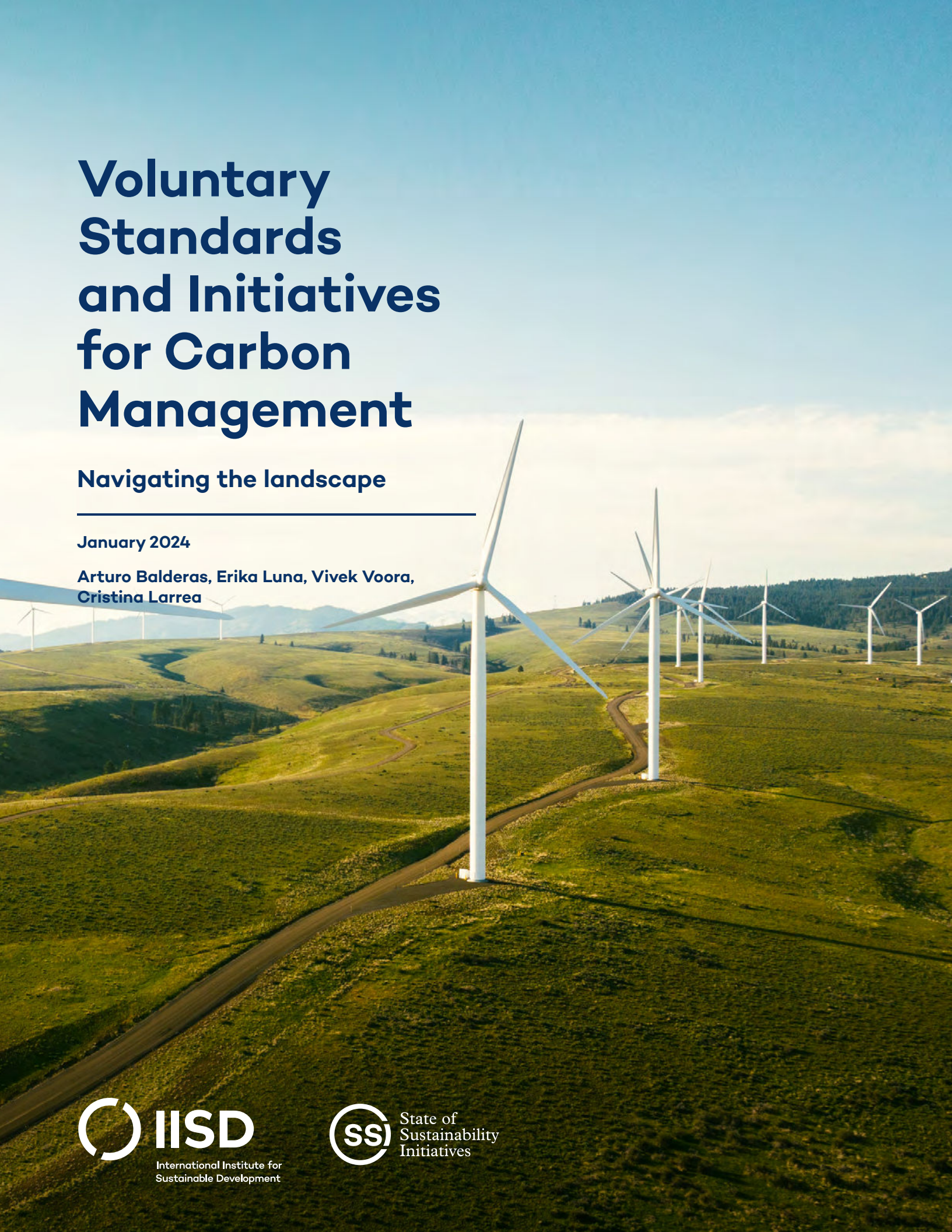
Voluntary Standards and Initiatives for Carbon Management

Navigating the landscape

January 2024

Arturo Balderas, Erika Luna, Vivek Voora, Cristina Larrea



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Executive Summary

Voluntary standards and initiatives for carbon management (VSICMs) have emerged and developed rapidly in the past 30 years to respond to the climate emergency. Here, we refer to VSICMs as the voluntary measures established by different organizations (including public, non-governmental, and international institutions) that companies, organizations, or individuals can use to integrate different aspects of carbon management into their activities.

The proliferation of VSICMs has been driven by emerging science-based methods to reduce and mitigate greenhouse gas (GHG) emissions and maintain global warming below the Paris Agreement target of 1.5°C. These voluntary measures have evolved in parallel to international and domestic legal frameworks to act on climate change. Most companies' actions associated with VSICM processes remain largely voluntary—particularly for micro, small, and medium-sized enterprises. This is especially true for initiatives that disclose carbon-related information and pursue carbon-neutrality certifications. While there are no legal requirements for carbon neutrality, the drive to reach net-zero emissions has boosted interest in the use of these schemes.

In this report, we provide an overview of the drivers, development, and implementation of VSICMs. Furthermore, we describe the different VSICMs that entities can use, particularly companies in the private sector, to advance their carbon management to reach net-zero emissions. These standards and initiatives can also be used by other types of organizations, such as non-governmental organizations (NGOs) and universities. In general, the information presented here can be used by these civil society actors; however, when using the word "organizations," we are primarily referring to companies and corporations in the private sector.

Voluntary standards and initiatives operate in a partial void created by regulations still under construction. NGOs, international organizations, and private sector actors have established VSICMs at a faster rate and with more flexibility than legally binding initiatives. This has led to the co-existence of—and competition among—multiple standards and initiatives. They often have overlapping and complementary goals but different scopes and functions, creating a complex landscape. To better understand this landscape and provide private sector companies with an initial guide, we have grouped VSICMs into four main types according to their goals. These categories align with the four main steps taken by private actors when advancing their carbon management practices:

- VSICMs for preparing GHG inventories and measuring carbon footprints,
- VSICMs for issuing carbon offsets,
- VSICMs for disclosing climate-related information, and
- VSICMs for certifying carbon/climate neutrality.

This report includes a general description of 33 VSICMs: nine VSICMs for preparing GHG inventories, 10 VSICMs for issuing carbon offsets, four initiatives for disclosing climate action, and 10 VSICMs for certifying climate neutrality. These were identified through a participatory survey with experts in carbon markets and climate change mitigation. VSICMs are quickly evolving, and the list presented here is just a snapshot of some popular initiatives, particularly in the Global North. However, we acknowledge that many initiatives in other geographies with similar scopes are gaining momentum, and we encourage the reader to keep an eye out for these.

We also highlight opportunities to use different VSICMs for various purposes, such as setting emissions goals, conducting an initial GHG inventory, defining carbon emissions reduction and mitigation strategies, or compensating unabated emissions and disclosing related information. Engaging with these practices can reflect a company's ambition to initiate comprehensive action on carbon management, both within itself and in its value chain. Adopting different VSICMs, particularly obtaining carbon-neutral certification and disclosing related information, can work as entry points for including ambitious climate mitigation actions into corporate agendas.

The ambition required to limit the global temperature increase to 1.5°C requires all organizations to reach net-zero emissions by 2050 at the very latest. Best practices on climate mitigation indicate that companies should establish two separate goals for carbon management: first, directly reduce emissions consistently with 1.5°C emission pathways, and second, use high-quality offsets to compensate for unabated emissions.

The greater a company's ambition, the more likely it is to contribute to substantive climate change mitigation. Companies' climate goals set the scope of VSICMs—for example, by defining which processes or activities would need to be included to prepare GHG inventories or in the strategies implemented to reduce and mitigate emissions. A company's climate goals will also determine the amount of offsets required to compensate for residual emissions to achieve carbon neutrality. For example, less ambitious mitigation scenarios would require a growing number of offsets to compensate for residual emissions.

Throughout the integration of carbon management practices, entities can use the different VSICMs presented in this report. Nevertheless, the organic evolution of VSICMs has created various challenges for comprehensive climate mitigation action. These challenges include

- a lack of harmonization among standards and initiatives to calculate GHG inventories that target different entities, such as a company, product, activity or procedure, event, or entire value chain;
- a lack of incentives for regulated entities to compensate unabated emissions and use high-quality offsets; and
- the unavailability of a consistent, transparent, and traceable system to present and verify data and information obtained through the use of VSICMs to prevent greenwashing.

The complexity of these issues increases if we consider the entire value chain, where there is often a lack of data collection, sharing, and standardization.

In the context of the climate emergency, there is a growing and urgent demand for ambitious climate change mitigation action driven by factors that go beyond compliance with legal regulations. These include societal and consumer pressure, financial sector requirements, and corporate policies. At a time when there are no legal requirements that apply to all the emissions-related activities (i.e., measuring, reducing, offsetting, disclosing) for specific and necessary action, VSICMs can provide roadmaps that a company can use to reduce and mitigate carbon emissions. By presenting step-by-step methods and considerations, VSICMs can help companies initiate or increase the ambition of their climate change mitigation strategies. However, this needs to be done transparently and traceably—and it needs to include targets aligned with 1.5°C emission pathways to contribute to global mitigation efforts.

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Abbreviations and Acronyms

ABC	Association pour la transition Bas Carbone
ADEME	Agence de l'Environnement et de la Maîtrise de l'Energie
ART	Architecture for REDD+ Transactions
BAU	business as usual
BCR	BioCarbon Registry
BSI	British Standards Institution
CAR	Climate Action Reserve
CBAM	Carbon Border Adjustment Mechanism
CDM	Clean Development Mechanism
CDP	Carbon Disclosure Project
CEPI	Confederation of European Paper Industries
CER	certified emission reduction
CITEPA	Technical Reference Centre for Air Pollution and Climate Change
COP	Conference of the Parties
CORC	CO_2 Removal Certificates
CO_2	carbon dioxide
CO_2e	carbon dioxide equivalent
CRT	climate reserve tonnes
EC	European Commission
U.S. EPA	United States Environmental Protection Agency
ETS	emissions trading system
EU	European Union
GCC	Global Carbon Council
GFANZ	Glasgow Financial Alliance for Net Zero
GHG	greenhouse gas
GWP	global warming potential
ICAO	International Civil Aviation Organization
IEA	International Energy Agency

IFRC	International Federation of Red Cross and Red Crescent Societies
IISD	International Institute for Sustainable Development
IPCC	Intergovernmental Panel on Climate Change
ISO	International Organization for Standardization
LEAF	Lowering Emissions by Accelerating Forest finance
LCA	life-cycle assessment
NDC	nationally determined contribution
NGO	non-governmental organization
OECD	Organisation for Economic Co-operation and Development
OEF	Organization Environmental Footprint
PAS	Publicly Available Specification
PEF	Product Environmental Footprint
PEFCR	Product Environmental Footprint Category Rules
REDD+	reducing emissions from deforestation and forest degradation, plus the sustainable management of forests, and the conservation and enhancement of forest carbon stocks
SBTi	Science Based Targets initiative
SDG	Sustainable Development Goal
TCR	The Climate Registry
TFI	IPCC Task Force on National Greenhouse Gas Inventories
TREES	REDD+ Environmental Excellence Standard
TSVCM	Taskforce on Scaling Voluntary Carbon Markets
UN	United Nations
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
VCM	voluntary carbon market
VSICM	voluntary standards and initiatives for carbon management
VCS	Verified Carbon Standard
WBCSD	World Business Council for Sustainable Development
WEF	World Economic Forum

1.0 Introduction

Voluntary standards and initiatives for carbon management (VSICMs) have emerged and developed quickly in the past 30 years to respond to the current climate emergency. The definition of a VSICM is not straightforward since there are standards and methodologies for different processes for carbon management. Thus, we refer to VSICMs as the voluntary measures established by different organizations (e.g., public, non-governmental, international institutions) that companies, organizations, or individuals can use to integrate different aspects of carbon management into their activities. We focus mainly on those initiatives intended to be used by companies in the private sector and ideally at the supply chain level.

These voluntary efforts have derived from and evolved in parallel to international and domestic legal frameworks to act on climate change. Relevant scientific-based methods and related information on greenhouse gas (GHG) emissions have driven the development of mandatory and voluntary actions that create the required institutional frameworks to mitigate emissions. This report focuses on the drivers, development, and implementation of VSICMs to provide a comprehensive overview of the landscape.

Adopting VSICMs with rigorous requirements can help non-state actors increase the transparency and credibility of their carbon management efforts and claims, such as carbon neutrality and net-zero pledges. It can also help to address greenwashing, climate misinformation, and confusion among regulators, businesses, and their end consumers (UN High-Level Expert Group, 2022).

1.1 Objective

In this report, the International Institute for Sustainable Development's (IISD's) State of Sustainability Initiatives aims to provide a general description of the different VSICMs that private sector companies can use to advance their climate action toward net-zero emissions. It also describes the drivers behind adopting VSICMs and their integration into private climate action. This report also includes a general description of 35 leading VSICMs and initiatives encompassing four categories of VSCIMs: (i) for preparing GHG inventories and measuring carbon footprints; (ii) for issuing carbon offsets; (iii) for disclosing climate-related information; and (iv) for obtaining carbon-neutral certification.

This report is structured as follows: Section 1 presents introductory information on climate change, private climate action, and VSICMs. Section 2 discusses the main drivers behind adopting VSICMs in the private sector. Section 3 shows the processes and steps usually included in private climate action and how different VSICMs are embedded in this cycle. Section 4 presents general information about and uses of the four types of VSICMs examined, as well as key highlights of the 35 leading VSICMs selected for this report. Finally, we present the main conclusions of this work. The appendices present background information on climate action and more information about these 33 VSICMs. This report is accompanied by a set of scorecards of nine carbon-neutral standards that we have benchmarked using IISD's coverage, assurance, responsiveness, and engagement (CARE) methodology and corresponding indicator set.

