MSCI

RESEARCH INSIGHT

Investment Trends and Outcomes in the Global Carbon-Credit Market

MSCI Carbon Markets

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Contents

Executive summary

This report presents an analysis conducted by MSCI Carbon Markets examining capital flows in the global voluntary carbon-credit market. The analysis considered both publicly announced raises and commitments of capital and capital expenditure at a project level.

Capital expenditure

- We estimate that between 2013 and 2023, almost USD 42 billion was spent on the origination and development of 11,752 registered and pre-registered carbon-credit projects globally. Around half of this (about USD 22 billion**)** occurred between 2021 and 2023.
- Asia, the Americas and Sub-Saharan Africa accounted for 99% (USD 41.5 billion) of the total spend. Europe, the Middle East and North Africa are yet to emerge as material suppliers of carbon credits in the voluntary market. During this period, almost USD 5 billion was spent on projects located in the "least developed countries" (LDC's) as recognized by the United Nations (UN).[1] Although this accounted for just 11% of total expenditure — LDC-focused project expenditure grew 100% faster between 2021 and 2022 than for non-LDCs from USD 0.4 billion to USD 1 billion.
- Between 2013 and 2023, almost USD 23 USD billion (54% of total capital expenditure) was channeled into nature-based projects, of which 54% (USD 12.1 billion) occurred after 2020. This is three times greater than the next largest individual project type.

Capital raised and commitments

- We estimate that from 2021 to Q3 2024 around USD 43.4 billion has been committed or directly raised to invest in carbon-credit activities. From 2021 to 2023, the quantity of capital raised or committed was 50% higher than actual expenditure. 2024 looks set to be a record year, with USD 14 billion raised or committed already by Q3 2024.
- The majority of capital raised and committed between 2021 and 2024 (70% or USD 29.6 billion) has been for carbon-removal projects, including nature and engineered projects. Nature-based removals accounted for 45% of the total (USD 19.6 billion) and engineered carbon removals, such as bioenergy with carbon capture and storage (BECCS) and direct air capture (DAC), 23% (USD 10.1 billion).
- The proportion of capital raised and committed for engineered removals nearly doubled for the first three quarters of 2024 compared to the whole of 2023, from USD 2.6 billion to USD 4.7 billion, while capital for nature removals increased by 22% over this period.
- Nature-based activities — including restoration and REDD+ both at the project-level and for jurisdictional projects — were the focus of around 70% (USD 30.3 billion) of all capital-

[1] There are currently 45 economies designated by the UN as LDCs, entitling them to preferential market access, aid, special technical assistance and capacity-building on technology among other concessions. For the full list, please refer to "UN list of least developed countries," UN, accessed Nov. 4, 2024.

raising.[2] Across all project types, Nature Restoration attracted the most capital, accounting for 45% of all announced capital raises (USD 19.6 billion).

Benefits of carbon projects

- **Climate benefits** — Carbon projects registered since 2020 have an estimated annual emission-reduction capacity of over half a gigaton per year, having more than doubled the registered-issuance capacity of 2021 (from 420 MtCO2e/yr). To date, registered projects have posted carbon reductions of some 2.6 GtCO2e of carbon emissions — 92% of this volume is from activities that reduce emissions and 8% from removal activities.
- **Sustainable Development Goals (SDGs)** — Socioeconomic benefits such as improved health and sanitation (SDG 3), affordable clean energy (SDG 7) and economic growth (SDG 8) are the top priorities of carbon-credit projects and supported by more than 1,000 such projects, with many supporting multiple initiatives. With the exclusion of SDG 13 (the climate-related SDG), almost 1,000 registered projects report support of three or more SDGs, as of Q3 2024.
- **Protecting nature** — As of Q3 2024, there are almost 2,200 nature-based projects in the voluntary carbon market, of which roughly half are registered and half are still seeking registration. The area of forest covered by registered nature-based projects has increased by 70% from 30 million hectares, prior to 2021, to 51 million hectares in 2024. This is equivalent to an area just smaller than the size of France. As of Q3 2024, registered REDD+ projects covered 78% (40 million hectares), while Nature Restoration projects accounted for the remaining 11 million hectares.[3]
- **Supporting biodiversity** — According to MSCI Carbon Market analysis, around 66% of 670 Afforestation, Reforestation & Revegetation (ARR) projects globally have the potential to materially improve local biodiversity.
- **Supporting jobs** — Our analysis of REDD+ and ARR projects shows that on average each of these projects created jobs for around 100 people, with some larger projects reporting new employment into the thousands as of Q3 2024.

[2] "REDD" stands for "Reducing emissions from deforestation and forest degradation in developing countries." The "+" stands for additional forest-related activities that protect the climate, namely sustainable management of forests and the conservation and enhancement of forest carbon stocks.

[3] These land area estimates are based on an analysis of almost 1,500 project area shapefiles and project documents where data is available. However, not all projects produce accurate shape files, hence the true area protected by nature-based carbon-credit is likely to be much greater.

1. Introduction

This report presents an analysis conducted by MSCI Carbon Markets examining the nature of capital flows in the global voluntary carbon-credit market. The analysis considered both publicly announced raises and commitments of capital and capital expenditure at a project level.

It updates and builds on the research published by Trove Research (now MSCI Carbon Markets) in September 2023. The new edition focuses on publicly announced capital raises and commitments between January 2021 and the end of Q3 2024 and estimates of capital expenditure for carbon-credit project development between 2013 and 2023.

Methodology

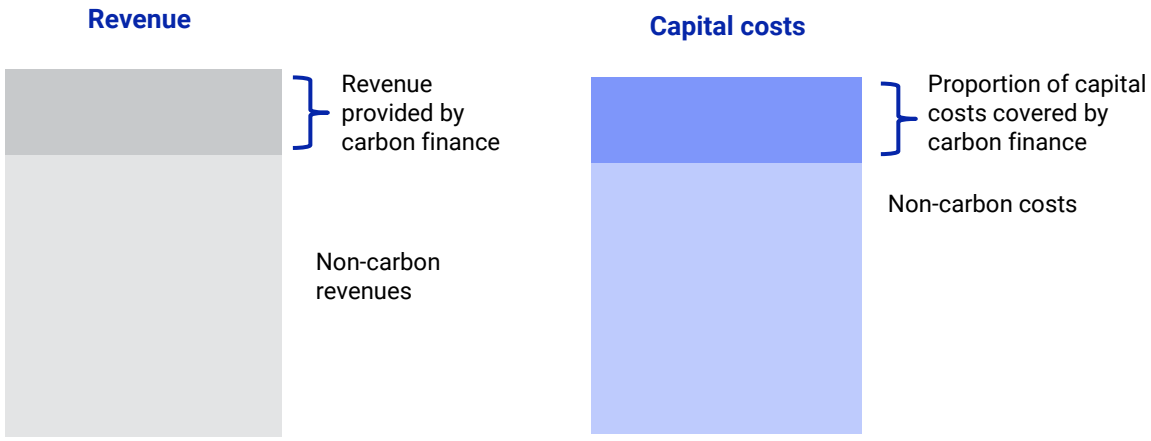
Capital-expenditure estimates

The capital-investment figures in this report represent the capital invested in carbon-reduction projects for the purposes of creating and selling carbon credits. These projects are a subset of all possible activities that could reduce or sequester carbon emissions. In 2022, for example, USD 1.3 trillion was invested in all energy-transition technologies, of which USD 0.5 trillion was in renewable-energy projects.[4]

Projects that produce carbon credits differ from other emission-reduction activities in that, in theory, they are only made viable by the presence of carbon finance. Other projects can be viable without carbon finance, funded through the sale of products, such as electricity or by government subsidy.

Where projects have multiple revenue streams, we include the proportion of the capital invested that is required to be covered by the sale of carbon credits. This is illustrated in the exhibit below. For example, ARR projects typically have few other revenue streams other than carbon credits, so the majority of the capital in these projects is included in our analysis. In contrast, the majority of the costs of renewable-energy projects are covered by sales of electricity, so we assume only a small proportion of the capital costs are attributable to carbon credits.

Exhibit 1: Proportion of costs represented by carbon revenue



[4] IRENA, 2023, "Global landscape of renewable energy finance 2023," IRENA, 2023.

