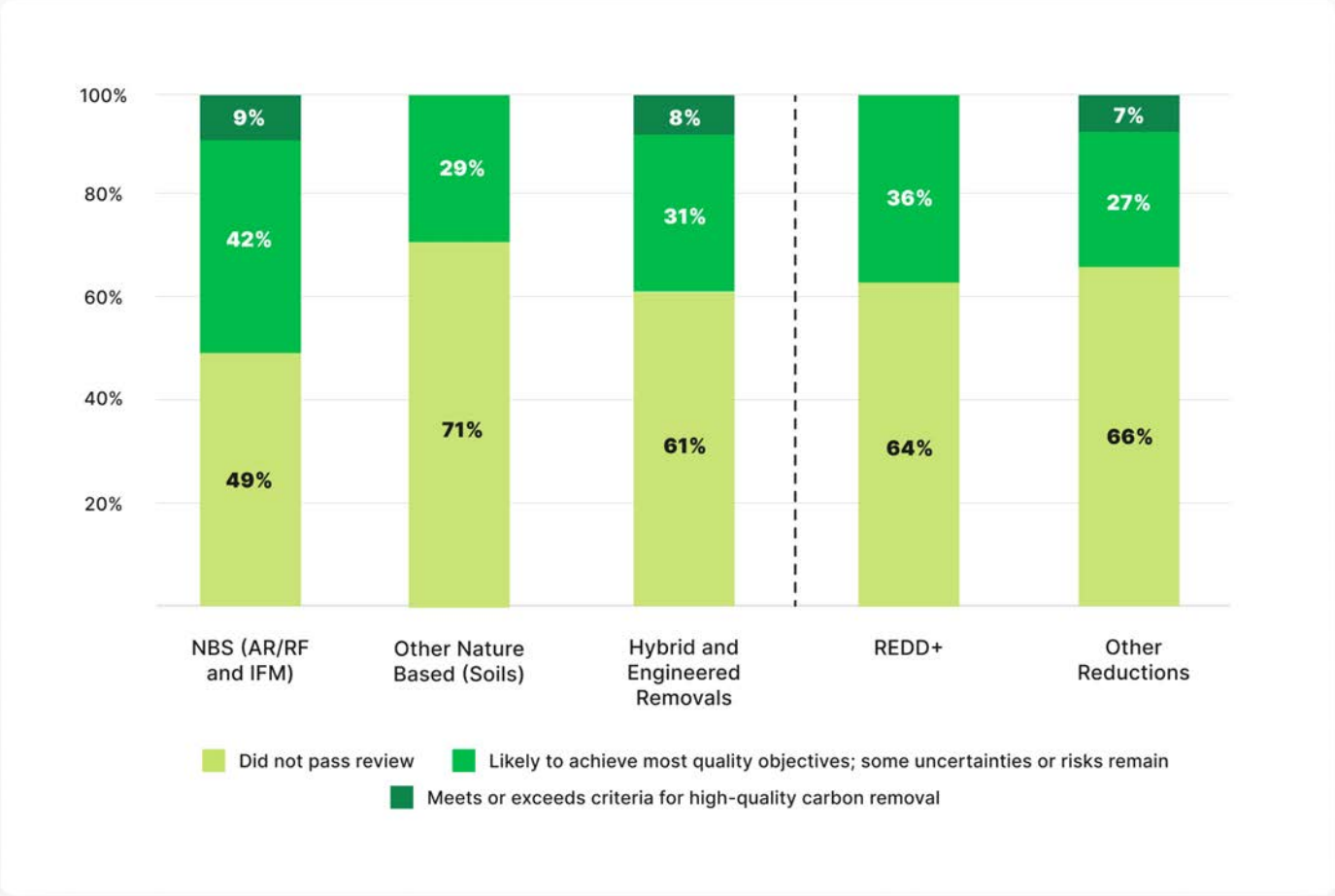

Figure 11: *Project reviews by score against quality standards*

Across all verticals, fewer than 10% of projects formally evaluated met or exceeded our quality criteria with minimal reservations. 37% of projects formally evaluated were likely to meet most of our quality criteria, these either required some adjustments (such as setting more conservative baselines) or stronger data verification (such as missing geospatial data).