1.2 Climate Change

Not long ago, the impacts of climate change were perceived as something that would happen in the distant future. That future has arrived. People worldwide are experiencing firsthand the harmful effects of global warming resulting from increasing GHG emissions. The Intergovernmental Panel on Climate Change (IPCC) *Global Warming of 1.5 °C Special Report* states that every bit of warming matters and declares that limiting warming to 1.5°C would have positive outcomes. If the world continues with the current trend and lack of ambition, we will continue to experience disasters caused by rising temperatures, which are already affecting all sectors, from agriculture to energy, and, more importantly, having a disproportionately negative impact on vulnerable societies (IPCC, 2018b).

For instance, extreme heat has directly affected regions with extensive irrigated agriculture, creating food and economic losses. In Eastern Africa, climate change has exacerbated the already poor agricultural conditions and contributed to food insecurity and a steady wave of famines (Barone, 2022). In the summer of 2022, London reached unimaginable temperatures, hitting 40.2°C. That heat wave severely tested the electricity system's ability to supply cooling systems, leading the city to pay 5,000% more than normal to cover the energy demand (BBC News, 2022).

In addition to high temperatures, droughts have caused many losses in the agricultural sector, particularly affecting smallholder farmers who rely on rainfed agriculture (Harvey et al., 2018). Droughts are a major problem, but excessive rain can also have disastrous impacts on communities. Flooding has displaced and killed people in many regions, including Western Europe, where 15 cm of rain fell in just under 24 hours in the summer of 2021. Around 196 people died from this extreme flooding (Cornwall, 2021). Similarly, in Bangladesh, extreme flooding in the summer of 2022 affected 7.2 million people. This unprecedented flooding required the International Federation of Red Cross and Red Crescent Societies (IFRC) to launch an emergency appeal for USD 7.8 million (IFRC, 2022).

In the summer of 2022, flooding in Pakistan was recorded as the greatest climate disaster in the country, with at least 1,700 dead and more than 33 million people estimated to be affected (IFRC, 2022; Youde, 2023). The floods were directly associated with higher surface temperatures that led to extreme heat waves, causing glaciers to melt (Youde, 2023). It is clear that the effects of climate change are not in the distant future—they are our current reality, and they disproportionately affect developing countries and vulnerable societies. To tackle the emergency, a loss and damage fund was established at the latest United Nations Framework Convention on Climate Change (UNFCCC) 27th Conference of the Parties (COP 27) in Sharm El Sheikh to benefit the most affected developing countries. However, the climate emergency also needs mitigation efforts from different fronts and through the collaboration of the public and the private sectors.

Although the Earth goes through natural cycles in its climate, the current climate variability is, without a doubt, the result of human activity (IPCC, 2021b). The industrialization of many societies is reflected in the accumulation of GHGs in

the atmosphere. Although industrialization began in the 19th century, in recent years, the total warming effect caused by GHG emissions increased by 45% from 1990 to 2019 (U.S. Environmental Protection Agency, 2022). Energy consumption accounts for more than 76% of GHG emissions, which includes transportation, electricity and heat, buildings, manufacturing and construction, fugitive emissions, and other fuel combustion (Climate Watch, 2023). The energy sector is followed by agriculture and industrial processes (cement, chemical, and petrochemical), which account for 12% and 6% of total GHG emissions, respectively. Land-use change and forestry and waste both account for 3.3% (Ge et al., 2020). These sectors largely involve businesses and private sector actors that are being urged to act because they are part of the problem—and also part of the solution.

Multiple initiatives from different sectors have emerged to reduce and mitigate GHG emissions as climate change concerns have grown. At the global level, countries joined an international treaty, the UNFCCC, to reflect members' ownership of the issue. The UNFCCC has led to agreements, partnerships, and actions among governments and private sector actors to reduce GHG emissions. For instance, many jurisdictions and private sector actors have defined commitments and established targets to reduce their GHG emissions and become carbon neutral or net-zero by a given year (see Box 1 for definitions).

To address the climate crisis, stakeholders must come together to strengthen climate action at rates far beyond current commitments. This will require the involvement of governments and other stakeholders—particularly the private sector—that can do more than just lower emissions. The private sector plays an essential role in mitigating climate change impacts. Companies across sectors must work to decarbonize their supply chains by reducing and offsetting emissions and collaborating with and encouraging their competitors and suppliers to join the climate action journey (see Appendix B for further information on the emergence of VSICMs).

Box 1. Definitions of gross and net emissions, net-zero, and carbon and climate neutrality

The concepts in this box have been defined at different times by different actors and are subject to various interpretations. Therefore, it is necessary to clearly identify, and agree on, the underlying definition in each context and for each standard and the associated claims made by compliant entities. The concepts discussed in this box stem from the definitions and conventions for carbon accounting (i.e., GHG inventories) and criteria for setting emissions reduction and mitigation goals.

Gross and **net emissions** are concepts that emerged in the preparation of GHG inventories to describe the GHG processes included in the inventories. Thus, **gross emissions** consider only the processes and amounts of GHG emissions produced in preparing a GHG inventory. On the other hand, **net emissions** refer to the figure obtained when considering GHG emissions minus the removals by sinks (i.e., stored in forests and soils) (Bernoville, 2022; Levin et al., 2023).

The concept of **net-zero emissions** became more consistently used after the IPCC's (2018a) *Global Warming of 1.5°C Special Report*. When analyzing the collective effort required to achieve the 1.5°C goal set in the Paris Agreement, the IPCC established that net-zero emissions should be achieved globally by 2050; by that time, anthropogenic emissions should be balanced out by anthropogenic removals. This means that total emissions produced are balanced with total removals of GHG. This definition does not provide any details on *how* net-zero emissions can be achieved or the role that specific policies and instruments (such as offsets or carbon markets) could play. The net-zero emissions goal has been adopted as an objective for climate action to limit global temperature increase. It is also a term now adopted by the Science Based Targets initiative (SBTi) to provide a common definition for more consistent and more impactful net-zero targets. At the industry level, companies must achieve reduction levels consistent with net-zero emissions pathways that limit warming to 1.5°C in their operations and throughout their value chains (SBTi, 2023).

Carbon neutrality as a concept has been around for a while. It emerged in the early 2000s, and by 2006, it became so common that the *New Oxford American Dictionary* selected "carbon neutral" as its Word of the Year (Oxford University Press, 2006). Thereafter, carbon neutrality involved estimating your carbon footprint, reducing it as much as possible, and balancing it by buying offsets (from emissions reductions or carbon removal projects—i.e., by planting trees or using technologies such as wind and solar power) (Bernoville, 2022).

Since then, definitions of carbon neutrality have emerged and evolved with differences depending on their scale (i.e., global, country and organization level) and their associated carbon emission mitigation actions. In 2022, IPCC provided a more detailed definition of carbon neutrality in its glossary as a "condition in which anthropogenic carbon dioxide (CO_2) emissions associated with a subject are balanced by anthropogenic CO_2 removals"[1] (IPCC, 2022a). It indicates that carbon neutrality can be attained by subjects such as countries, organizations, or events and usually considers direct (Scope 1 and 2) and indirect (Scope 3) CO_2 emissions.

However, the IPCC acknowledges that carbon neutrality can also be reduced to processes under the control of the organization (i.e., Scope 1 and Scope 2 emissions) for a given period under the guidelines of specific carbon-neutral schemes (IPCC, 2023). Additionally, it clarifies that at the global level, the terms carbon neutrality and and net-zero CO_2 emissions are equivalent (see the definition above). However, at the country or company level, these terms are not exactly equivalent because "net-zero CO_2 emissions" applies in general to processes (emissions and removals) under the control of the reporting organization (Scope 1 and 2), while "carbon neutrality" generally includes processes beyond their control (Scope 3). Finally, it mentions that in some cases, to achieve carbon neutrality, entities require the supplementary use of offsets.

Lastly, **climate neutrality** is a more recent concept in this context. In 2018, the IPCC defined it as a state in which human activities have no negative impact on the climate system by balancing residual emissions with emission removals (IPCC, 2018a); nevertheless, this definition does not include the use of offsets as a means to achieve it.

Perhaps the most functional definition distinguishing between carbon neutrality and climate neutrality is provided by the UNFCCC's initiative Climate Neutral Now.[2] The IPCC's definitions indicate that to achieve climate neutrality, after implementing emissions-reduction actions, stakeholders' residual emissions must be compensated by offsets removing GHGs in the long term (UN Climate Change, 2022a). On the other hand, "carbon neutrality" implies that a given stakeholder (individual, organization, company, or country) has undertaken efforts, first, to reduce emissions and, second, to compensate residual emissions with offsets from projects that contribute to reducing emissions or temporarily capturing GHG emissions.

Finally, there are other differences related to the GHGs covered in each concept. Thus, carbon neutrality is the result of reducing and offsetting emissions exclusively from carbon dioxide, while climate neutrality also includes reducing and offsetting other GHG emissions (CLEAR Center, 2020). It is necessary to clearly identify the definition of the terms used in each context.

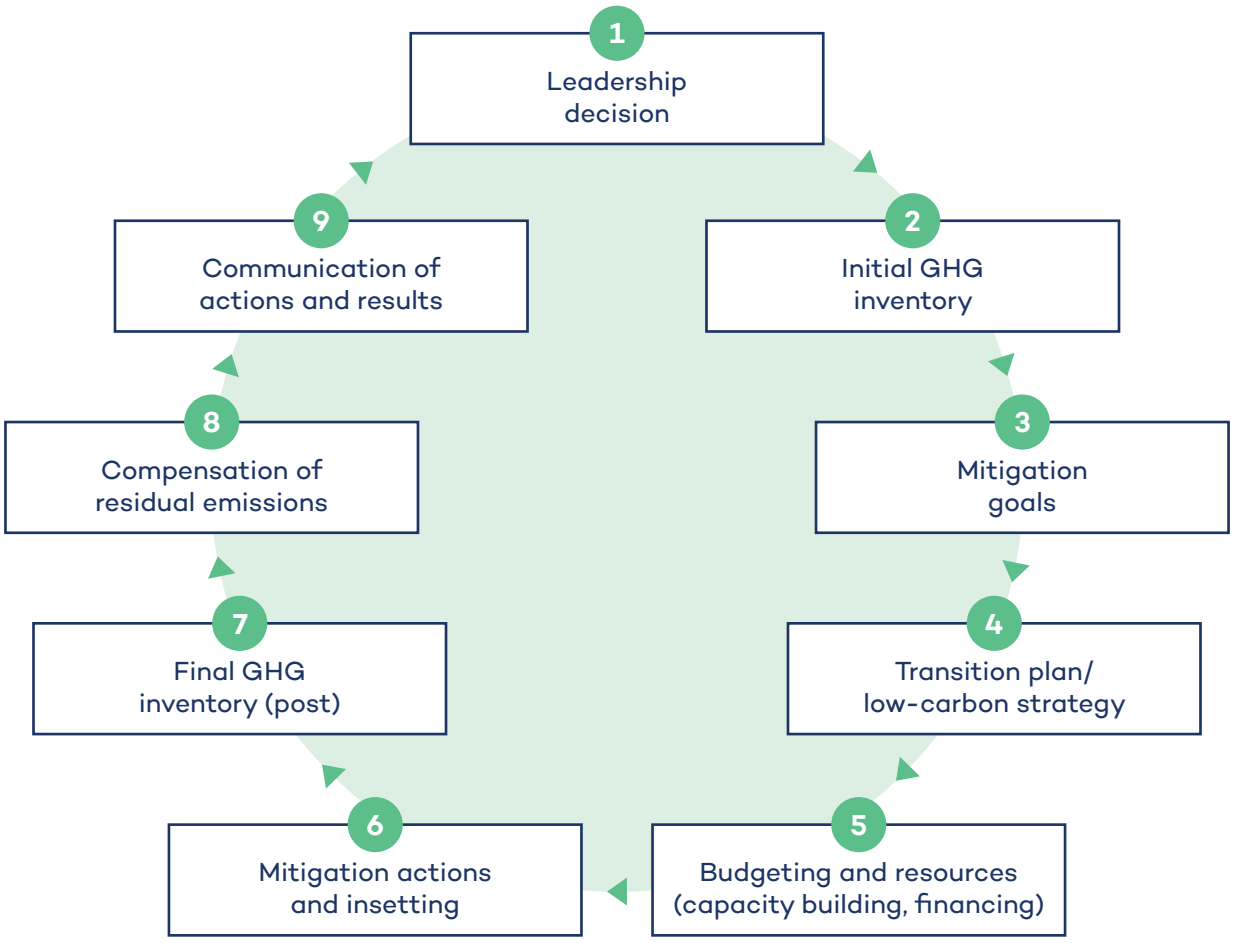
[1] Similarly, GHG neutrality implies a balance in anthropogenic GHG emissions and anthropogenic GHG removals.

[2] At the time of writing, Climate Neutral Now was operational, but as of July 2023, the UNFCCC is in the process to phasing it out.

1.3 Conceptual Framing of Organizational Carbon Management

Most voluntary private climate action is focused on GHG emissions from Scope 1 and Scope 2 since those emission sources are generally directly under the control of organizations. Even for Scope 2 emissions, companies can reduce electricity consumption or, when necessary, rely on renewable sources.[3] Comprehensive actions to reduce Scope 3 emissions require innovative ways to monitor, report, and cut indirect emissions along corporate value chains, many of which are in developing countries (see Box 2) (UNFCCC, 2021c; World Business Council for Sustainable Development [WBCSD], 2022). Requirements for reducing Scope 3 emissions, which for many businesses account for more than 70% of their carbon footprint, remain voluntary (Carbon Trust, 2020b; Greenhouse Gas Protocol, 2016).

Figure 1. Typical phases of corporate carbon management



Source: Authors' elaboration.

[3] Pursuant to the Glasgow Climate Pact of the Paris Agreement, companies are required to report Scope 1 and 2 emissions, while Scope 3 emissions are voluntary (see definition of scopes in Box 2).