The range of project costs used in the analysis are based on in-depth MSCI Carbon Markets cost models for 16 project types, covering low, medium and high-cost development scenarios. Cost ranges vary by project type. For example, for Renewable Energy projects in LDCs we estimate total unit cost to be between USD 1 and USD 20/tCO2e and for ARR between USD 19 and USD 120/tCO2e. The overall project costs are divided into capital and operating costs, with capital costs broken down into feasibility costs (conducting feasibility studies, "feasex"), development costs (detailed planning of the carbon project and preparing the project-design documentation, "devex") and construction-related costs (physical building of the project, "capex"). The main sources of project-cost variability are labor costs, land-based carbon uptake and opportunity costs (for nature-based types), as well as equipment and material cost (for engineered projects). All cost components vary based on the project methodology and region-based economic disparity.

Pre-registration projects (referred to as "pipeline projects") are assumed to be pre-operation and only incur feasex and devex costs. For projects that had initially registered under the Clean Development Mechanism (CDM) framework and then transferred later to other voluntary registries, we assumed that no further capex would be required, but some devex may be incurred to re-register with voluntary standards. These assumptions are summarized below.

Exhibit 2: Capital expenditure cost assumptions by project status

Project status	Assumption	Feasex	Devex	Capex
Registered	Project is assumed to allocate all costs to activities that generate voluntary carbon credits.	100%	100%	100%
Pipeline	Project is assumed to have partially allocated capital to feasibility and initial development activities.	25%	50%	0%
Transferred to California Air Resources Board Cap-and-Trade scheme	Project is assumed to have allocated none of its capital to voluntary carbon-credit generation as credits produced will be utilized for compliance purposes.	0%	0%	0%
Transferred from CDM	Project is assumed to face no further capex but would require some devex to re-register.	0%	50%	0%

Project universe

The analysis covers registry data for almost 12,000 projects in 10 ICROA-endorsed carbon-crediting standards: ACR, BioCarbon Standard, CDM, Climate Forward, Climate Action Reserve (CAR), EcoRegistry, Global Carbon Council (GCC), Gold Standard, Puro Earth and Verra.[5] Projects that were on hold, withdrawn, rejected or cancelled for credit use in the California Air Resources Board Cap-and-Trade scheme were excluded from this analysis.

The overall capital costs for each project are scaled according to the project's size based on estimated credit-issuance potential and crediting lifetime. These costs are then assigned to specific dates based on key individual carbon-credit project milestones (e.g., date of listing or project start). Where available, data is sourced from registry files and validated against available project

[5] ICROA is the International Carbon Reduction and Offset Alliance, an industry trade group for providers of voluntary carbon offsets. It was established in 2008 and aims to promote industry self-regulation based on its ICROA Code of Best Practices.

documentation. Where unavailable, values were extrapolated based on the project type and location for a given project.

Publicly announced capital commitments and raises

The analysis of capital commitments in section 3 of this report, is taken from the MSCI Carbon Market database of over 900 public announcements relating to the capital raises or purchasing commitments for carbon-credit projects.

We define a "capital commitment" as a pledge by an investor to allocate or raise funds for a project, developer, fund or investment vehicle in the future. The term "capital raise" refers to a completed transaction of funds. We have taken care to acknowledge completed transactions that are in fact fulfilling a commitment, to address double counting.

Categorizing these funds is challenging, as capital is often raised for multiple purposes and only part of it may be devoted to carbon credits. For example, funds may invest in general clean technologies or forest assets, which may or may not generate carbon credits at some point in the future. For the purposes of this analysis, we only include announcements where the creation of carbon credits is stated as the primary purpose of the fund or activity. This definition excludes many funds that invest in low-carbon technologies, but where returns are not dependent on revenues from carbon credits.

Based on these definitions, our analysis includes data from 252 of the more than 900 reviewed announcements. Of these, 205 specified a capital amount and the remaining 47 provided an estimated volume of credits that would be delivered. For the latter we have estimated the implied capital amount by applying our in-house cost models.

Updates to data sources

This report updates the 2023 Trove Research report, including adding five registries to the initial five and including over 900 references to capital-raising activity compared to around 400 previously.

Exhibit 3: Analysis updates

Topic	Updates in this report
Carbon-credit registries / standards	Addition of BioCarbon Standard, CDM, Climate Forward, EcoRegistry, GCC and to ACR, CAR, Gold Standard, Puro Earth and Verra.
Number of projects covered	Increase from 6,961 to 11,752 projects — due to inclusion of more registries and listing of new projects on the initial registries.
Project estimated annual credits data	Increased quality and coverage of estimated annual credits data for projects registered with ACR, CAR, Gold Standard and Verra. Data points were extracted from over 4,000 project documents, with manual validation applied to fill gaps and correct inaccuracies found in registry downloads.
Project-development cost models	New bottom-up ARR cost model, combining a new geospatial modeling of carbon-uptake rates with a bottom-up, country-specific implementation and opportunity cost model.

Only projects registered through the CDM that are NDC-eligible (registered after 2012) were included in this report.

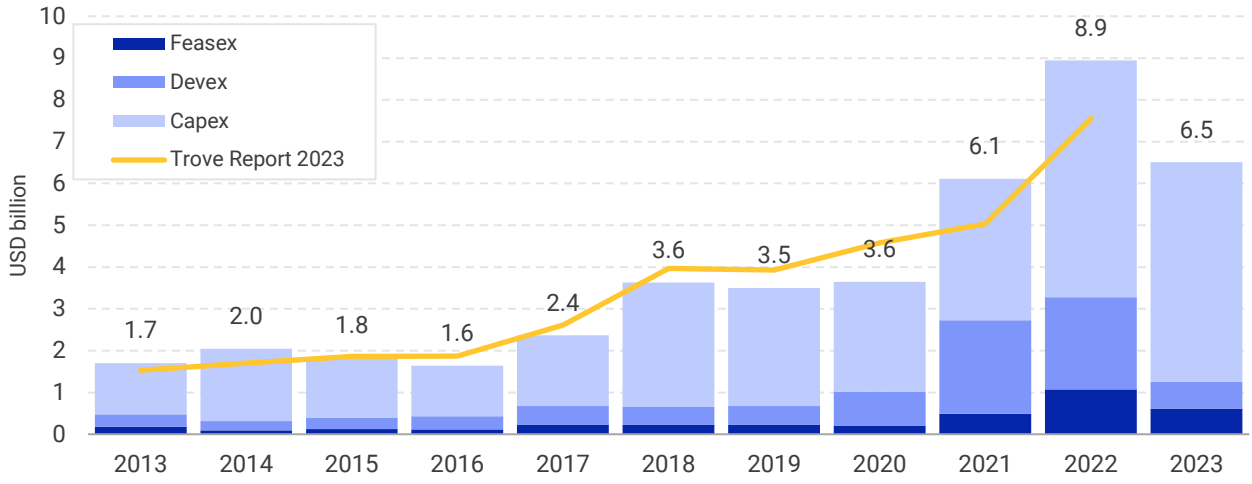
2. Investments in carbon-credit projects

The analysis presented in this section shows the estimated capital expenditure for 11,752 voluntary carbon-credit projects globally. We estimate that between 2013 and 2023, over USD 40 billion was spent on the origination and development of registered and pre-registered carbon-credit projects.

The annual expenditure estimates are shown in the exhibit below, split by expenditure type, alongside the previous year's figures. Expenditure types are broken down into three categories: feasex, devex and capex.

Annual project-related capital expenditure has gathered momentum steadily since 2013, especially toward 2021 and 2022, with some 50% of investment (about USD 22 billion) occurring between 2021 and 2023. We estimate that expenditure peaked in 2022 at around USD 8.9 billion, but a slowing carbon market, coupled with a more uncertain medium-term outlook, tempered project investment with capital expenditure falling back to USD 6.5 billion in 2023.