Conclusion

The 2023 State of the Voluntary Carbon Market report is a tale of two markets. The first is predominantly an emissions reduction and avoidance market that is stagnating amidst increased public criticism and buyer scrutiny. The second is an emerging quality-oriented and removals-focused market that is growing quickly, driven by a small set of motivated buyers. From 2021 through Q3 2023, this quality- and removals-focused market has increased fivefold.

However, the quality-oriented market remains small. The 15.1 million tonnes transacted through spot market and forward purchasing represent fewer than a quarter of 1% of the 6 to 10 Gt CO2 of annual carbon dioxide removal needed by 2050. Achieving the goals outlined by the Paris Agreement requires the rapid scaling of high-quality removals across nature-based, hybrid, and engineered solutions.

Corporate buyers have a critical role to play in these solutions. While current carbon market leaders like Microsoft and Airbus have made some of the largest purchases of carbon removal to date, more buyers are needed to invest in market development. Whether in tech, finance, or harder-to-abate sectors, there are a number of organizations poised to begin purchasing high-quality carbon dioxide removal and set into motion gigatonne-scale deployment.

For carbon markets to effectively transform capital into climate impact, credits must deliver their stated climate impact. As the voluntary carbon market matures, buyers must be able to trust that their purchases will deliver climate benefits. As it stands today, many projects in the VCM present a serious risk of failing to do so.

In this sense, the decline in demand for credits with known risk, coupled with the growth in purchases from quality-oriented buyers, may signal the beginning of a transition towards a market that enables buyers to confidently use credit purchases against their climate targets.

Credits and Disclaimer

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Carbon Direct

Carbon Direct helps organizations go from climate goal to climate action. We combine technology with deep expertise in climate science, policy, and carbon markets to deliver carbon emission footprints, actionable reduction strategies, and high-quality carbon dioxide removal. With Carbon Direct, clients can set and equitably deliver on their climate commitments, streamline compliance, and manage risk through transparency and scientific credibility. Our expertise is trusted by global climate leaders including Microsoft, American Express, and Alaska Airlines, as well as by the World Economic Forum, which selected Carbon Direct as an Implementation Partner for the First Movers Coalition. To learn more, visit www.carbon-direct.com.

Appendix

A Note on Methodology

The 2023 State of the voluntary carbon market report relies on four core sources of data:

- The Voluntary Registry Offset Database to assess the major registries;
- Cdr.fyi for high-durability removal purchase data;
- Carbon Standards International and Puro.earth for issuances and retirements from biomass conversion (also known as "hybrid") projects; and
- Carbon Direct scientific project reviews and market tracking for high-quality purchasing.

The Voluntary Registry Offset Database (VROD), maintained by the University of California Berkeley, is the primary source for tracking carbon credits on the major carbon registries. This database contains issuance and retirement data on the four largest voluntary offset registries: Gold Standard (GS), Verified Carbon Standard (VCS), American Carbon Registry (ACR), and Climate Action Reserve (CAR). The VROD also identifies active and planned California Air Resources Board (ARB) compliance credit projects. We have used V8 to support our analysis, which was last updated to include data through May 10, 2023.

Furthermore, REDD+ is classified as "mixed" within the Voluntary Registry Offsets database because a small fraction of carbon benefits generated may be derived from removals. However, the majority of these credits fall into the reduction and avoidance categories. For this analysis, we treat REDD+ as a reduction/avoidance credit.

The Cdr.fyi database was used for public purchases of high-durability carbon removal. Cdr.fyi tracks public announcements of purchases, commitments to purchase, letters of intent (LOIs), and memorandums of understanding (MOUs) for high-durability removals. We also collected registry data for biomass conversion issuances and retirements from **Carbon Standards International and Puro**.earth, the two issuers of currently retireable high-durability tonnes. Both of these groups have set their own protocols for certifying and issuing biochar credits, and track retirements of those credits on their websites. For all of these sources of data, we have included data available through July 1, 2023.

Finally, we have used proprietary, anonymized, and aggregate data from **Carbon Direct** scientific reviews and market tracking. This includes the 550+ projects that we have assessed for eligibility in client procurement cycles and hundreds of carbon projects that we have formally evaluated against our Criteria for High-Quality Carbon Dioxide Removal. We have also included our own tracking of removals and quality oriented purchasing.