Box 2. Scopes of emissions

There are three different scopes to clarify the level of influence and control each company has over its emissions:

Scope 1: Direct emissions that occur within the control of the reporting entity or company. These usually include emissions from the combustion of fuels in mobile and fixed sources and fugitive or unintentional emissions.

Scope 2: Indirect emissions from the generation of purchased energy electricity, heat, steam, and cooling.

Scope 3: All indirect emissions (not included in Scope 2) that occur in the value chain of the reporting company, including upstream and downstream emissions. Upstream emissions are associated with the extraction of raw materials, production, processing, and transport of goods, materials, and services used by the reporting entity. Downstream emissions from all the activities occur outside the control of the company after delivering their goods or services to consumers. They include emissions from the distribution, storage, transport, packaging, sale, use, and disposal of products; emissions from the management of any waste produced as part of the operations of the reporting company; transport emissions from clients and workers; and business trips.

Source: Greenhouse Gas Protocol, 2016.

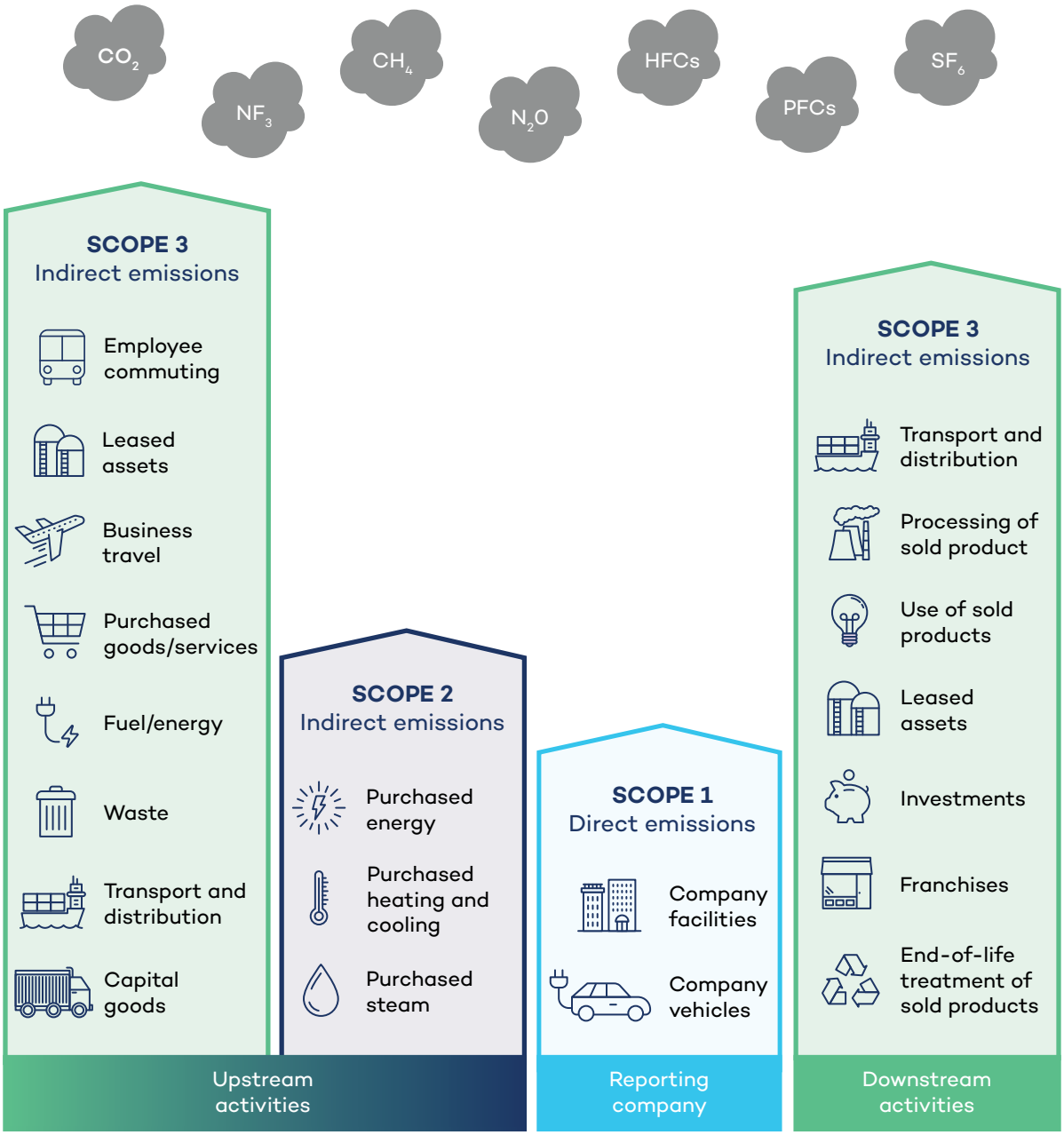
For instance, reducing and reporting Scope 3 emissions is optional under the leading GHG Protocol Corporate Standard (See Section 5.1.4). To account for Scope 3 emissions, companies may choose to additionally report in conformance with the GHG Protocol Scope 3 Standard (Carbon Trust, 2020b; Greenhouse Gas Protocol, 2016).

On top of voluntary reporting, net-zero commitments have increased in the past years. As of 2021, about 21% of the world's largest companies were committed to net-zero, representing nearly USD 14,000 billion in sales (Energy and Climate Intelligence Unit, 2021).

Actions to reduce emissions and manage carbon in the private sector can follow a typical iterative and cyclical pattern. Figure 1 portrays an ideal and sequential approach, but we recognize that corporate action can follow different paths.

There is usually an initial leadership decision to initiate the process to reduce and mitigate carbon emissions. In the next step, the company prepares an initial inventory of GHG emissions. The inventory information is used to identify and assess opportunities and challenges to reduce emissions at the company level (Scope 1 and Scope 2) or across the value chain (Scope 3). Preparing a complete inventory implies collaboration with other actors in their supply chain to reduce Scope 3 emissions; for instance, through insetting (see Section 3.4.2). The next step for a company is adopting ambitious mitigation goals, such as reducing emissions, becoming carbon-neutral, or aligning to net-zero.

Figure 2. A representation of emission processes by Scope 1, 2 and 3



Source: GHG Protocol, 2019.

Then, the company might set a transition plan or a strategy for low-carbon emissions. The best practices indicate that these plans should set short-, medium-, and long-term goals for emissions reductions aligned to scientific information (e.g., according to emissions pathways consistent with the 1.5°C target) (SBTi, 2021).

For the successful implementation of a plan, it is necessary to assign the appropriate resources to yearly budgets and include the necessary investments and capacity building of employees and suppliers. Once the company has adopted mitigation goals and has defined an investment and implementation plan, it will implement mitigation actions and strategies. After implementation, the company periodically elaborates GHG inventories; ideally, these are prepared and reported yearly to update emissions figures and evaluate mitigation actions' effectiveness (UN, 2022). All the emissions that cannot be reduced and are registered in the final or ex-post inventory are called residual emissions. Companies can compensate for residual emissions above their emission-reduction targets (UN, 2022) by purchasing offsets from certified projects in the voluntary carbon market (VCM).[4] At the end of the yearly cycle, the company writes a report of the climate mitigation actions implemented in the period and the results obtained to report to the leadership and, thus, re-evaluate the needs and goals for the next implementation period.

Different types of organizations (e.g., public or private, national or international) establish VSICMs as guidelines for generating, reporting, registering, or certifying certain activities or processes related to climate action. Many measures and tools are included under the term VSICMs, such as standards,[5] methodologies, and initiatives. Companies, organizations, or individuals can use them in their climate change mitigation actions or those of their suppliers for different purposes; in this work, we group these purposes into four categories:

i) Preparing GHG inventories and measuring carbon footprints (Type 1)

ii) Formulating, registering, and certifying carbon offset projects for trading carbon certificates (Type 2)

iii) Reporting or disclosing advances in climate actions (Type 3)

iv) Certifying or registering products, activities, facilities, or services as carbon neutral[6] (Type 4).

As VSICMs are implemented on a voluntary basis, a company may not necessarily use all of them at the same time. However, suppose a company sets a goal of being carbon neutral and, thus, works under a carbon-neutrality standard. In that case, the company may first need to work with a standard to prepare a GHG inventory and may also buy offsets in the VCM using other standards or initiatives.

[4] VCMs refer to platforms or systems where individuals, organizations, or companies can purchase carbon credits or offsets voluntarily to compensate for their own GHG emissions or support emissions reduction projects. These markets operate independently of mandatory compliance programs, such as government-mandated emissions trading schemes.

[5] The United Nations Forum on Sustainability Standards (2013) defines voluntary sustainability standards as "specifying requirements that producers, traders, manufacturers, retailers or service providers may be asked to meet, relating to a wide range of sustainability metrics, including respect for basic human rights, worker health and safety, environmental impacts, community relations, land-use planning and others." The standards can focus on products or on other stages of supply chains, from processing methods to transportation and product end-of-life.

[6] As mentioned in Box 1, some actors make a distinction between carbon neutrality and climate neutrality, where climate neutrality refers to the emission and mitigation of all GHGs (not only carbon). However, for the purposes of this report, we use the term "carbon neutrality" to refer to standards for which certifications are either carbon or climate neutral.

The four types of VSICMs integrate the cycle of corporate carbon management as follows:

- Companies usually use the first type of VSICMs to prepare GHG inventories (Type 1), which inform and facilitate the operative initiation of the corporate carbon management cycle (Step 2). The results of inventories inform leadership decisions and set the reference for defining carbon reduction and mitigation strategies. GHG inventories should also be prepared after mitigation actions are implemented—ideally, every year (UN, 2022)—to evaluate their performance and estimate residual emissions (Step 7). However, it must be acknowledged that this process is not followed in all cases as described in the diagram (for instance, a company can elaborate an initial GHG inventory after setting mitigation goals).
- As a company moves forward in its corporate carbon management cycle, it will implement mitigation actions within its own activities (i.e., Scopes 1 and 2) and through the supply chain (i.e., Scope 3, through insetting, for example). Once the company has met its emission-reduction goals, it may buy offsets to compensate for residual emissions (Type 2) (Step 8). In this step, the company can consider different offset options from projects in different locations, implementing different activities and using different certification standards. The life cycle of available carbon offset projects in VCMs (i.e., issuance, trading, and retirement)—see Section 4 for more details—occurs as a previous process in Step 8 to enable the company to choose from different options. Actors external to the company—developers of carbon offset projects—mainly use specific VSICMs within the VCM to estimate emissions and carbon offsets to trade. However, by purchasing offsets, a company will use Type 2 VSICMs, as described in this work.
- The company can disclose or report its advances on carbon management or, more broadly, climate action to voluntary reporting platforms; we identified these initiatives as Type 3 VSICMs. The whole process for advancing in the corporate carbon management cycle is often initiated to motivate the leadership to report actions and results to one of these platforms (Step 9).
- Finally, the fourth type of VSICMs covered here are those for obtaining carbon-neutral certification (Type 4). We identify the use of these standards at the end of Step 9, as this process requires implementing the previous steps. Nevertheless, companies can initiate working on carbon-neutral certification while implementing other phases.

According to the IPCC, mitigation goals and strategies aligned to net-zero emissions targets require companies to reach net-zero emissions as soon as possible and no later than 2050 to limit the temperature increase to 1.5°C (IPCC, 2018b) (Box 1). This commitment shapes actions in steps 1–6 as the company needs to prepare GHG inventories and implement ambitious strategies to reduce its emissions directly before considering and compensating for unabated emissions (e.g., UN, 2022).

2.0 The Drivers for Private Climate Action and Adoption of VSICMs

Drivers for a carbon-neutral future are multiple and varied, emerging in part from an increasingly dynamic collaboration among actors from the public and private sectors as well as civil society to meet GHG emission-reduction targets under the UNFCCC's Paris Agreement on climate change.

The development of a broad range of VSICMs has followed the evolution of global climate action. Under the framework of the Paris Agreement, state and non-state actors (private sector and civil society organizations) are defining measures and tools to support their climate mitigation actions. This multistakeholder approach intrinsically involves a broader number of actors and initiatives in the agreed-upon common goal of attaining net-zero by 2050. The current emerging scenario for private–public partnerships—for example, implementing carbon offset schemes—illustrates this approach. It is clear that enhanced private sector and civil society involvement and leadership, alongside government intervention, is needed to address the challenges of mitigating and reducing GHG emissions (WBCSD, 2022).

Momentum toward net-zero[7] is evident and accelerating, with GHG reduction commitments expanding almost six-fold since 2019 to encompass more than 90% of global emissions (Climate Action Tracker, 2021). Furthermore, financial institutions, accounting for more than USD 130,000 billion in capital, have pledged to manage their assets to maintain global warming below the Paris Agreement target of 1.5°C (Birchan et al., 2022; Glasgow Financial Alliance for Net Zero [GFANZ], 2021; NewClimate Institute & Oxford Net Zero, 2022). Interestingly, the COVID-19 pandemic has often deepened, rather than deflected from, commitments to climate action. The private sector, consumers, and financial institutions have been pushing for green economic recovery plans that incentivize climate innovation and investment (Carney, 2022; Robins, 2020). Nevertheless, there is evidence that economic recovery packages have been a missed opportunity to advance the climate agenda concretely (Sanchez, 2021; UN Environment, 2022). While some private sector actors increasingly commit to reducing their GHG emissions, others forge ahead with business as usual. Small and medium-sized enterprises, for instance, cannot access equitably the options available to reduce their carbon emissions through global and national initiatives, such as the UNFCCC, government, or voluntary programs (United Nations Conference on Trade and Development, 2022).

Scientific information has been a significant driver of climate action and the formation of VSICMs at all levels. The recent IPCC report summarizes the latest scientific understanding of climate impacts, vulnerability levels, and adaptation needs while highlighting justice and equity considerations, as well as the action needed to build resilience (IPCC, 2022c). The cumulative scientific evidence assessed by the IPCC is unequivocal: climate change threatens human well-being and planetary health. Without decisive action on mitigation, there is a rapidly closing window of opportunity to secure a livable and sustainable future for all (IISD, 2022).