Exhibit 4: Annual voluntary carbon-credit project capital expenditure by cost type

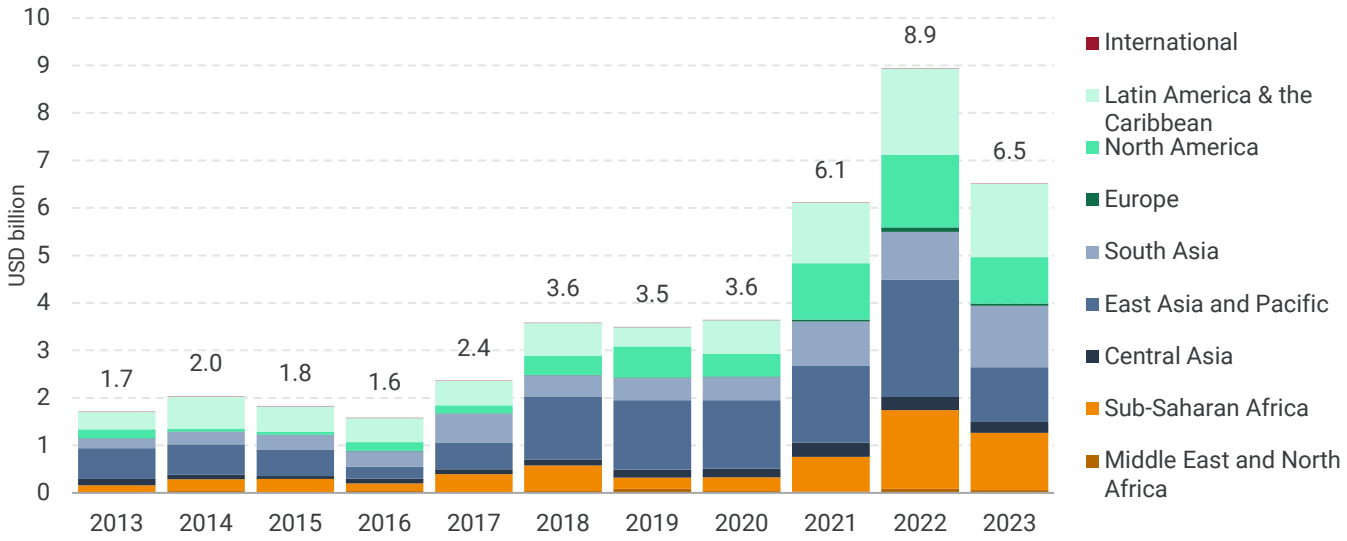


Data as of Sept. 30, 2024. The Trove Report 2023 line indicates the total annual project expenditure reported in the initial iteration of this report. Source: MSCI Carbon Markets

2.1 Capital expenditure by project location

Asia, the Americas and Sub-Saharan Africa accounted for 99% (USD 41.5 billion) of capital spend between 2013 and 2023. Europe, the Middle East and North Africa are yet to emerge as material suppliers of carbon-credits in the voluntary market. During this period, almost USD 5 billion was spent on projects located in LDCs. Although this accounted for just 11% of total expenditure — LDC-focused project expenditure grew 100% faster between 2021 and 2022 than for non-LDCs from USD 0.4 billion to USD 1 billion. Further growth occurred in 2023, taking this to USD 1.1 billion against the backdrop of a market-wide downturn.

Exhibit 5: Annual voluntary carbon-credit project capital expenditure by region



Data as of Sept. 30, 2024. Source: MSCI Carbon Markets

Asia

Asia represented the largest share of project expenditure, accounting for roughly half of all expenditure between 2013 and 2023 (USD 20.2 billion). Of this total, 60% (USD 12.1 billion) came from the East Asia and Pacific region and 31% (USD 6.4 billion) from projects in South Asia, with the remaining share accounted for by Central Asia (USD 1.8 billion).

Around 70% of the region's total expenditure was accounted for by China and India (USD 8.9 billion and USD 5.4 billion, respectively). China has led global project expenditure, not just in Asia, since 2013, though its overall share of the global market has dropped from 37% in 2019 to 10% in 2023.

In contrast, investment in India peaked in 2023 with USD 1.1 billion, up more than 10-fold from USD 0.1 billion in 2013. The year 2023 was the first time that India overtook China in investment in carbon-credit projects.

Americas

The Americas accounted for the second largest portion of global project expenditure, accounting for 36% between 2013 and 2023 (USD 14.9 billion). Of this total, about two-thirds (USD 9.0 billion) was deployed to Latin America and the Caribbean, and the remainder to North America (USD 5.9 billion).[6]

Latin America and the Caribbean steadily increased their project expenditure from 2020, peaking at USD 1.8 billion in 2022, having grown two-and-a-half times its 2020 spend of USD 0.7 billion. Latin America has been dominated by Colombia and Brazil, USD 3 billion and USD 3.6 billion spent since 2013, respectively. Brazil has become a more established destination for carbon projects in recent years, with two-thirds of its total (USD 2.4 billion) being spent between 2021 and 2023. In 2023, Brazil recorded USD 1.1 billion of project spending and led the market with a 17% share of total expenditure.

[6] North America includes Canada, the U.S. and Mexico.

Much of Latin America's recent expenditure has been driven by developments under regionally focused carbon-credit programs such as BioCarbon Standard and Cercarbono (represented by EcoRegistry data).

In North America, expenditure has been driven by Mexico and the U.S., with investments of USD 3.9 billion and USD 1.9 billion, respectively, on voluntary carbon-credit projects between 2013 and 2023. The U.S. has consistently seen 4%-7% of annual global project expenditure between 2013 and 2023, compared to Europe which is yet to make a material impact on the supply of credits.

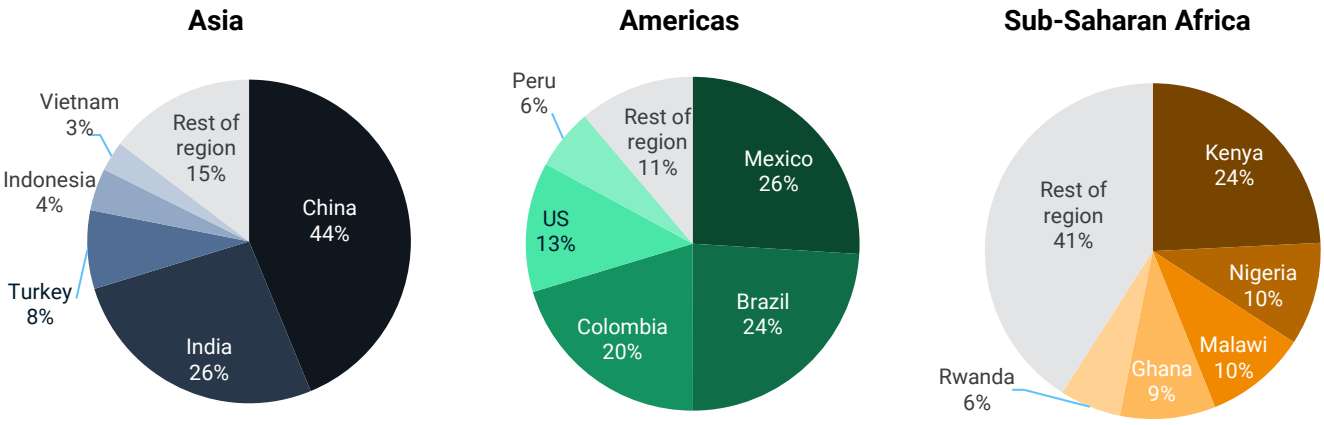
Sub-Saharan Africa

Although Sub-Saharan Africa had the smallest share of the top three regions (14% / USD 5.9 billion), it is the fastest emerging for project expenditure. Between 2021 and 2022, annual expenditure increased by USD 1 billion (+128%), the most of any region in absolute terms.

Kenya accounted for the largest share of expenditure in Sub-Saharan Africa between 2013 and 2023. About USD 1 billion was spent on projects during this period of which USD 0.7 billion occurred since 2020.

Unlike the more established supply markets of Asia and the Americas, Sub-Saharan Africa has been less concentrated in its project expenditure. The five largest countries for project expenditure in the region accounted for less than 60% of the total, compared to shares of 85% and 90% in Asia and the Americas, respectively.

Exhibit 6: Top five country share of regional project capital expenditure

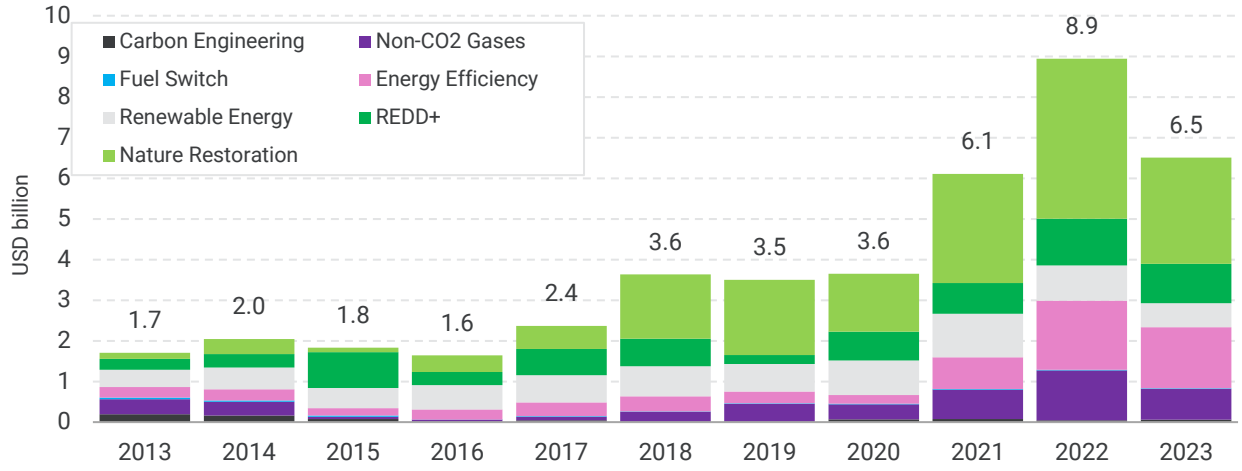


Data as of Sept. 30, 2024. Data for project capital expenditure between 2013 and 2023. Source: MSCI Carbon Markets

2.2 Capital expenditure by project type

Beyond geographic diversity, the voluntary carbon-credit market has also helped channel capital into a variety of project activities with a focus that has shifted over time to reflect the market's evolving priorities. Between 2013 and 2023, almost USD 23 billion (54% of the total) has been channeled into nature-based projects, of which more than half (USD 12.1 billion) occurred after 2020. This was three times greater than the next largest individual project type.[7]

Exhibit 7: Annual voluntary carbon-credit project capital expenditure by project type



Data as of Sept. 30, 2024. Source: MSCI Carbon Markets

Nature-based project activities

Nature-based project activities include carbon-credit generation through Nature Restoration, which focus on the restoration and sustainable management of forests, agricultural land and wetlands, and REDD+ which aim to conserve existing forests.

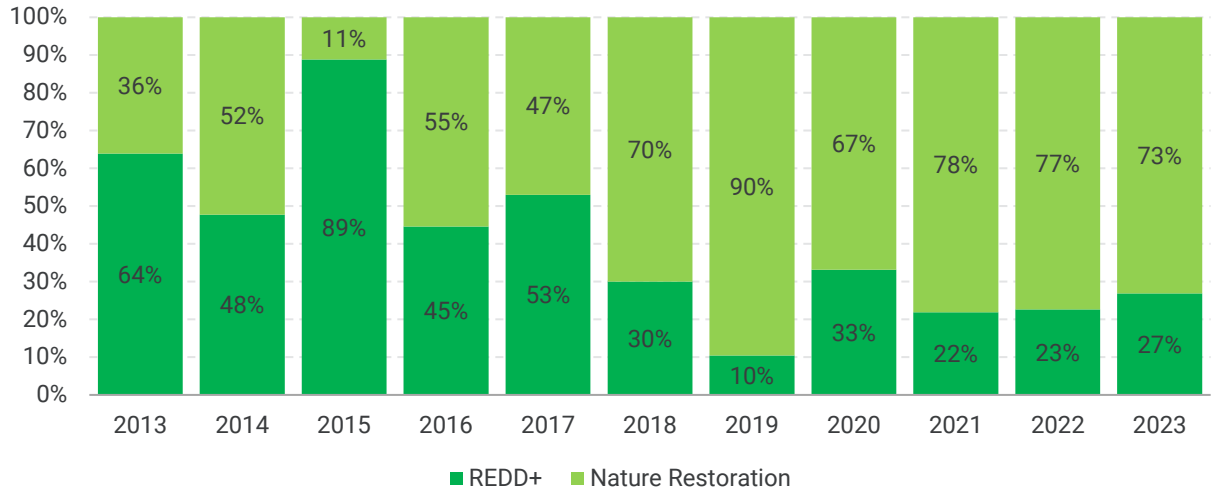
Between 2013 and 2023, around USD 15.7 billion was invested in Nature Restoration projects, accounting for 37% of the total spend. REDD+ accounted for less than half of this (USD 6.9 billion) during the same period.

Nature Restoration presented strong and consistent growth from just USD 0.1 billion in 2013 to a peak of USD 3.9 billion in 2022. Between 2021 and 2023, it represented 43% (USD 9.2 billion) of expenditure across all project types — more than double the equivalent share of any other project type during this period. Its market share has increased almost four-fold from an average 11% between 2013 and 2015.

REDD+ has been consistent in its expenditure since 2013 where it ranged between USD 0.2 billion and USD 1.2 billion at its peak in 2022. It has lacked the more sustained growth, however, of other project types which brought its market share down from a high of 37% in 2015 to 15% in 2023. Despite this, it was still the third-largest project type by total expenditure between 2013 and 2023. The exhibit below shows the split of investment in nature-based projects over the last 10 years between REDD+ and Nature Restoration activities.

[7] Nature-based projects include those classified as nature restoration and REDD+.

Exhibit 8: Annual share of nature-based project capital expenditure by project type



Data as of Sept. 30, 2024. Source: MSCI Carbon Markets

Technology-based project activities

Technology-based project activities generate carbon-credits by reducing the carbon intensity of industrial and domestic processes or removing carbon with engineered methods.[8] Collectively, these project types represented 46% (USD 19.3 billion) of total expenditure between 2013 and 2023.

Renewable Energy saw a notable but declining share of project expenditure, accounting for 18% (USD 7.5 billion) during the period. Between 2021 and 2023, USD 2.5 billion was spent on Renewable Energy projects, with just USD 0.6 billion in 2023, returning to annual expenditure levels seen only pre-2017. Its market share has declined steadily since 2016 when it accounted for over one-third of annual project expenditure to just 9% in 2023.

In contrast, Energy Efficiency has emerged as a significant focus for expenditure in recent years with USD 4.0 billion of project expenditure between 2021 and 2023, accounting for two-thirds of all technology-based expenditure during this period. This recent focus was the main driver in Sub-Saharan Africa's growth due to the scale up in clean-cooking projects.

Similarly, Non-CO2 Gases saw increasing spend in recent years, accounting for USD 4.7 billion in total expenditure over the period, roughly a quarter of all tech-based expenditure. Between 2021 and 2023, USD 2.7 billion was allocated to these projects, making up around 30% of technology-based project expenditure during this period.

Projects that remove carbon from the atmosphere, such as DAC and BCCS, represented a relatively small proportion of expenditure during this period due to the relative nascency of project development.[9] Investment is increasing, however, as shown by the amount of capital raised for these types of projects.

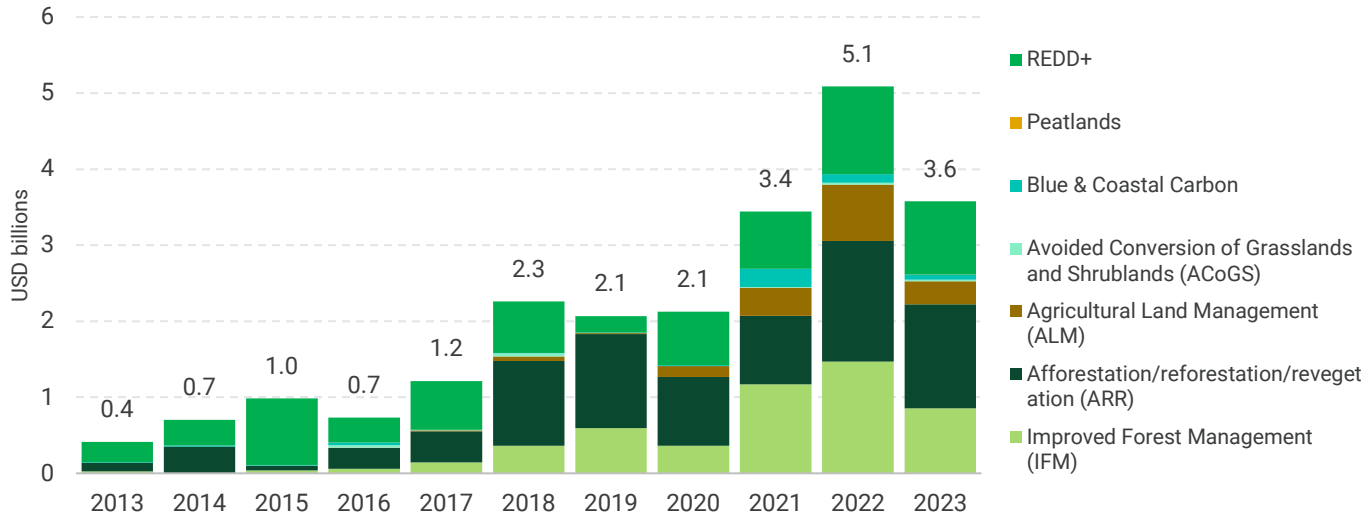
[8] Technology-based project types include carbon engineering, energy efficiency, fuel switch, non-co2 gases and renewable energy.