[7] The United Nations Race to Zero represents 5,235 businesses and 441 of the biggest investors in its drive to incentivize the private sector to cut emissions to net-zero by 2050 in line with the Paris Agreement.

Below, we elaborate on specific drivers of private climate action and the use of VSICMs, including regulations, particularly carbon pricing initiatives, corporate policies and programs, investment strategies from financial service providers, and consumer behaviour.

2.1 Regulations

Governments have established different regulations to address climate issues. Climate action is divided between mitigation and adaptation efforts. Mitigation efforts relate to policies and actions to reduce carbon emissions and increase carbon removals by sinks. Adaptation is the process of adjusting to current climate change impacts. Loss and damage refer to the destructive impacts of climate change that cannot be or have not been avoided through either mitigation or adaptation (Liao et al., 2022).

Regarding climate mitigation, most countries have enacted domestic legislation to limit emissions in accordance with their international climate commitments under the Paris Agreement on climate change. The United Kingdom and Mexico were among the first countries to enact national climate change laws in 2007 and 2008 (Vance, 2012). Since then, countries have enacted 2,891 national and subnational climate regulations globally (Climate Change Laws of the World, 2022). Nationally determined contributions (NDCs) are at the heart of the Paris Agreement and are driving action to reach net-zero by 2050 (see Box 3). NDCs embody efforts by each country to reduce national GHG emissions and adapt to the impacts of climate change. Each party to the Paris Agreement must establish an NDC and update it every 5 years. So far, 193 parties to the Paris Agreement have issued at least a first NDC; 151 parties had communicated a new or updated NDC as of November 2021 (UNFCCC, 2022a). The quality and ambition of NDCs vary significantly for many reasons, including a lack of adequate finance and capacity and, in some cases, insufficient political commitment. The pandemic-related economic downturn is estimated to have also constrained the implementation of NDC plans (OECD, 2020; UN Climate Action, 2022).

Furthermore, there are other emerging climate-related regulations, such as those targeting deforestation, that could impact voluntary actions. For instance, the European Union [EU] Regulation on Deforestation-free products (European Commission, 2023) aims to reduce carbon emissions caused by the EU's consumption and production of relevant commodities (such as palm oil, coffee, and soy). This could impact whole supply chains and each supply chain actor's actions to reduce carbon emissions derived from deforestation without compromising their European market (World Trade Organization, 2022). However, many challenges remain regarding this regulation's implementation, such as the indirect impacts on forest supply chain stakeholders, particularly for producing countries and their large share of small producers (Oeschger, A., 2022; Spencer, 2023).

Additionally, measures and policies are promoted to reduce emissions and increase carbon removals by sinks. Different regulations and policy instruments used for these purposes include command and control policies (e.g., prohibition of selling new internal combustion vehicles by 2025

Box 3. GHG inventories and the UNFCCC

Under the UNFCCC, parties to the agreement are required to prepare national communications on the activities implemented under the convention, including national GHG emissions inventories and removals by sinks. Countries prepare these inventories following the methods and guidelines published by the IPCC (e.g., IPCC, 2019b), and inventories are updated every 2 years. As part of activities to implement the convention, countries have enacted national legislation and regulations (e.g., in GHG emissions registries or as part of emissions trading systems). Governments often require specific companies—for instance, of a given size or sector—to report their carbon emissions annually according to specific methodologies. This can be the first driver for companies to prepare their inventories. In Mexico, organizations emitting more than 25,000 tonnes of carbon dioxide equivalent (tCO_2e) per year are obliged to report their direct emissions to the Ministry of Environment annually (Secretaría de Medio Ambiente y Recursos Naturales, México, 2022). This information is used as a reference to monitor mitigation efforts and contributions to emission-reduction goals.

in Norway [Staufenberg, 2016]), taxes on carbon emissions, and market-based mechanisms, such as emissions trading schemes. Below, we discuss how these policy instruments incentivize the use of VSICMs, notably the generation and use of carbon offsets.

2.1.1 Carbon Taxes

Carbon taxes are a particular type of regulation that increases the cost of emissions to companies for them to consider implementing mitigation efforts to reduce their costs. The higher the tax, the higher the incentive to reduce emissions and invest in alternatives to low/zero emissions. Carbon taxes stimulate companies to inventory their GHG emissions, analyze their mitigation options, and, when allowed, consider the purchase of carbon offsets.

Emissions reductions associated with taxation depend significantly on the level of taxes imposed and the sector being regulated. For instance, in British Columbia, Canada, the introduction of a carbon tax may reduce transportation emissions by 5%–19% (Pretis, 2022). Emission reductions can only be estimated ex-post when emission trends can be measured through successive inventories and linked to the effects of taxation.

The tax creates a new source of income for governments. Carbon tax revenues could be used to invest in mitigation projects. In some cases, however, a carbon tax is only an additional measure to fund the general public budget (Piquero et al., 2021).

There were 38 carbon pricing instruments at the national or subnational level (carbon taxes and emissions trading systems [ETSs]), covering less than 4% of global carbon emissions in 2022; this includes countries such as Argentina, Canada, France, South Africa, and Uruguay (World Bank, 2022). Carbon tax levels in 2022 ranged from USD 1.03 to USD 137 per tCO_2e (World Bank, 2022). According to the World Bank, global

carbon pricing revenue increased by almost 60% from 2020, reaching around USD 84 billion in 2021. The increase contributes to financing sustainable economic recovery programs, broader fiscal reforms, or investing in communities as part of the low-carbon transition (World Bank, 2022).

Some countries, such as Colombia and Mexico, have created hybrid systems in which carbon taxes and offsets coexist (Piquero et al., 2021). In these schemes, a regulated company can decide to pay the tax or buy offsets from authorized certification schemes as an alternative to paying the tax. These mechanisms were developed to incentivize the demand for offsets after 2012, when it was at historically low levels, and to provide flexibility to comply with evolving tax requirements (Kainou, 2021; World Bank, 2022).

2.1.2 ETS and Cap and Trade

Another regulation that drives the implementation of climate action is "cap and trade" or ETS. In ETS, governments limit the emissions of regulated companies and sectors by capping the annual emissions that can be produced. The cap is based on GHG emission registries and inventories for regulated sectors. Thus, the quality and completeness of inventories have a significant influence on the effectiveness of ETS.

Year after year, the cap is set lower than the expected emissions in the baseline scenario (e.g., it can be designed to lower emissions by 10% annually). Each year, the total number of permits issued is equivalent to the emissions established by the cap. Permits can be given for free to regulated entities (grandfathering) or auctioned. At the end of the period, the authority verifies that the regulated entities possess a number of permits equivalent to the emissions they have generated and reported. Entities that fall short have to pay a fine or may receive fewer permits in the future.

As there are fewer permits compared to the demand of regulated companies, firms are incentivized to cut emissions and avoid penalties. Companies are allowed to trade their permits, which creates incentives for companies with more efficient opportunities to reduce emissions at a lower cost. These companies can trade permits at a profit to other regulated entities that emit more emissions and have higher mitigation costs. The price of the permits is dynamic and depends, among other things, on their relative scarcity of permits, the mitigation costs, and penalties. In certain jurisdictions, ETS can allow regulated companies to use carbon offsets from specific certification programs instead of permits to demonstrate compliance with emissions caps. Operational rules in each case define the maximum number of offsets that can be used by companies.

The firms regulated by ETS will conduct internal assessments to define their strategy regarding how many permits to buy and at what cost, which mitigation actions they will undertake in their operations, and whether they can profit from selling permits or buying offsets. These systems can create new revenue streams for governments through the auctioning of permits, but as in the case of carbon taxes, there is no guarantee that these resources will be used in mitigation projects.

For example, the EU Green Deal raises concerns that higher carbon prices could make emission-intensive industries (such as cement, aluminum, iron, and steel)

less competitive in international markets. This could result in carbon leakage, where dirtier production abroad replaces EU industry products and global emissions increase. In December 2022, the EU agreed on a landmark tool, the Carbon Border Adjustment Mechanism (CBAM), to put a price on the carbon emitted during the production of carbon-intensive goods that enter the EU and to encourage cleaner industrial production in non-EU countries. The gradual introduction of the CBAM is aligned with the phase-out of the allocation of free allowances under the EU ETS in order to support the decarbonization of EU industry and address carbon leakage, which occurs when companies based in the EU move carbon-intensive production abroad to countries where less stringent climate policies are in place, or when EU products get replaced by more carbon-intensive imports.

By confirming that a price has been paid for the embedded carbon emissions generated in the production of goods imported into the EU, the CBAM aims to ensure that the carbon price of imports is equivalent to the carbon price of domestic production and does not undermine EU climate objectives (Xiaobei et al., 2022). Similar to the EU regulation on deforestation-free products, the CBAM, if implemented correctly, could have unique positive impacts. However, its implementation could bring unintended consequences, particularly to developing countries that rely heavily on exports to the EU. For instance, Mozambique's economy could shrink by 2.5% due to a drop in demand for carbon-intense products (Xiaobei et al., 2022). The CBAM and other recent developments, such as the recently launched loss and damage fund, are intrinsically linked to the historical and ongoing conversation surrounding North–South imbalances within both multilateral environmental (UNFCCC) and trade (World Trade Organization) negotiations (Liao et al., 2022).

2.2 Corporate Policies and Programs

A company can be motivated to create a comprehensive climate mitigation strategy for many good reasons. First and foremost, the private sector operates in the context of regulatory frameworks; hence, voluntary measures to reduce GHG emissions are undertaken in anticipation of increasingly vigorous regulations. Second, as a financial motivation, reducing carbon emissions can lower costs and increase resource use efficiency. For instance, companies measuring their carbon footprint can reduce their electricity consumption by 5% to 25% per million dollars of revenue (Boukherroub et al., 2017). Third, consumers are increasingly aware of how different industries contribute to climate change. This awareness has created demand and public pressure for accountability and transparency in emissions and the accountability of actors but also, most importantly, in how they act and drive change. Global facts inform consumer awareness. For instance, the World Economic Forum ranks failure to mitigate and adapt to climate change, natural disasters, and extreme weather events as the top corporate risks over the next 10 years (Markovitz, 2022)

The private sector is starting to lower and report GHG emissions across supply chains to reach net-zero emissions by 2050 (Climate Action 100+, 2021). Private sector zero-carbon initiatives have the potential

to increase revenues, lower operating costs, engage stakeholders, minimize regulatory and legal interventions, and mitigate climate risks. This is in addition to diversifying low-carbon business strategies (i.e., energy efficiency, reuse and recycle materials) and continuing to create jobs and support local communities (i.e., supporting carbon removals through reforestation).

The private sector is exploring proactive, climate-neutral strategies that are often more economical and create innovative green opportunities while reducing GHG emissions throughout global supply chains (WBCSD, 2022). For example, companies are improving energy efficiency and using more renewable energy, which is becoming more competitive than fossil fuels, especially given government incentives to phase out fossil fuel subsidies, rising fossil fuel prices, and growing consumer awareness and demand (Climate Policy Initiative, 2021; International Energy Agency [IEA], 2021b; Wooders et al., 2019). Research finds that broader corporate social responsibility policies and practices, which can include climate mitigation strategies, can significantly lower operating expenses (e.g., reducing energy and water consumption) by as much as 60% (Henisz et al., 2019). In addition, global firms such as Unilever report that demonstrating a commitment to corporate social responsibility allows them to become sustainability leaders and attract more talented employees (GlobeScan & The SustainAbility Insitute, 2022).

According to the Taskforce on Scaling Voluntary Carbon Markets (TSVCM), voluntary actions supporting decarbonization are growing and need to increase 15-fold by 2030 and 100-fold by 2050 compared with 2020 levels to meet net-zero targets (Blaufelder et al., 2021; TSVCM, 2021). Driven by net-zero corporate commitments and growing interest in carbon markets to achieve the Paris Agreement climate goals, transactions in the VCM rose 60% from 2020, reaching a value of nearly USD 1 billion in 2021, with traded credits from projects in 80 countries (Forest Trends, 2021). Purchasing carbon offsets is one way for the private sector to advance toward climate neutrality and contribute to compensating voluntary Scope 3 emissions reductions in the context of Article 6 of the Paris Agreement (South Pole, 2021). The UN estimates that transitioning to net-zero depends on developed countries realizing their commitment under the Paris Agreement to provide developing countries USD 100 billion in climate finance (UN Climate Action, 2022). Purchasing carbon offsets could be a way to materialize this commitment.

2.3 Investment Strategies

Investors recognize their role in committing to and promoting strategies to achieve a low-carbon, net-zero global economy. Given the unprecedented pace and scale required to reach net-zero, investments in climate mitigation are vital. Responsible investment strategies increasingly consider environmental, social, and governance factors when selecting portfolios (Global Sustainable Investment Alliance, 2021). Stockholders are demanding accountability toward more profitable investments that aim to protect the climate, environment, and social well-being, which motivates action in the private sector. Research shows that sustainability and business profitability can go hand in hand, whereby proactively addressing social and environmental risks can provide a competitive

advantage, improve brand recognition, put businesses ahead of regulatory developments, and contribute to reducing GHG emissions (WBCSD, 2023). Moreover, consumer demand for more sustainable goods and services is estimated to be nearly four times higher than the average market growth for conventional products (Gatzer & Magnin, 2021; Henisz et al., 2019).

Climate change poses risks and offers opportunities for investors. More than half of the global economic output, USD 44,000 billion, is moderately or highly dependent on nature (Task Force on Nature-related Financial Disclosures, 2022). Risks are reduced by aligning industry-wide standards with net-zero targets to accelerate climate action across the board (TSVCM, 2021). Global initiatives have spearheaded the increasing transparency and availability of information to incentivize investors to consider climate change impacts on financial performance, risk management, and asset allocation decisions (Carney, 2022; Climate Accountability Institute, 2020).