[9] These project types are included within the broader "Carbon Engineering" category of projects which also include more conventional Carbon Capture and Storage technologies.

2.3 Focus on nature-based project expenditure

As noted above, there has been increasing interest in nature-based projects, both to conserve existing ecosystems and restore depleted or degraded forests. The scope of these project activities, however, expands beyond traditional reforestation projects to include many subtypes, such as IFM, ALM and emerging areas like Blue and Coastal Carbon, reflecting a more diverse approach to carbon sequestration and ecosystem restoration.

Exhibit 9: Annual nature-based voluntary carbon-credit project capital expenditure by project type



Data as of Sept. 30, 2024. Source: MSCI Carbon Markets

ARR projects represented the largest single category of nature-based expenditure over the period, with a total of USD 8.3 billion, about 37% of all nature types. Investment in ARR saw consistent growth after 2017, nearly tripling to USD 1.1 billion in 2018 and peaking at USD 1.6 billion in 2022 — the growth was sustained in 2023 at USD 1.4 billion (down 13% versus a fall of 27% for the market average).

About a third (USD 5.1 billion) was allocated to IFM projects which showed a steady growth from just USD 0.1 billion (8% share of nature-based expenditure) in 2016 to peaks of USD 1.2 billion and USD 1.5 billion in 2021 and 2022, respectively, accounting for roughly a third of nature-based expenditure in each year.

Despite the prevalence of ARR and IFM in the market, largely driven by the earlier movement of programs such as ACR and CAR in North America, ALM emerged as a growing focus for investors post-2020. Notable investment occurred in 2021 (USD 0.4 billion) having increased four-fold from 2020 (USD 0.1 billion) and then by a further two-thirds in 2022, to peak at USD 0.7 billion. Between 2021 and 2023, ALM accounted for 12% of all Nature Restoration expenditure.

ARR, IFM and ALM collectively represented over two-thirds of expenditure in Nature Restoration projects between 2013 and 2023. Lesser represented nature types included Blue and Coastal Carbon (USD 0.5 billion), ACoGS (USD 0.1 billion) and Peatlands (<USD 0.1 billion).

3. Capital raises and commitments for carbon-credit activities

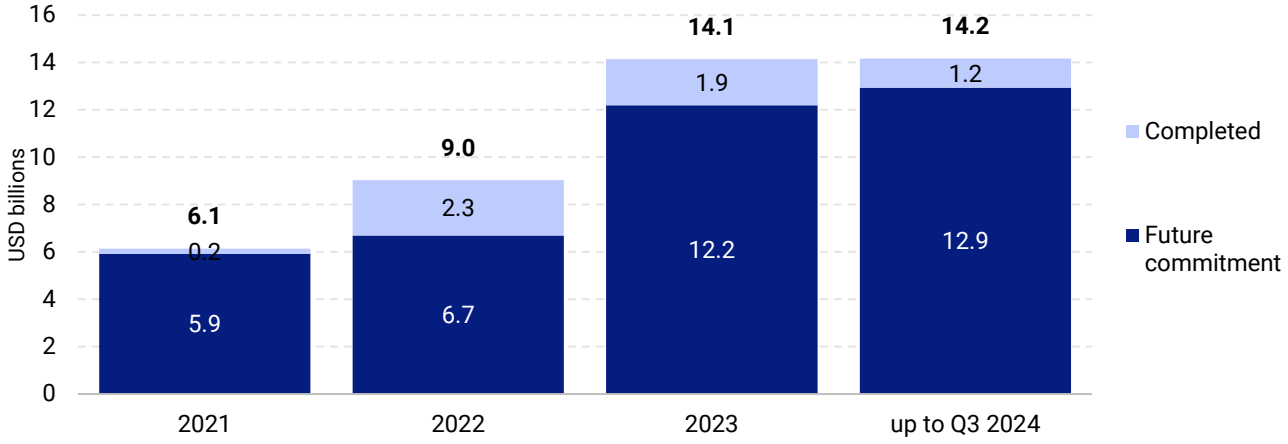
3.1 By type of announcement

The following analysis is based on MSCI Carbon Markets analysis of over 900 public announcements reported between January 2021 and Q3 2024. The methodology for categorizing and aggregating these announcements is summarized in section 1 of this report.

Based on this analysis, we estimate that between 2021and Q3 2024 around USD 43.4 billion was committed or raised to invest in carbon-credit activities, as shown in the exhibit below. These activities include investments in project developers to generate credits and forward-purchase commitments or to deliver carbon credits. Of this USD 43.5 billion, around USD 5.6 billion has been completed in the form of capital transactions, with the remaining USD 37.9 still in the form of future commitments.

The value of announcements rose from USD 9 billion in 2022 to USD 14.1 billion in 2023, marking a pivotal moment for the voluntary carbon-credit market. This increase was driven by higher future capital commitments which almost doubled during this period. 2024 looks set to be a record year, with USD 14.2 billion raised or committed already by the end of Q3 2024.

Exhibit 10: Capital raises and commitments for carbon projects by type of announcement



Data as of Sept. 30, 2024. Source: MSCI Carbon Markets

3.2 By project type

Between 2021 and 2024, we estimate that around 70% (USD 29.6 billion) had been committed and raised for the purposes of carbon-removal credits, including nature and engineered projects. Nature-based removals accounted for 45% of the total (USD 19.6 billion) and engineered carbon removals, such as BECCS and DAC, 23% (USD 10.1 billion). In Exhibit 1, we show the complete split in capital announcements by project type.

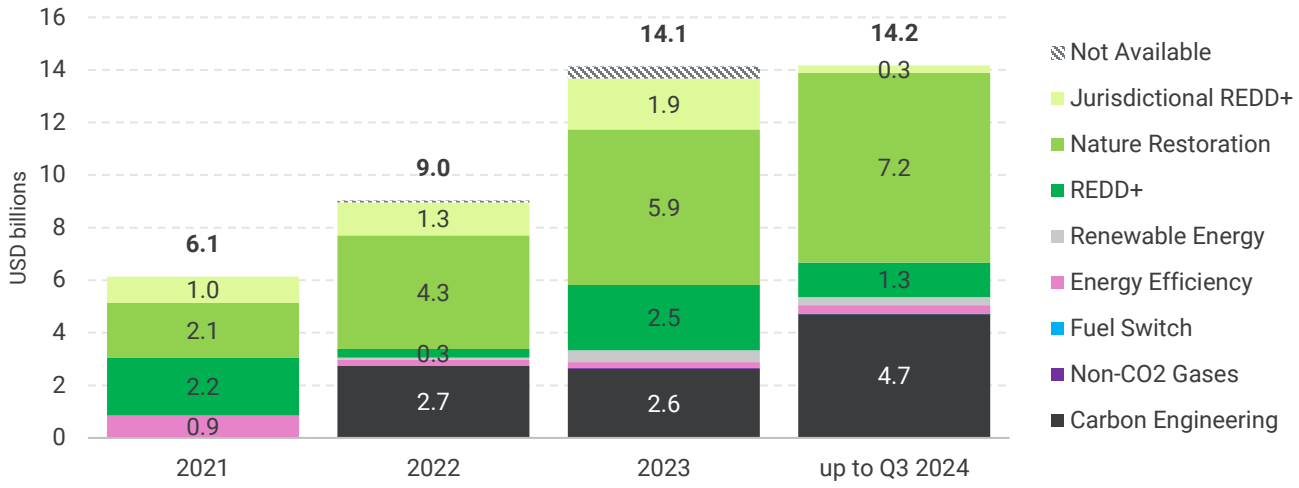
The proportion of capital raised and committed for engineered removals nearly doubled for the first three quarters of 2024 compared to the whole of 2023, up from USD 2.6 billion to USD 4.7 billion, while it increased by 22% for nature removals over this period.

All nature-based activities — including restoration and REDD+ both at the project and jurisdictional project level — have been the focus of around 70% (USD 30.3 billion) of all capital-raising activity.

Across all project types, nature restoration has attracted the most capital, accounting for 45% of all announced capital raises (USD 19.6 billion).

Fewer agreements and long-term purchases have been made in 2024 to date than in 2023, but deal sizes have increased, suggesting growing confidence among buyers and investors. A significant part of this growth has been driven by interest from major global corporates, such as Microsoft Corp., Alphabet Inc., Meta Platforms Inc., Amazon.com Inc. and Rio Tinto Group, with large forward-purchase commitments for removal-focused projects.

Exhibit 11: Capital raises and commitments for carbon projects by project type



Data as of Sept. 30, 2024. Source: MSCI Carbon Markets

3.3 By source of capital

A growing number of companies have started to take a more active role in sourcing carbon credits, shifting from buying credits in the spot market to direct investment in projects or long-term forward-purchase agreements. These direct investments are increasingly being made by corporates rather than independent project developers.

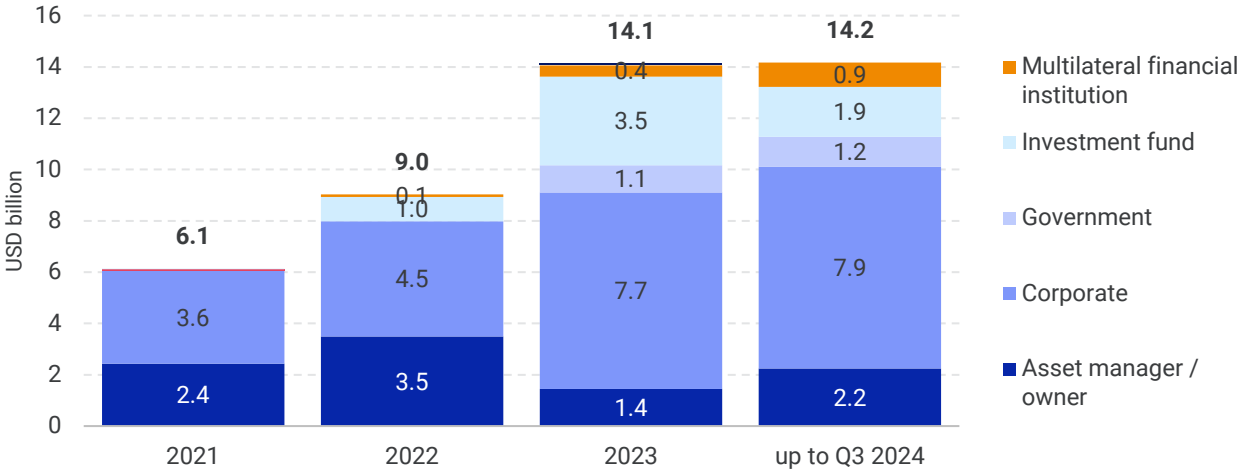
According to our analysis, around 54% (USD 23.6 billion) of all capital committed and raised for the generation of carbon-credits since 2021 has come from the corporate sector, as detailed in Exhibit 112. Of this, USD 15.6 billion occurred between 2023 and Q3 2024 — nearly double the amount across 2021 and 2022 (USD 8.1 billion). Some of these commitments involved significant forward-purchase agreements. For example, in July 2024, Microsoft announced an agreement with CDR developer 1PointFive to deliver half a million credits generated by DAC over six years. Based on the 2023 average prices for DAC, this would be valued at almost USD 400 million.[10]

Corporates have also started collaborating through buying clubs to create large-scale and long-term solutions in mitigating against climate change and achieving their own climate goals. Notable examples include alliances such as Frontier, the LEAF Coalition and Symbiosis. As of Q3 2024, Frontier and LEAF together have committed over USD 1.5 billion of capital. With large commitments of private capital through these clubs, public finance can also be crowded in. The LEAF Coalition, for

[10] "1PointFive and Microsoft Announce Agreement for Direct Air Capture CDR Credits," 1PointFive, Sept. 12, 2023.

example, has been supported by the national governments of the U.K., the U.S., Norway and the Republic of Korea.

Exhibit 12: Capital raises and commitments for carbon projects by source of capital



Data as of Sept. 30, 2024. Source: MSCI Carbon Markets

4. Benefits of investments in carbon-credit projects

4.1 Climate impacts

Investment in the voluntary carbon-credit market has become an important catalyst for advancing global climate goals. Since 2012, the market has facilitated the registration of at least 5,000 new projects across 11 main registries, as highlighted in Exhibit 13.[11]

Between 2021 and 2024, new projects were being registered at a rate of approximately 500 per year — almost twice the annual rate between 2012 and 2021 (275 per year). Of all the newly registered projects, a third (924 projects) focused on Energy Efficiency (mainly cookstoves) and about a fifth (512 projects) on Nature Restoration activities.

Collectively, projects registered since 2020 have an estimated annual emission-reduction capacity of over half a gigaton per year, having more than doubled the registered-issuance capacity of 2021 (from 420 MtCO2e/yr), as shown in Exhibit 14. To date, registered projects have posted carbon reductions of approximately 2,600 MtCO2e of carbon emissions. Around 2,400 MtCO2e (92%) of this volume is from activities that reduce emissions, and 200 MtCO2e (8%) from removal activities.[12]

Exhibit 13: Number of registered voluntary carbon-credit projects

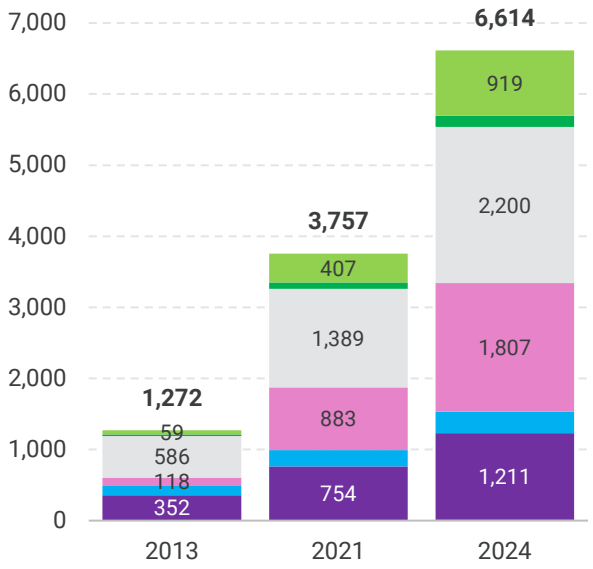
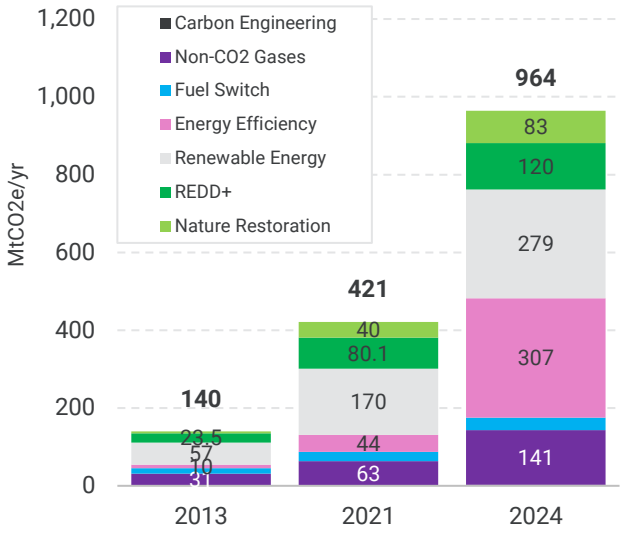


Exhibit 14: Estimated annual issuance capacity of registered voluntary carbon-credit projects



Data as of Sept. 30, 2024. Source: MSCI Carbon Markets

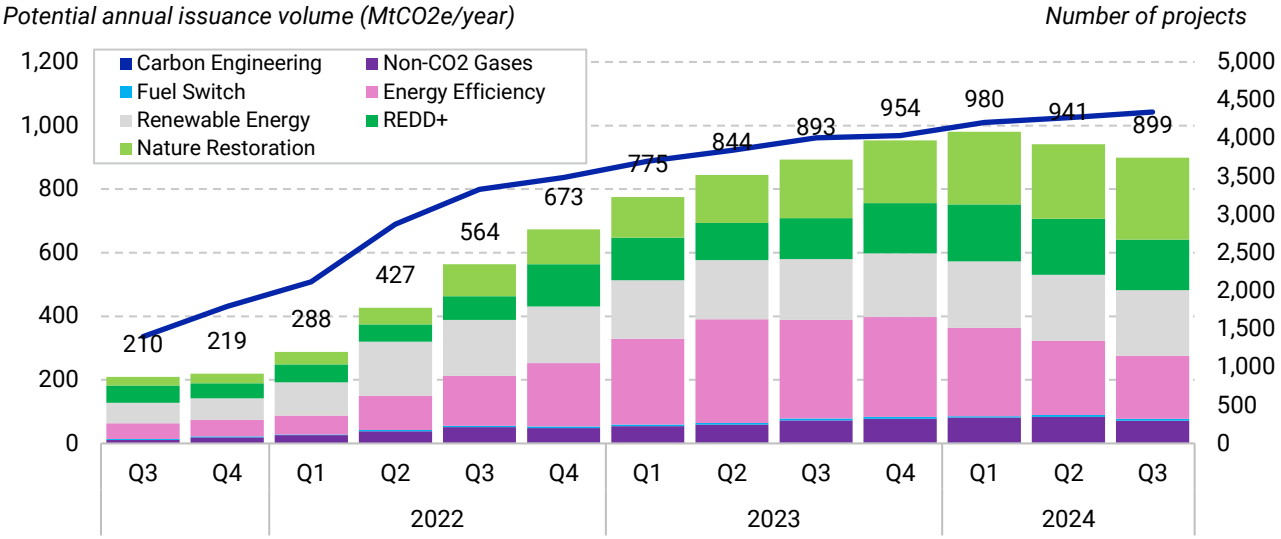
Capital investment has also been channeled into early-stage project activities, with around 3,000 new projects currently in the process of being registered. Between Q3 2021 and Q3 2024, the number of projects seeking registration with major standards more than doubled from 1,400 to 4,344. These new projects have increased potential issuance capacity by over four times from 210 MTCO2e/yr to 899 MtCO2e/yr, as shown in Exhibit ***15***15.