Sustainable investments are a major force shaping global capital markets and influencing how capital is being raised and scrutinized (Bertram et al., 2021; Network for Greening the Financial System, 2022). For example, GFANZ, which unites 160 banks representing USD 70,000 billion in global financial system assets, illustrates the commitment to transitioning lending and investment portfolios to net-zero emissions by 2050 (GFANZ, 2021; United Nations Environment Programme [UNEP], 2022).

Transforming the energy sector, which underpins global economic prosperity, is at the core of the net-zero transition, as the sector is responsible for 75% of global GHG emissions. Considering the capital-intensive nature of the transition to net-zero, the UN Taskforce on Climate-related Financial Disclosures considers the sustainable energy transformation daunting because it requires significant investments, almost at the scale of the industrial revolution, and rapid actions, almost at the speed of the digital transformation (Wolf, 2021b). To this end, the IEA estimates that getting on track for net-zero by 2050 will require clean energy investments of around USD 4,000 billion annually by 2030 (IEA, 2021a, 2021b), with emerging carbon markets in developing countries estimated to require around a fourth of this investment (USD 1,000 billion per year) to stay on track with net-zero (Bhattacharya & Stern, 2021; Carney, 2022).

Transitioning to a net-positive carbon economy must be underpinned by supportive public policies and financial frameworks to reduce risks and enhance collaboration. That is why regulatory and policy drivers, such as sustainable finance disclosure regulations, also influence global investment markets, requiring investors, asset managers, and advisers to report on and incorporate climate risks in their investment portfolios (Task Force on Climate-related Financial Disclosures, 2022; Taskforce on Nature-related Financial Disclosures, 2022). Investors are increasingly orienting their decisions toward carbon-neutral investments, given the risks involved with continuing to overlook carbon externalities that contribute to GHG emissions (Enders Analysis, 2022; Worldwide Fund for Nature [WWF], 2019).

Investors are also untapping credit to finance carbon-neutral projects. For instance, investment vehicles that target carbon-

neutral initiatives and well-functioning carbon markets can potentially bring billions in capital toward net-zero projects and investments. Scaling up carbon markets may result in a growth of USD 5 billion to USD 50 billion by 2030 (TSVCM, 2021). As stockholders and investors base investment decisions on environmental efficiency and climate neutrality, a review published in 2021 finds that global sustainable investment assets continue to grow, reaching USD 35,300 billion in five major markets—an increase of 15% between 2018 and 2020 (Global Sustainable Investment Alliance, 2021).

The financial sector is driving climate action because investors require that the long-term risks (related to environmental externalities) are managed to protect their long-term investments (de-risking), especially the risks associated with Scope 3 emissions. If Scope 3 emissions are not disclosed, they can become hidden risks for investors (Thornton, 2021). An example, among many, of how a company can encourage its suppliers to disclose their GHG emissions comes from Moody's Corporation, which uses webinars and other activities to help its suppliers set more ambitious emission-reduction targets and participate in disclosure initiatives. By encouraging its suppliers, Moody's Corporation supports efforts to de-risk its supply chain and advance toward its net-zero goal (Cummings, 2022).

Furthermore, Scope 3 emissions data must be consistent, reliable, and comparable so investors know that the companies they invest in are fulfilling their net-zero pledges. This lack and inconsistency in data can hinder achieving climate mitigation goals across sectors. A study by Accenture and the UN in the years 2021–2022 found that 63% of chief executive officers said difficulty measuring environmental, social, and governance data (which include GHG emissions) across their value chain was a reason for not advancing their sustainability strategies (Accenture & UN Global Compact, 2021).

Innovative financial mechanisms, including de-risking instruments and a broader investor base, are deemed essential to spur low-carbon investment, especially in emerging and developing countries, so that investors who wish to deploy capital in these countries can overcome a myriad of constraints, including high upfront costs and long time frames associated with climate investment, a lack of liquid markets, foreign exchange risk, and the scarcity of scalable projects (Li, 2023). Overcoming these obstacles requires a change of mindset—from the public, private, and multilateral institutions—to redesign the global financial architecture to attract private finance to climate projects.

2.4 Consumer Preferences and Behaviours

While firms are responsible for the carbon footprint of the goods they produce and the services they offer, consumers are increasingly demanding greater corporate accountability (Owen-Burge, 2021). Public campaigns to promote consumer environmental responsibility and awareness stimulate clean innovation, especially in more competitive markets (Stern & Valero, 2021). End consumers around the globe are becoming increasingly aware of the linkages between GHG emissions and an unstable climate that causes erratic weather patterns and climatic extremes. This understanding motivates the adoption of lower-carbon-footprint

lifestyles and consumption patterns, which are also often more economical (UNFCCC, 2022b; Wynes & Nicholas, 2017). Support for climate-friendly policies is also growing. For example, a recent survey found that two thirds of respondents in the United States backed the introduction of a carbon tax (Carbon Tax Center, 2021).

For purchasing power to drive decarbonization, consumers need reliable information on the carbon footprint of goods and services (Carbon Trust, 2020a). Consumer choices can shift markets toward more sustainable alternatives. A global Carbon Trust survey found that two thirds of consumers are ready to change their lifestyles to reduce their environmental impact (Carbon Trust, 2020a). For example, consumers can reduce their carbon footprint by adopting low-carbon, climate-friendly diets, which is particularly important as agri-food systems (which include on-farm production, associated land-use changes due to deforestation, fertilizer manufacturing, food processing, packaging, retail, household consumption, and food waste disposal) accounts for about 30%[8] of global GHG emissions (Carbon Trust, 2020a; Organisation for Economic Co-operation and Development [OECD] & Food and Agriculture Organization of the United Nations, 2021). Another survey finds that around 70% of consumers of products from the automotive, building, electronics, and packaging sectors, among others, would pay a premium for green goods (Gatzer & Magnin, 2021). Moreover, the COVID-19 pandemic showed that more sustainably responsible companies tended to respond better to market and climate disruptions (WBCSD, 2020).

Consumer demand and spending are crucial drivers to incentivize the private sector and investors to account for and reduce GHG emissions throughout their supply chains and investment portfolios. Consumers increasingly understand that climate change is an urgent global challenge that stems from and undermines the current economic growth model. This model poses major systemic risks to our future well-being and threatens sustainable development worldwide, especially for climate-vulnerable developing countries facing increasingly frequent extreme weather disruptions (Gould, 2022; IPCC, 2022b, 2022c). In addition, the COVID-19 pandemic, exacerbated by the war in Ukraine, has dramatically affected the delivery of global climate goals, highlighting our reliance on natural capital and integrated global supply chains to maintain quality of life (Husain, 2022; Muggah, 2022; OECD & Carbon Trust, 2020; OECD & Food and Agriculture Organization of the United Nations, 2021; Wolf, 2021a).

Building climate resilience is imperative. It will require consumers to make more sustainable choices supported by goods and services with transparent and smaller environmental footprints. Consumers are increasingly concerned with lowering GHG emissions and sustainable sourcing of raw materials along the agricultural supply chain. This means the private sector will have to continue to assume greater corporate sustainability along the supply chain.

[8] Agriculture alone accounts for 12% of total GHG emissions, but when looking at the entire supply chain, we notice that the impact of growing food, in terms of emissions contributing to global warming, is larger. This is an example of the importance of incorporating Scope 3 emissions into GHG inventories.

3.0 The Cycle of Corporate Carbon Management

This section describes the steps private actors can follow to reduce their carbon emissions to mitigate climate change. We describe how different steps and decisions are nested and enable a comprehensive and systemic approach to implementation, as well as in which steps VSICMs can be used. Figure 4 presents the typical steps included in developing a corporate carbon management strategy. Companies undertake the steps in blue, while boxes in red are activities that occur in the VCM and are carried out by other actors, mainly carbon offset project developers.

The process is iterative, and not all companies may follow the entire cycle. For instance, some companies may not seek carbon-neutral certification, and thus, their cycle would go from 1 to 8. Others may not address residual emissions and thus would shorten their cycle from steps 1 to 7. The following sections briefly describe each step in the private carbon management cycle.

3.1 Leadership Decision

Meaningful implementation processes ideally start when the management of a company decides to adopt a climate mitigation policy and acts accordingly, for instance, to align its operations to net-zero emissions (e.g., UN, 2022) or to minimize climate-related risks (e.g., OECD, 2018). As noted in the previous sections, companies can be driven by legal requirements (e.g., carbon taxes or an ETS), corporate requirements (e.g., by stockholders or investment groups to reduce climate exposure), or prospects to increase revenue and market share. In other cases, big companies can push others in their supply chains to incorporate specific practices and policies, including climate action.

3.2 Initial GHG Inventory

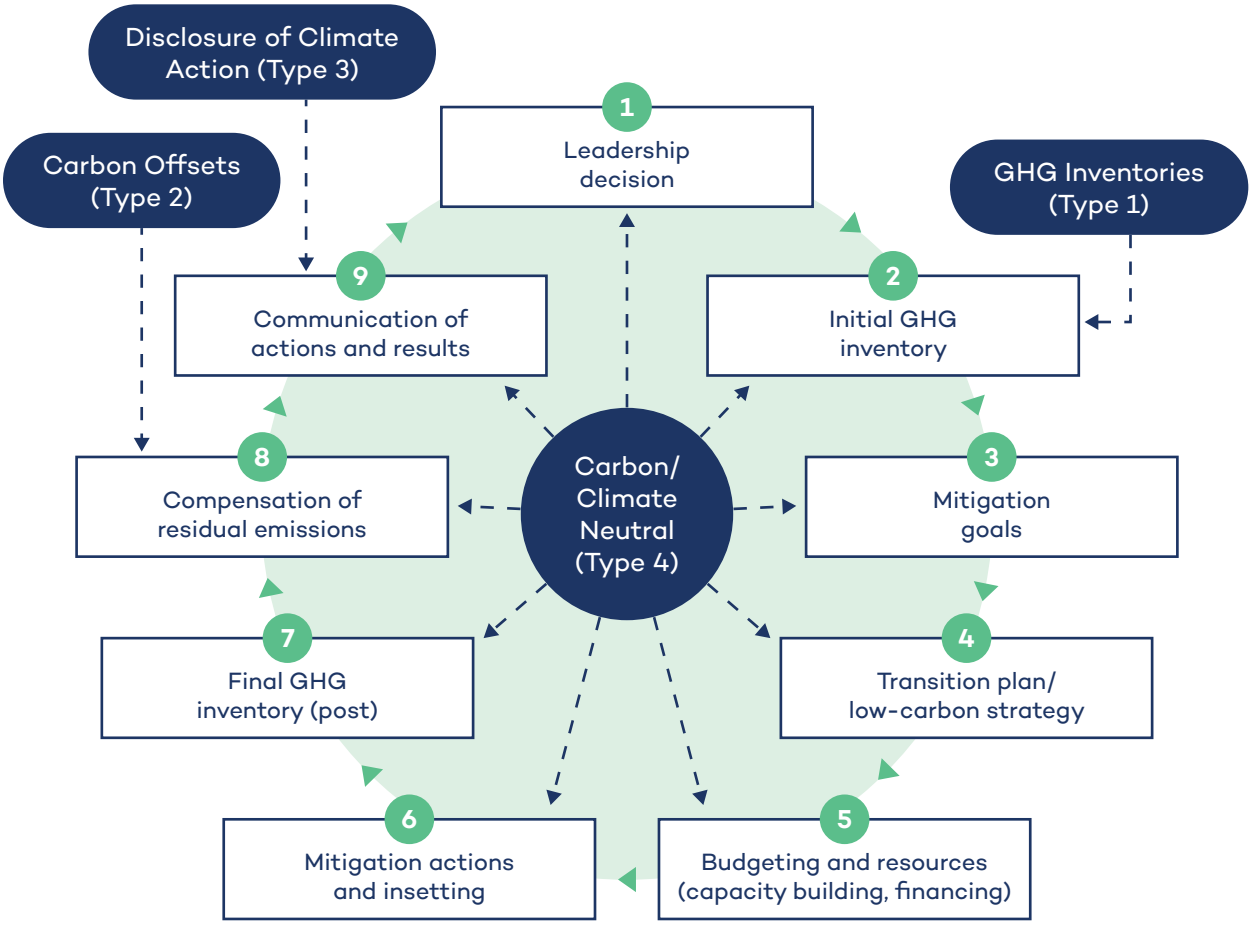
The initial technical step is to develop an inventory of GHG emissions and removals for the company's operations to set the emissions baseline. Inventories provide a systematic review of different processes or activities and their contribution to emissions of different GHGs.

The level of estimated emissions is determined by the boundaries defined for the company for the inventory, as well as the different processes generating emissions included in the analysis. The boundaries of an inventory can be defined at a facility level or for a production line, product, event, or activity. Inventories are prepared for a specific period (usually annually). Additionally, the company needs to define which scopes will be included in the inventory (i.e., Scopes 1, 2, and 3). To prepare a comprehensive strategy to address the climate emergency, companies should aim to prepare complete inventories, including all processes in the three scopes. This requires coordination and collaboration with suppliers and clients in the supply chain.

The initial inventory defines the level of emissions for a specific year (defined as the base year), and inventories are obtained by documenting two key information sources: activity data and emissions factors (Box 4). If companies have previously estimated their carbon emissions, they can generate a historical trend and relate it to different operational or economic factors that might explain changes and historical trends (e.g., production, sales, and population). Comprehensive mitigation strategies are forward-looking. Companies need to project the expected future pathways their emissions may have according to a business-

as-usual (BAU) scenario. These baselines can be built by extrapolating a historical trend or by including other factors, such as expected changes in operations and markets. The baseline describes the scenario of the emissions in the future in the absence of mitigation actions.

Figure 3. The four types of VSICMs in corporate carbon management



Source: Authors' elaboration..

Box 4. Key information for preparing and analyzing results of GHG inventories

Activity data

Activity data describe the scale of the type of processes producing emissions and can be expressed in different units (e.g., physical or monetary units). For instance, when estimating emissions from transportation, activity data can include information on the number of litres of fuel burned or the information required to estimate it. Activity data can be measured directly (e.g., by metering devices) by collecting information from purchase/consumption receipts estimated based on a census of all activities or processes producing the emissions or through a statistical sampling/survey. They can also be estimated considering proxy information (e.g., using the total km travelled in a vehicle and fuel usage per km to obtain fuel consumption). Usually, the companies own and have already generated the information that can be used to characterize activity data of the different emissions processes, especially for Scopes 1 and 2; for emissions in Scope 3, companies need to collaborate with other actors in their supply chains and even with consumers.

Emission factors

Emission factors define the number of specific GHGs that are emitted by each corresponding unit of the activity data. Following the previous example of the transport sector, the emissions factor indicates the number of GHGs produced per litre of fuel burned. As there are different GHGs, emission factors must be generated/selected for each one separately; these factors are expressed in mass units of each GHG (methane, nitrous oxide, or specific hydrofluorocarbons). The calculation should also include the global warming potential (GWP) corresponding to each GHG. The GWP is the metric that allows carbon equivalent units (CO_2e) to be calculated by comparing the potential that each GHG has to trap heat in the atmosphere over a given period relative to the potential that 1 tonne of CO_2 has to absorb the same amount of heat (to learn more about the GWP, see Box B1 in Appendix B). Organizations preparing GHG inventories can obtain emission factors from datasets published by government offices, scientific bodies (e.g., IPCC), organizations associated with different VSICMs, or scientific or technical literature.

Estimate of emissions

Inventories contain a summary table or section where emissions are presented for each process included, along with a description of the information used and assumptions made. Emissions are estimated by multiplying each of the values of the activity data by the corresponding emissions factors.

Uncertainty Management

Different sources of uncertainty are associated with the estimation of GHG emissions. Uncertainty is linked to information obtained from activity data and emissions factors. It can be described quantitatively and qualitatively. It is necessary to consider whether the information comes from a complete census or direct metering or if data are collected through a survey. In the latter case, some estimates can be expressed as a central value and a statistical confidence interval. The IPCC has produced guidelines and recommends using percentage uncertainty to monitor the uncertainty in inventories quantitatively. In the context of national inventories of GHG emissions and removals by sinks, the uncertainty percentage is 50% of the width of the confidence level set at 90% (IPCC, 2000b). When quantitative methods to assess uncertainty are introduced, an uncertainty propagation analysis can be made in combination with modelling techniques such as a Monte Carlo analysis (IPCC, 2000). The qualitative description of uncertainty sources can illustrate the major areas of concern, whether the information is complete, the assumptions followed and their effects, and strategies to reduce it/them.

3.3 Mitigation Goals

Once companies gather information about the processes that produce GHG emissions and conduct the inventory, they can identify opportunities to reduce emissions and set mitigation goals. After taking mitigation actions, GHG inventories are periodically checked (usually on an annual basis), which also helps to evaluate the performance of these strategies.

Ambitious mitigation goals aim to reach net-zero emissions or become climate or carbon neutral. Reaching net-zero internally implies that a firm has lowered emissions to a level where residual emissions are equal to any carbon removals under the organization's control.

In practice, however, few companies control carbon removal processes or own large tracts of forest land sequestering carbon,[9] so their inventories would present only information on GHG emissions. Mitigation goals can be expressed as absolute or relative reductions of emissions. Absolute goals indicate the total amount of GHGs that will be reduced; relative goals are presented as ratios of emissions toward relative measures (e.g., per USD 1,000 in sales per customer). While these relative goals can show some decreases, absolute emissions must be consistently reduced as soon as possible with a 1.5°C

It is important to establish emission-reduction targets focusing on direct mitigation actions and for which offsets cannot be used to show compliance

[9] When forests are owned and included in carbon accounting purposes to consider carbon sequestration, it is important to consider also the associated sources of emissions when these are present (i.e., extraction of timber, forest fires, decay of deadwood following pests, or hydrometeorological events, etc.)

emissions pathway (e.g., UN, 2022). It is important to establish emission-reduction targets focusing on direct mitigation actions and for which offsets cannot be used to show compliance (e.g., UN, 2022). Thus, companies would need to purchase carbon removal offsets to balance residual emissions (remaining or unabated emissions after the implementation of mitigation actions). In this context, companies could commit to becoming carbon-neutral or be certified as such.

3.4 Transition Plan/Low-Carbon Strategy and Resources

GHG inventories are also the starting point for identifying opportunities and the need to reduce emissions. Mitigation actions aim to reduce emission rates, eliminate emissions processes, or foster the removal of GHGs from the atmosphere for Scopes 1, 2, and 3. Companies across different economic sectors can use different strategies that are specific to their contexts—for instance, using renewable energy sources, implementing circularity (as packaging is an important contributor to supply chain emissions), incorporating recycled products (e.g., Ikea has introduced recycled mattresses, which saves 76 kg of carbon emissions compared to incinerating the product at disposal), and increasing efficiency in transportation (e.g., Unilever has been testing battery-operated refrigeration systems in its trailers) (Pomeroy, 2022; Zurich, 2021).

Integrating a task force or a team to lead the implementation of an integrated carbon management strategy in the company's governance is critical. Actions and investments will materialize if they are adequately budgeted and included in capital and operational expenditures and plans. The assignment of adequate resources includes capacity building of the key personnel and teams, as well as suppliers, as needed.

In the following sections, we present different elements that are usually considered in the definition of a carbon management strategy.

3.4.1 Technical Feasibility

An initial step is to look for alternatives to the processes generating GHG emissions. In some cases, it is necessary to change equipment or substitute technologies (e.g., for generating electricity and transport). Choices are limited to existing technologies. Behavioural changes can also reduce emissions and lead to savings (e.g., energy efficiency), which should not be overlooked.

3.4.2 Insetting

Companies can promote the execution of mitigation actions within their supply chains (upstream or downstream). When these actions are taken, they will reduce emissions within Scope 3 of the GHG inventory, which will be reflected in their yearly reports and performance. This process is known as insetting, as emissions are reduced within the same supply chains—in contrast to offsets that can come from projects disconnected from the core business activities of the reporting companies. These actions can promote energy efficiency, production, and use of renewable energy and eliminate emissions from deforestation and forest degradation associated with the supply chains of interest.

3.4.3 Contribution to Emissions Reductions

It is vital to estimate the number of carbon emissions from Scope 1, 2 and 3 that could be reduced or the amount of carbon that can be removed from the atmosphere from the various mitigation options. This is done by comparing the expected emissions or removals after the action is carried out with those of previous inventories or those expected in the baseline (i.e., emissions if mitigation strategies are not implemented).

3.4.4 Ancillary Benefits/Co-Benefits

Mitigation actions usually produce other economic, environmental, or social co-benefits, or ancillary benefits, in addition to reducing GHG emissions (e.g., Pearce, 2000). For instance, cutting emissions in the transport sector can lead to health benefits by reducing exposure to air pollutants in a populated city (social). It can also help reduce acid rain problems (environmental) and promote the creation of new jobs and economic activities (socio-economic). Identifying and describing the relevant co-benefits associated with the potential mitigation actions is essential.

3.4.5 Social Feasibility

Mitigation activities may affect various members of society and stakeholders differently. Before undertaking these activities, it is crucial to identify if they are likely to benefit or disadvantage certain groups. By doing this in advance, it will be possible to define strategies to increase the social feasibility of the measures, reduce the risks of opposition and resistance, and enable an inclusive transition.

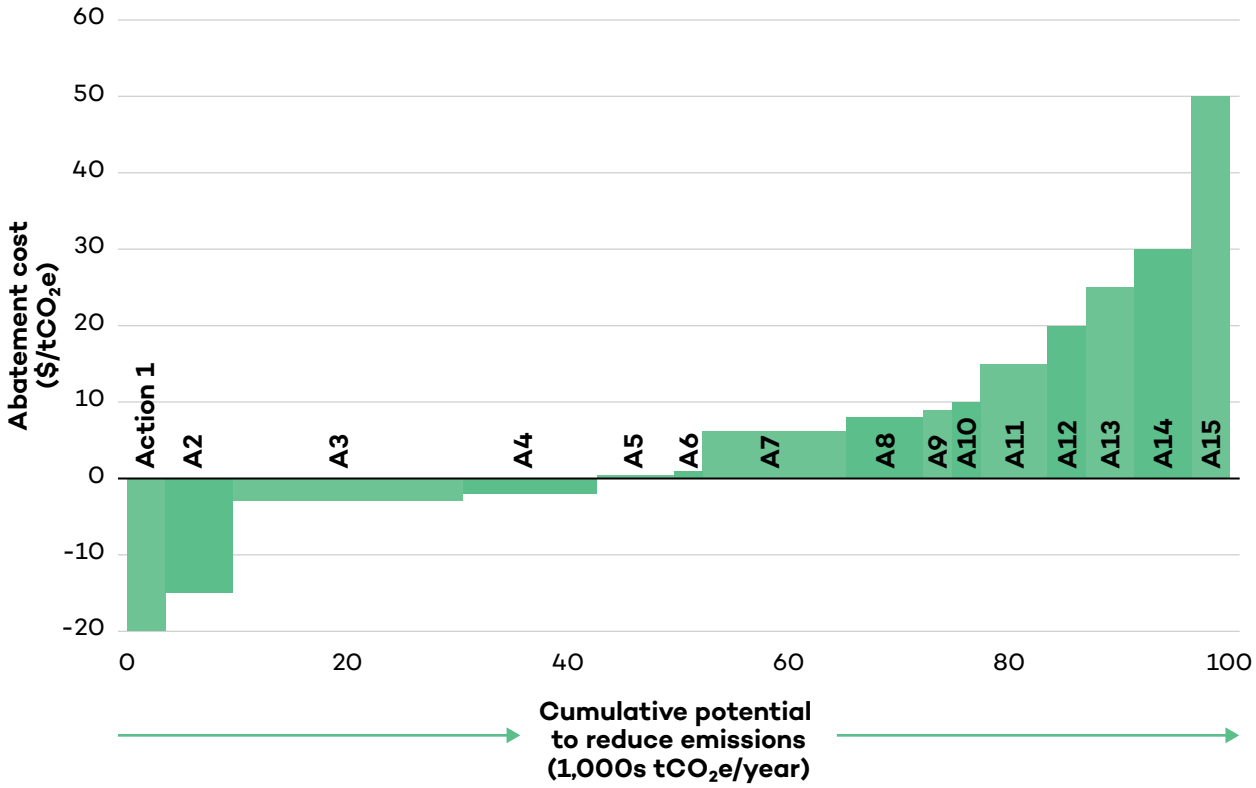
3.4.6 Economic Feasibility

Mitigation actions are usually evaluated from an economic perspective based on cost-efficiency criteria. This requires estimating the total cost of each action and the expected financial benefits (e.g., savings) over the project's entire life. This analysis focuses on the additional costs of the project compared with practices in the BAU scenario. The net costs or financial benefits for each potential intervention are divided by the expected quantity of emissions that can be reduced to get an average cost of mitigation per abated tonne of carbon. To identify the mitigation actions with the most feasibility, they can be ordered, starting with those with the greatest benefit or lowest cost per tonne and ending with those having higher costs; this helps create a marginal carbon abatement cost curve.

Figure 4 presents a hypothetical example of a marginal carbon abatement cost curve for a fictitious company. The graph shows the different mitigation actions available to the company ordered from those with the lowest costs to those with higher costs per tonne of carbon reduced. Given a limited budget or a maximum carbon cost to be paid, this tool enables companies to select the mitigation actions to be implemented first, following the cost-efficiency principle.

Figure 5 offers an example of a marginal abatement curve presenting the mitigation potential and associated costs of 15 hypothetical actions. When all the actions are implemented, emissions reductions would be 100,000 tCO_2e per year, as read in the

Figure 4. Example of the marginal abatement cost curve for 15 mitigation actions



Source: Authors' elaboration.

horizontal axis. The first four actions have a negative cost of implementation, which indicates that they will produce savings or net financial benefits for the company. In terms of reduced emissions, they contribute to around 40% of the total mitigation actions identified. The graph provides guidance for the company to determine the marginal cost per tonne of CO_2e and the expected expenditure required for undertaking different actions. For instance, if the cost of offsets in VCMs is about USD 20 per tonne of CO_2e, the company will face lower mitigation costs if it decides to implement the first 11 mitigation actions identified and reduce around 85,000 tCO_2e per year, as these activities have costs below the prices of offsets (USD 15 per tonne of CO_2e).

However, it is important to stress that the decision of a company either to invest in mitigation actions and reduce the demand for offsets (for unabated emissions) or not to invest in mitigation actions and thus needing more offsets has important implications in the long term. Many of these actions to reduce or eliminate carbon emissions require large capital investments with time horizons beyond decades; if the action is not implemented, the company would need to buy offsets during the same period.

Given the decision of a company to contribute to net-zero goals or to become carbon neutral, it will be necessary to include the avoided costs of offsets that would be no longer needed if that action is implemented

in the investment analysis of its mitigation options. This inclusion will favour the implementation of actions with higher costs (depicted in Figure 5) as, usually, marginal abatement cost curves do not include costs of averted offsets. The scenario described in the previous figure is dynamic as technology and carbon markets evolve. For instance, if long-term forecasts indicate that the price of offsets is going to increase, this is an argument in favour of the implementation of more ambitious direct mitigation actions. The bottom line is that the inclusion of averted costs of offsets in marginal abatement costs analysis, even with a conservative costing of carbon offsets, will point to the early and ambitious implementation of direct emission-reduction actions.