[11] Covers the following registries: ACR, BioCarbon Standard, CAR, Climate Forward, CDM (NDC eligible projects only), EcoRegistry, GCC, Gold Standard, Plan Vivo, Puro Earth and Verra.

[12] MSCI Carbon Markets data as of Sept. 30, 2024.

Within these pipeline projects, 952 are for Nature Restoration, growing from just 150 in Q3 2021. These projects now represent around 30% of the total pipeline capacity — the largest proportion of any project type.

Exhibit 15: Carbon projects in the registration pipeline



Data as of Sept. 30, 2024. Source: MSCI Carbon Markets

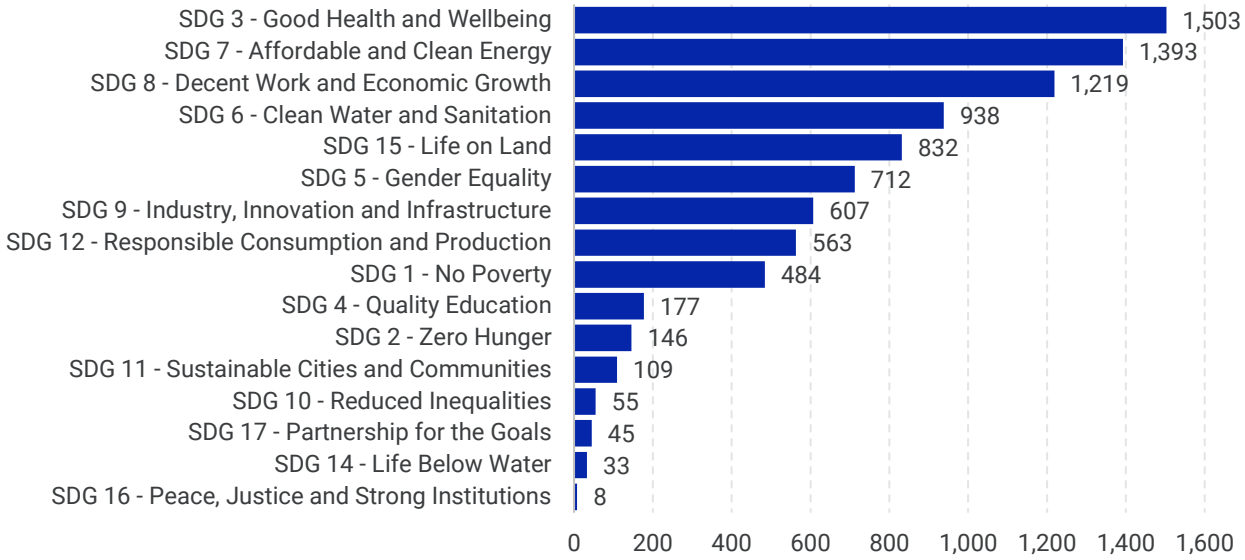
4.2 Environmental and social impacts (co-benefits)

The impact of investment into carbon-credit projects goes beyond just climate mitigation. Some projects support broader environmental and social objectives from the protection and enhancement of forest ecosystems to the empowerment of local communities in developing regions.

The UN SDGs have been used as a universal benchmark for developers to align their activities to help stakeholders identify projects intending to deliver additional benefits. Socioeconomic benefits, such as improved health and sanitation, affordable clean energy and economic growth, are the top priorities of carbon-credit projects. Each of these areas — represented by SDGs 3, 7 and 8 — are supported by more than 1,000 projects, with many supporting multiple initiatives (Exhibit 16). With the exclusion of SDG 13 (the climate-related SDG), almost 1,000 registered projects report support of three or more SDGs.[13]

[13] SDG 13, Climate Action, describes the urgent action to combat climate change. All verified carbon-credit projects should be aligned with this SDG.

Exhibit 16: Number of registered carbon-credit projects aligned with the UN SDGs (exc. SDG 13)

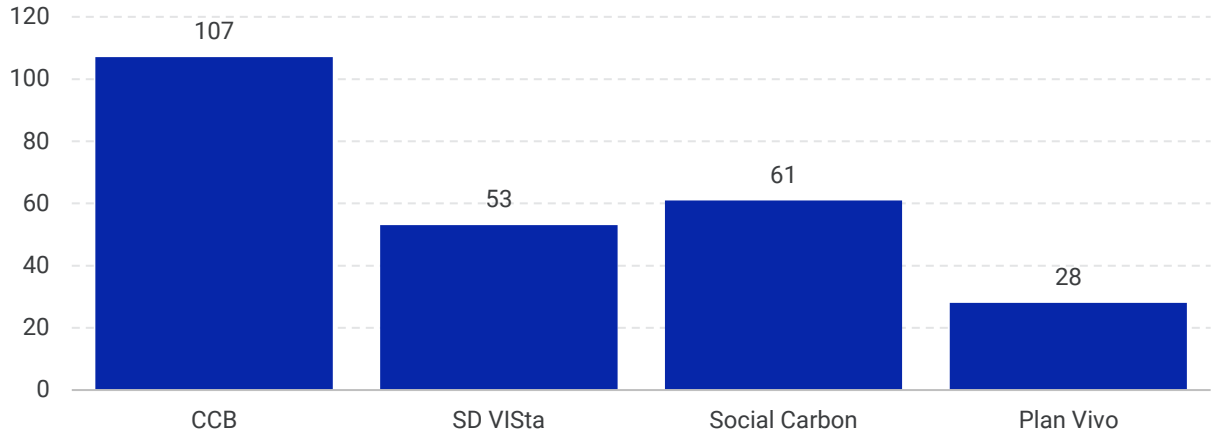


Data as of Sept. 30, 2024. Source: MSCI Carbon Markets

Our analysis of REDD+ and ARR projects shows that, on average, these projects created jobs for around 100 people, with some larger projects reporting new employment into the thousands.[14]

As co-benefits have become more important, certifications, such as the Climate, Community & Biodiversity (CCB) Standards, SDVISta and Social Carbon, have emerged for projects to quantify their co-benefits beyond just aligning with the SDGs. Carbon-crediting standards such as Plan Vivo have also developed a framework that prioritizes community-led initiatives and promotes fair revenue sharing. The number of registered projects for these certifications is shown below. As of Q3 2024, more than 100 projects have achieved at least one class of CCB certification, with 53 for SD VISta, 61 for Social Carbon and 28 for projects registered under Plan Vivo.

Exhibit 17: Number of registered carbon-credit projects certified by co-benefit standards



Data as of Sept. 30, 2024. Source: MSCI Carbon Markets

[14] Based on the median reported employment figure from a review of individual project documentation for 149 projects.

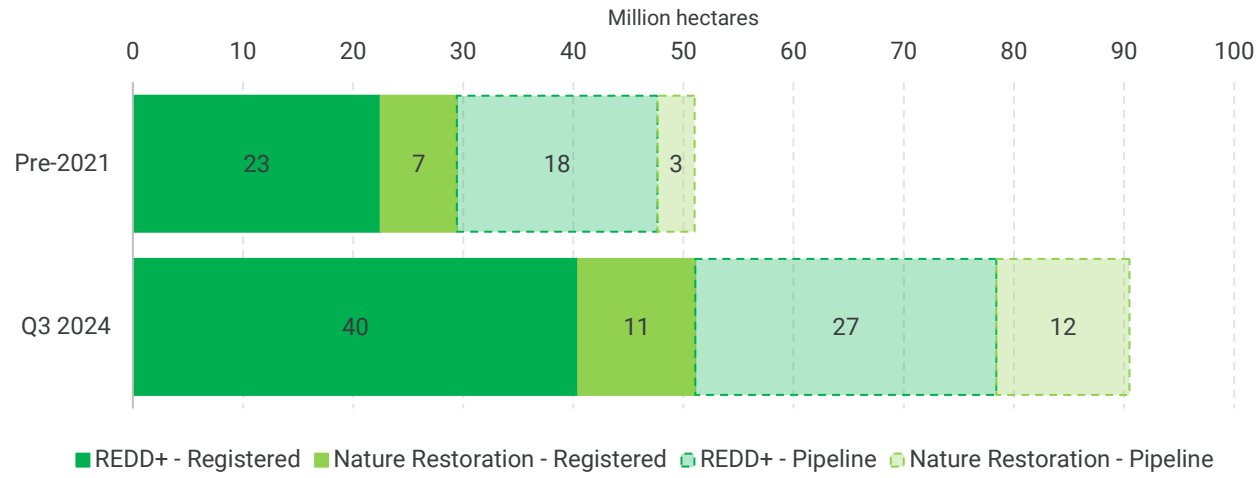
Protection and enhancement of forest land and natural ecosystems

Beyond their climate benefit, nature-based projects have broader benefits for nature and biodiversity, such as improving habitat connectivity and regulating water cycles. There are currently almost 2,200 nature-based projects in the voluntary carbon market — roughly half are registered and half are still seeking registration.

Cumulatively, the area of forest covered by registered nature-based projects has increased by 70% from 30 million hectares before 2021 to 51 million hectares in 2024, as shown in Exhibit 18. This is equivalent to an area just smaller than the size of France. As of Q3 2024, registered REDD+ projects covered 78% (40 million hectares), with Nature Restoration projects accounting for the remaining 11 million hectares.

These land area estimates are based on an analysis of almost 1,500 project area shapefiles and project documents where data is available. However, not all projects produce accurate shape files, hence the true area protected by nature-based carbon credits is likely to be much greater.

Exhibit 18: Area of forestland protected by registered and pipeline nature-based projects



Data as of Sept. 30, 2024. Source: MSCI Carbon Markets

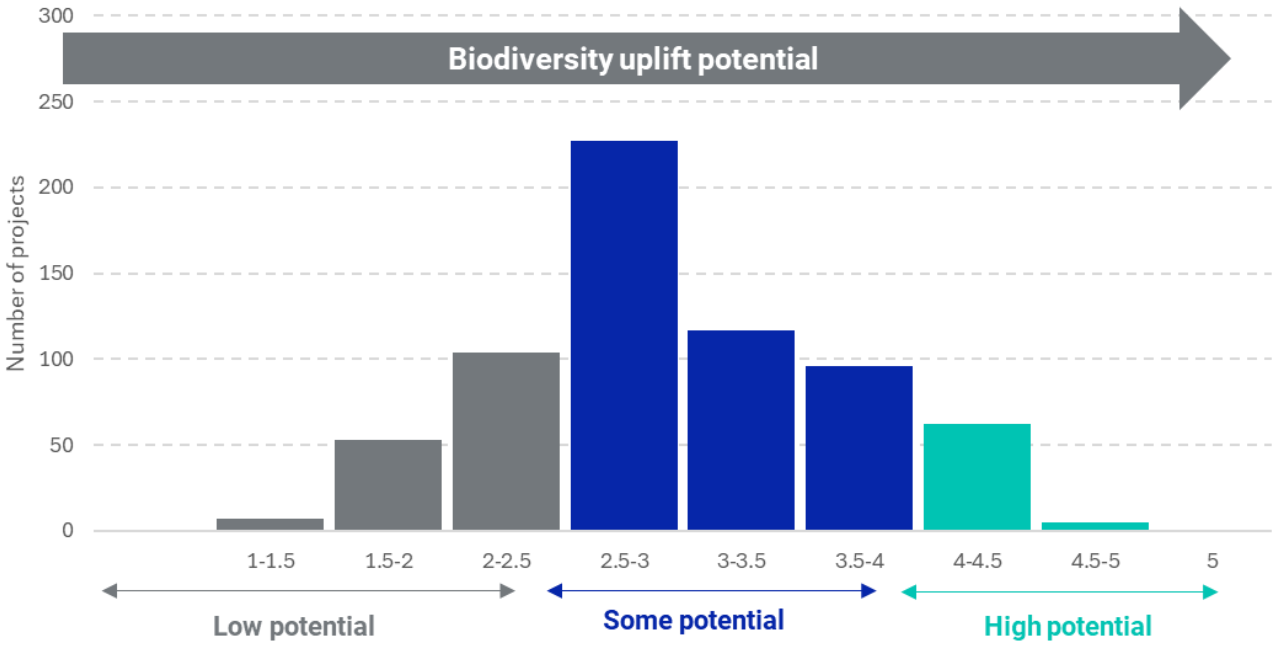
Through the protection and expansion of forestland, carbon-credit projects have also had positive impacts on biodiversity. These vary between nature-based projects, depending on location, topography and project activities. For example, some 66% of 670 ARR projects globally have the potential for biodiversity uplift (Exhibit 19).[15] Uplift potential in this case does not only consider the project in its current state, but also incorporates the potential positive impact on biodiversity from a fully-planted forest.

A regional example is Colombia, the location of this year's COP16, or Biodiversity COP. The country hosts 63 ARR projects, which collectively span some 500,000 hectares. Four-fifths of this area, representing 60% of the ARR projects, are in highly fragmented landscapes, indicating threats to

[15] This an estimate of the potential positive impacts on biodiversity. Actual benefits are based on multiple components of project design. Our assessment of biodiversity impacts considers multiple factors associated with the geography of the project area. We break these down into: (i) ecosystem scarcity, (ii) biodiversity uplift, (iii) biodiversity intactness and threat and (iv) biodiversity support. Performance in these factors is assigned a score on a scale of 1-5, with 5 representing the highest biodiversity-uplift potential and 1 representing minimal potential.

habitats with ongoing biodiversity decline. Nature-based projects can help boost forest connectivity and revive flora and fauna in these areas, supporting both climate change mitigation and the fight against biodiversity decline.

Exhibit 19: Biodiversity uplift potential of registered afforestation and reforestation carbon projects



Data as of Sept. 30, 2024. Source: MSCI Carbon Markets

5. Conclusion

This analysis examined capital flows in the global voluntary carbon-credit market through consideration of both publicly announced capital raises and commitments and capital expenditure at a project level.

It was estimated that almost USD 42 billion was spent on the origination and development of nearly 12,000 registered and pre-registered carbon-credit projects globally. Around half of this (about USD 22 billion) occurred between 2021 and 2023. Nature-based projects accounted for more than half of total expenditure, driven by typically higher-cost project activities like ARR. Further, project expenditure has been focused in Asia, the Americas and Sub-Saharan Africa — accounting for 99% (USD 41.5 billion) of total expenditure — whilst Europe, the Middle East and North Africa are yet to emerge as material suppliers of carbon-credits.

From our analysis of public announcements, we estimated that from 2021 to Q3 2024 around USD 43 billion has been committed or raised to invest in carbon-credit activities. Amidst recent growth, 2024 looks to be a record year, with USD 14 billion raised or committed already by Q3 2024. The majority of capital raised or committed during this period has been for carbon-removal projects, with almost USD 30 billion to both nature-based and engineered removal projects. The proportion of capital raised and committed for engineered removals nearly doubled for the first nine months of 2024 compared to the whole of 2023, from USD 2.6 billion to USD 4.7 billion.

Investment in the voluntary carbon-credit market has become an important catalyst for advancing global climate, environmental and social goals. Since 2012, the total estimated emission-reduction capacity of registered carbon-credit projects has more than doubled from 420 $MtCO_2e/yr$ to near a gigaton. Beyond climate, more than 1,000 projects were in support of three or more SDGs demonstrating clear effort to have impact beyond just climate mitigation. As of Q3 2024, there were almost 2,200 nature-based carbon-credit projects of which roughly half have successfully registered. These have increased the total area of forest protected by 70% from 30 million hectares, prior to 2021, to 51 million hectares in 2024. Further, according to MSCI Carbon Market analysis, around two-thirds of 670 ARR projects globally have the potential to materially improve local biodiversity.

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