Implicitly, the carbon price in the market defines the economically efficient scenario for setting a company's emissions-reduction goal (i.e., the potential emissions reductions of the actions with costs lower than the carbon price); thus, if carbon prices are low, there will be weak incentives for companies to invest in their own actions to reduce emissions. If carbon prices are high, it will be in the interest of the company to invest in reducing its emissions rather than purchasing carbon offsets. This highlights the importance of having the right carbon prices in the markets, including the VCM. These "right" prices should promote the adoption of emission-reduction targets consistent with a 1.5°C emissions pathway.

Companies can include in this analysis the social value of any co-benefits generated (e.g., reduced societal costs or the socio-economic value of increased benefits). This will provide a more comprehensive picture of the costs and benefits associated with their mitigation actions to identify the most socially desirable ones. This approach aligns with the principles of impact investment, as part of the returns of the investments may be not only financial but also environmental and social.

Considering the above factors, companies can prioritize the mitigation activities to be included in the short, medium, and long terms. These tools enable decision-making by analyzing the costs and benefits of specific alternatives and potential contributions to reduce emissions.

3.4.7 Monitoring of Mitigation Actions

Mitigation actions must be monitored so performance can be evaluated and progress can be reported transparently and reliably. Establishing specific procedures and protocols and defining roles and responsibilities among key employees is necessary. Companies can set timetables to verify the accomplishment of specific milestones. It is possible to define progress indicators regarding investment and other control variables, such as changes in energy consumption (e.g., electricity or fuel) or waste generated. These control variables can be linked to the information used to document activity data and will forecast the expected impact of the actions executed in the carbon inventory.

3.5 Final GHG Inventory (Ex-Post Mitigation Actions)

Complete inventories usually need to be prepared yearly, covering Scopes 1 and 2, as well as most categories of Scope 3 emissions. After the firms have applied their strategies to reduce emissions, the impacts of these

actions are expected to be detected in the new inventory. It will then be possible to compare the final emissions levels with those of the previous years and baseline inventory.

3.6 Mitigation Strategies and Residual Emissions

After mitigation actions are implemented, there may be certain unabated emissions (residual emissions). The following diagrams describe different scenarios of residual emissions for different emission-reduction goals; aggregated emissions figures include those in the GHG inventories (i.e., Scopes 1, 2, and 3). It should be noted that the scenarios refer to net emissions, so any direct carbon removals under the organization's control should be considered. Offsets are not considered at this point.

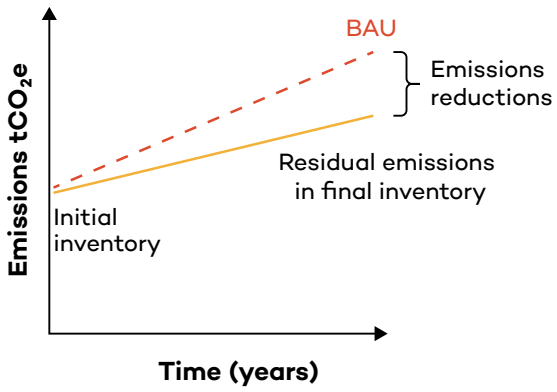
Depending on the expected trend of the baseline and the final level of emissions after mitigation actions are taken, different possible trajectories of residual emissions will have different implications for global mitigation pathways.

It should be noted that the concentration of GHGs in the atmosphere is building up because yearly emissions are larger than carbon removals by sinks. The wider the gap between growing emissions and the reduced capacity of sinks to remove carbon (for instance, due to deforestation), the more rapidly GHG concentrations will build up in the atmosphere. This is crucial to consider, given the positive relationship between increasing GHG concentrations and global temperatures. The following sections describe four possible scenarios about how a specific company can set baselines and mitigation actions and their implications for the level of residual emissions and impact on the atmospheric concentration of GHGs.

3.6.1 Scenario 1: Increasing emissions

After the mitigation strategies are applied, residual emissions can exceed the initial inventory in the base year but be lower than the baseline scenario (BAU) (Figure 5). This depicts a situation where emissions will contribute to the *accelerated* increase in atmospheric GHG concentrations. Although it can be argued that some emissions may have been reduced against the counterfactual BAU, emissions—and GHG concentrations—are increasing, albeit at a slower pace than in the BAU.

Figure 5. The expected trajectory of emissions for Scenario 1: Increasing emissions



Source: Authors' elaboration.

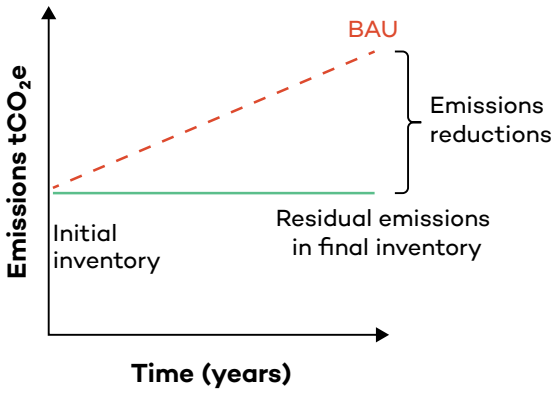
It is important to notice that these trajectories refer to absolute emissions levels. It is possible to present emissions intensity relative to the volume of production, per employee, or to the output's economic value (e.g., tonnes of CO_2e

per USD 1,000 of sales or per 1,000 units produced). If indicators and monitoring are presented for relative indicators of emissions, it is first necessary to present figures for total emissions.

3.6.2 Scenario 2: Constant emissions

A second scenario is when organizations can stabilize yearly emissions in their mitigation scenario (Figure 6). This implies that emissions remain constant year after year and are equal to the base year or the year of the initial inventory.

Figure 6. The expected trajectory of emissions for Scenario 2: Constant emissions



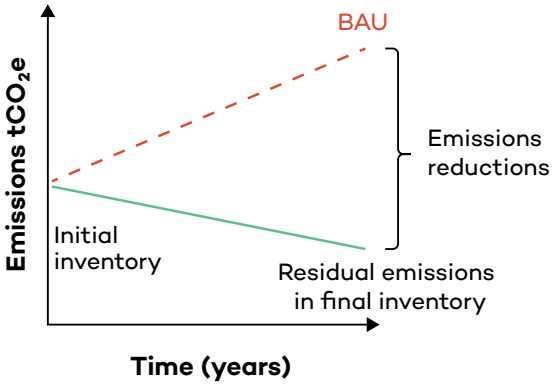
Source: Authors' elaboration.

As net emissions are still significantly above zero, this scenario contributes to a linear increase in GHG concentrations, albeit slower than Scenario 1.

3.6.3 Scenario 3: Decreasing emissions

In Scenario 3, companies can reduce absolute net yearly emissions compared to the base year and initial inventory (Figure 7).

Figure 7. The expected trajectory of emissions for Scenario 3: Decreasing emissions



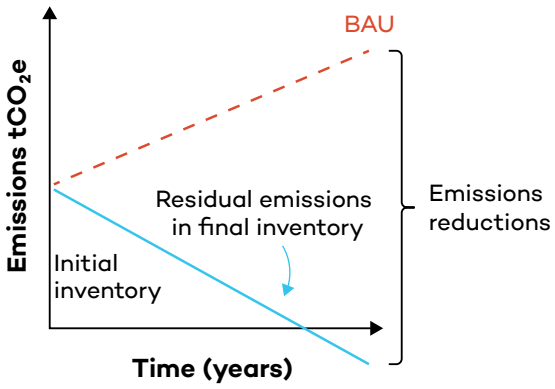
Source: Authors' elaboration.

In this case, the emissions still exceed zero and contribute to increasing the atmospheric concentrations of GHGs, albeit at a much slower pace. As residual emissions approach zero, contributions to higher atmospheric concentrations tend to be zero. An important condition is that the inventories adequately include all relevant processes leading to GHG emissions (Scopes 1, 2, and 3).

3.6.4 Scenario 4: Net removals or "negative"[10] emissions

Finally, Scenario 4 (Figure 8) describes the case when companies can completely reduce their emissions (i.e., achieve net-zero, internally without offsets), and their operations may even result in net carbon removals. This scenario starts reducing atmospheric concentrations as soon as net removals are achieved.

Figure 8. Expected marginal effect of mitigation actions on GHG's atmospheric concentration under the four mitigation scenarios



Source: Authors' elaboration.

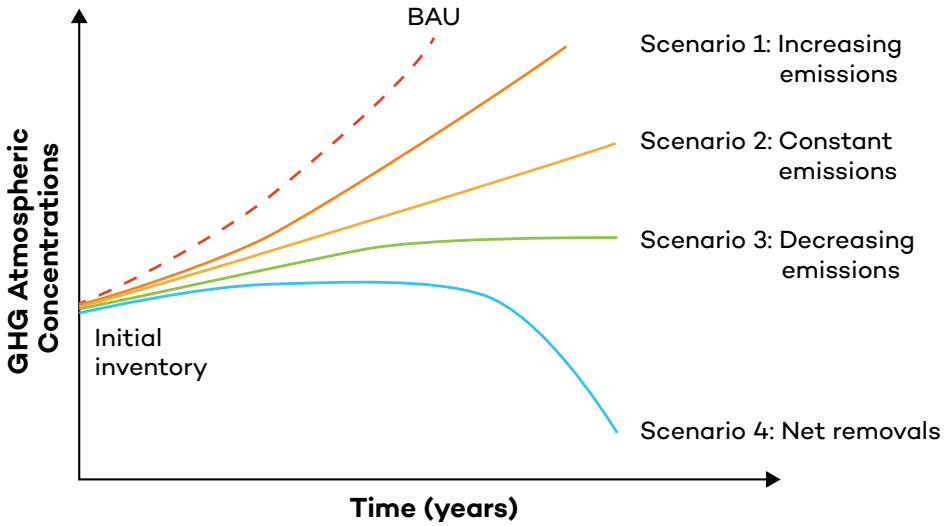
3.7 Impacts of Residual Emissions on Atmospheric Concentrations of GHGs

Figures 5 to 8 present emissions trajectories for different mitigation strategies and a company's ambition levels. The final level of emissions under each scenario points to the level of residual emissions as measured in the final GHG inventories. Figure 9 presents the different impacts that the mitigation strategies of a company will have on the atmospheric concentration of GHGs depending on the level of ambition according to the four archetypical scenarios described in the previous sections.

At the beginning of the period of interest at the time of the initial inventory, GHG concentrations are observed at a certain level (the point at which all scenarios depart in the vertical axis). Depending on the trajectory of residual emissions after mitigation actions are taken, the concentration will follow different patterns, which depend on the level of ambition of mitigation goals. It is important to stress the differences in the shape of the lines for the different scenarios. A baseline scenario (BAU) and unrestricted emissions growth imply accelerated atmospheric concentration growth. This is also true for a moderated mitigation case when rising emissions can still be measured (Scenario 1). Even if total emissions remain constant yearly (Scenario 2), atmospheric concentrations will build up linearly (considering only the company's actions and anthropogenic emissions and removals under analysis). Concentrations will tend to stabilize in Scenario 3 as net emissions are near zero, and emissions will only decrease when net carbon removals are achieved (Scenario 4). The ambition of the climate action required to limit the increase of temperature to 1.5°C implies that it is necessary to reach net-zero emissions by, at the very latest, 2050 (UN

[10] This refers to the case when carbon removals exceed emissions; as the vertical axis in Figure 9 shows emissions, negative values in the graph when the green line crosses the horizontal line can be identified either as net removals or negative emissions. The point at which the green line crosses the value of zero indicates that net-zero emissions have been achieved.

Figure 9. The expected trajectory of emissions for Scenario 4: Net removals



Source: Authors' elaboration.

Climate Change, 2022a). Organizations should strive to reduce emissions to net-zero levels and, if possible, achieve net removals immediately; this implies a quick transition to Scenarios 3 and 4, as shown in the previous sections.

The ambition of the climate action required to limit the increase of temperature to 1.5°C implies that it is necessary to reach net-zero emissions by, at the very latest, 2050.

It should be remembered that the effective contribution of this mitigation strategy depends on the completeness of and considerations adopted in the GHG emissions inventory. If the inventory is only partial and does not include relevant emissions processes or scopes, the contribution to mitigation will also be limited and may lead to greenwashing.

3.8 Residual Emissions and Demand for Offsets

Residual emissions represent the effort still required to reduce the contribution to climate change once mitigation actions are implemented. The ambition of the goals set by a company and the results obtained from its mitigation strategy are important to determine the role that the purchase of offsets would play, particularly if they include working under carbon-neutrality standards.

Less ambitious mitigation strategies will require more offsets to compensate for residual unabated emissions to achieve carbon neutrality. Given the limited capacity of the biosphere and current technologies to remove atmospheric carbon and produce the required offsets to balance growing emissions, relying on offsets as the major contribution to a mitigation strategy is simply not sustainable on a planetary basis in the long term. Thus, companies might establish two goals: one is to reduce direct emissions

Given the limited capacity of the biosphere and current technologies to remove atmospheric carbon and produce the required offsets to balance growing emissions, relying on offsets as the major contribution to a mitigation strategy is simply not sustainable on a planetary basis in the long term.

consistently with 1.5°C emission pathways, and the second is to use high-quality offsets to compensate for unabated emissions (UN, 2022). In this context, purchasing offsets is of the utmost importance, as they contribute to the transformation needed for managing and reducing carbon in sectors such as agriculture, forestry, energy, transport, and waste management. However, ambitious direct mitigation action and insetting to reduce Scope 3 emissions in supply chains must not be delayed. Objectives to compensate unabated emissions purchasing offsets complement, are not a substitute for setting goals to first reduce emissions aligned to net-zero goals.

The carbon pricing mechanisms that regulate a company's operations are another factor that influences demand for offsets. As described earlier, companies participating in ETS can buy offsets to show compliance. Less frequently, companies can also buy offsets to demonstrate or deduct the payment of carbon taxes when they exist and rules allow it (e.g., as in South Africa and Colombia). Demand for offsets is expected to be far lower than total unabated emissions if these are the only drivers for purchasing offsets. Certain specifications of pricing mechanisms limit the number of offsets that can be used to show compliance. As the companies have already gotten, and presumably paid for, permits or pay the tax for the bulk of emissions, there may be no additional legal incentives to reduce residual emissions or buy more offsets to compensate them.

Independently of the number of offsets purchased and the motivation for buying them, companies need to retire them from the market (after purchase) to include them effectively in their carbon accounting. This applies whether offsets are used only for internal purposes as part of an ETS to deduct a carbon tax or as part of carbon-neutral certification. It is essential to point out that some carbon pricing schemes may have specific rules for retiring offsets and that double counting must be avoided to prevent confusion among users and the unreliability of claims.

Offsets from activities removing and storing carbon are required to balance out net residual emissions. One risk with forestry-based carbon removal projects is that carbon sequestration is potentially reversible in the case of events such as logging, land-use changes, and forest fires. When such reversals occur, additional removals may be required; this will depend on contingency plans, insurance buffers, and specific carbon offset certification scheme provisions. This is particularly important when offsets are used to comply with regulations or corporate claims.

The figures presented in Section 3.7 underscore that companies managing their carbon emissions should achieve net carbon removals to help reduce both the

concentration of GHGs in the atmosphere and rising temperatures; this is consistent with the most recent definitions for net-zero goals, especially climate neutrality. These definitions have important implications for the role that different types of offsets can play. There are different types of carbon offsets depending on the project that produces them (e.g., activities to reduce emissions or to remove carbon from the atmosphere, temporarily or in the long term). As defined by initiatives like Climate Neutral Now, there is a role for the different types of offsets in the transition to net-zero emissions. Additionally, offsets of activities reducing emissions provide cost-efficient and most-needed resources to project offset developers— and very often to communities in developing countries— for the implementation of their projects. It is important to provide finance to develop projects that reduce emissions and to define the best mechanism to do so.

3.9 Communication of Actions and Results

3.9.1 Disclosure of Climate Action

Companies can report their climate mitigation strategy and results to different platforms. This information can include details on all the steps presented in Figure 1. They can also report information such as the climate risks to which they are exposed, adaptation measures, and climate investments. Companies may need to register formally and pay a fee to participate in these initiatives. The platforms usually provide a predetermined format or questionnaire that companies use to guide the reporting of their information. Companies may be open and even keen to report and disclose their information, as this may be public domain or presented formally to investors or regulators. This can also create competition among companies operating in the same sectors by showing higher levels of transparency and possibly having preferential access to finance.

3.9.2 Carbon-Neutral Certification

Companies may aim to become certified or recognized as carbon neutral. As an initial step, the company will usually have to choose a specific certification program and register in the selected initiative. Each certification scheme has specific requirements for recognition in terms of what emissions are included, the ambition of mitigation goals, and the type of carbon offsets permitted (these standards are described in the section below). The company must prepare and submit information on its GHG inventory, mitigation actions, and offsets purchased. This information may be revised internally by the organization running the carbon-neutral certification scheme or by a third party. If certification is successful, the company can use the certification logo or brand according to a predefined set of rules. The company will be able to communicate this achievement to various stakeholders.

4.0 Types of Voluntary Carbon Standards and Initiatives

VSICMs have been an ongoing development and essential aspect of climate action since the 1992 Earth Summit in Rio de Janeiro (see Appendix A for a timeline on the evolution of VSICMs). Standards, initiatives, and platforms that account for carbon emissions have evolved and are continuously adapting based on the latest scientific findings. In this section, we highlight a selection of voluntary standards and initiatives based on the most recent publicly available information. We have included 35 VSICMs that are divided into four categories: nine GHG inventories, 10 offset methodologies, four reporting platforms, and 10 carbon-neutral standards. To see an extended and more detailed description of each standard and its uptake, see Appendix B or click on the correspondent's name in the tables that follow. The standards and initiatives described here were selected based on a consultation with eight experts who identified them as the most widely known and used. We acknowledge that the development of VSICMs is rapidly evolving. Therefore, others may be gaining momentum or covering aspects beyond carbon emissions.

4.1 Type 1: GHG emissions inventories

4.1.1 What Are GHG Inventories?

A GHG emissions inventory and removals by sinks integrates and quantifies different processes producing and sequestering emissions following defined methods (U.S. Environmental Protection Agency [U.S. EPA], 2022c). Inventories are usually called "carbon footprints" and include different processes that are grouped by "scopes" (Box 2). Inventories should consider relevant processes leading to emissions and those that relate to carbon removal by sinks. Nevertheless, few companies own agricultural or forest lands where important removal processes occur, so most corporate inventories are focused on emission—especially when only Scopes 1 and 2 are considered.

4.1.2 What Are Inventories Used for?

Inventories aim to capture the anthropic contribution of a given entity or activity (e.g., jurisdiction, event, company, productive process, or the making of a product) to climate change for a given period. Corporate actors can prepare inventories to evaluate the performance of mitigation efforts (as part of regulatory or voluntary certification processes), manage risks, identify mitigation opportunities, or receive public recognition (U.S. EPA, 2022c).

4.1.3 Who Prepares a GHG Inventory?

Inventories are prepared by private and public actors driven by different motivations. Private sector actors can use various methodologies to prepare their inventories. Methodologies set the guidelines to prepare inventories for different purposes and objects of analysis. For instance, a company can set an inventory of its entire operations, a specific facility or activity, or product. Public entities corresponding to different jurisdictions (e.g., cities, regions, countries) can also prepare inventories for different economic sectors; carbon inventories or footprints can be prepared even at the level of individuals or households. Typically, the methodology

establishes steps and criteria to document and select values for emissions factors and the activities that produce the emissions. Depending on the characteristics of the regulations and motivation of reporting organizations, the inventories can be third-party verified.

4.1.4 Main GHG Inventories in Use

Table 1 includes the nine voluntary carbon standards and initiatives in this category that companies, governments, and other actors used most commonly at the time this report was prepared.

Table 1. Voluntary carbon standards and initiatives to prepare GHG inventories

Name	Key highlights
IPCC 2006 Guidelines for National GHG Inventories & 2019 Refinement Source: IPCC, 2019a	• The foundational reference for measuring, reporting, and verifying GHG emissions and removals. All GHG programs, methods, and policies are rooted in these guidelines. • Includes quality assurance and quality control procedures to apply during inventory compilation and a database with well-documented references for emissions factors to estimate the GHG inventory of a given activity. • Countries signatories of the UNFCCC must submit annual GHG inventories based on methodologies included in these guidelines.
Greenhouse Gas Protocol (GHG Protocol) Applies to products, value chains, projects, companies/organizations Source: GHG Protocol, 2022a	• The most widely used standard to measure and manage GHG emissions across operations and to evaluate emissions reductions. • Includes four standards: the Corporate Accounting and Reporting Standard, which serves as an international benchmark for establishing GHG emission inventories; the Corporate Value Chain Standard, which supports accounting for Scope 3 emissions; the Product Standard, which measures emissions through the product life cycle; and the Project Protocol, which provides methods to calculate emissions removals in climate mitigation projects.
International Organization for Standardization (ISO) 14064 Applies to products, value chains, projects, companies/organizations Source: ISO, 2018	• A set of tools for users to quantify, monitor, report, and verify GHG emissions inventories and removals. • Widely used to establish quality, consensus-based international standards to quantify, verify, and report GHG emissions as part of the ISO 14060 series of standards for environmental management. • It can be applied to any project in any sector, region, organization, or product to help measure indirect emissions (Scope 3) and those generated through the product life cycle.

Name	Key highlights
The Climate Registry (TCR) Applies to companies/ organizations Source: The Climate Registry, 2022a	• Designs and operates GHG reporting programs that target the voluntary and compliance markets; helps organizations to measure, report, and verify carbon emissions and reductions in their operations. • Used to calculate and publicly disclose annual carbon footprints in an online portal and work to reduce GHG emissions to reach net-zero goals.
Publicly Available Specification 2050 (PAS 2050) Applies to products Source: BSI, 2011	• A consensus-based, internationally applicable standard used for product carbon footprinting. • It focuses exclusively on measuring GHG emissions generated during a product's life cycle and is considered the first carbon footprint standard used internationally. • Broadly consistent with the GHG Protocol.
U.S. EPA's Inventory Guidelines Applies to companies/ organizations, value chains Source: EPA, 2022c	• These guidelines offer companies and organizations in the United States resources to develop GHG emissions inventories aligned with the GHG Protocol Corporate Standard. • They provide guidance on GHG accounting principles, calculation methodologies and emission factors, defining inventory base year and inventory boundaries, identifying GHG emission sources, and tracking emissions. • They help users identify reduction opportunities and participate in GHG emissions-reporting programs in voluntary and compliance markets.
EU Environmental Footprint Applies to products, companies/ organizations Source: European Commission, 2021	• This is a common framework and set of guidelines to calculate and communicate the life-cycle assessment of goods, services, and organizations. It includes the Product Environmental Footprint and the Organization Environmental Footprint. • It builds on existing approaches and international standards (i.e., ISO 14040 and the ISO 14025 series). • It aims to increase product comparability and communicate information to consumers through mechanisms such as a label.
Confederation of European Paper Industries (CEPI) Ten Toes Applies to paper products, paper value chains Source: CEPI, 2017	• This is a framework that provides guidance and a common approach for calculating GHG emissions and removals of paper and board products (carbon footprint). • It considers Scope 1, 2, and 3 emissions and proposes the GHG Protocol and ISO 14064:2006 for estimating them.

Name	Key highlights
Bilan Carbone® Applies to companies/ organizations Source: L'Association pour la transition Bas Carbone (L'ABC), 2022	• This is a method developed by the French Environment and Energy Management Agency to measure GHG emissions of citizens, companies, public institutions, and territorial collectivities. • It does so by multiplying data of a given organization's activity by an emission factor from the Bilan Carbone database. • The method complies with ISO 14064 and the GHG Protocol and aligns with EU Directive No.2003/87/CE for emission.

4.2 Type 2: Formulating, registering, and certifying carbon offset projects

4.2.1 What Are Carbon Offsets/ Certificates?

Carbon offsets are certificates of emissions reductions or carbon removals that are verified by private, independent, third-party organizations (World Bank, 2022). Offsets represent a tonne of CO_2 that is not emitted or is removed from the atmosphere. Offset markets range from mandatory to voluntary. Mandatory markets are regulated in national, regional, and international carbon-reduction regimes. In general, government bodies certify mandatory carbon offset programs, while non-governmental organizations certify voluntary carbon offset programs. Nonetheless, both government and non-governmental certifications serve both types of markets (Broekhoff et al., 2019). Offset programs are identified with different fungible units for each mechanism (e.g., GHG Management Institute & Stockholm Environment Institute, 2023) (Table 2).

Table 2. Examples of offset units of different certification schemes

Initiative	Offset Units
Clean Development Mechanism* (Global)	Certified emissions reductions (CERs)
Joint Implementation* (Global)	Emissions reduction units
Regional Greenhouse Gas Initiative* (USA, Multi-State)	Regional Greenhouse Gas Initiative CO_2 Offset Allowance
Alberta Emission Offset System*	Alberta Emissions Offsets Credit
California Compliance Offset Program*	Air Resources Board offset credit
Emissions Reduction Fund of the Australian Government*	Australian carbon credit units
Climate Action Reserve	Climate Reserve tonne
Verified Carbon Standard	Verified Carbon Units
	TREES Credits (TREES; Removals; High Forest Low Deforestation)

Initiative	Offset Units
Architecture for REDD+ Transactions	Emission reduction tonne
American Carbon Registry	Plan Vivo Certificate
Plan Vivo	Gold Standard Verified Emission Reduction
Gold Standard	Approved carbon credits
Global Carbon Council	Carbon Dioxide Removal Certificates
Puro.earth	Verified carbon credits
BioCarbon Registry	CCB label, which can be used to qualify carbon units of other standards
Climate, Community and Biodiversity Alliance	Fairtrade label, which can be used to qualify carbon units of other standards; in alliance with Gold Standard
Fairtrade Climate Standard	

*Compliance schemes required by specific regulations
Source: Author's elaboration.

The number of offsets that can be issued to projects is estimated according to different and specific methodologies derived from existing carbon certification standards, which compare the emissions reduced and carbon removed by the project to its baseline (e.g., a scenario without the project). Carbon accounting rules and methodologies under the different certification schemes include deductions based on risk and uncertainty. The number of offsets received by project developers is therefore not equal to the measured emissions reductions or carbon removed directly from the project activities.

Crediting organizations define certification standards and methodologies for specific sectors and activities. For example, methodologies have been created to estimate the benefits of GHG emission-reduction actions in sectors such as renewable energy from wind and solar power, landfill methane management, biogas, blue carbon, livestock methane, sustainable agriculture, clean cookstoves, improved forest management, energy efficiency, reforestation/afforestation, reducing emissions from deforestation and forest degradation (REDD+), and run-of-river hydro (Smith et al., 2014).

4.2.2 What Are Offsets Used for?

Once issued, carbon offsets can be used in the VCM and in compliance with carbon markets. In the former, buyers purchase carbon offsets mainly to compensate for (or offset) emissions from their operations, comply with voluntary environmental practices, obtain public recognition, or prepare for upcoming regulations. Offsets can also be used in compliance markets such as emissions trading schemes to substitute for permits or allowances and to demonstrate compliance with mitigation targets. In some places, governments allow the use of offsets to demonstrate emissions reductions and deduct carbon tax payments (e.g., Colombia and Mexico). Carbon offsets are purchased to reduce climate change mitigation costs and support the specific projects that produce them.

Project developers wishing to produce offsets must cover certain costs for participating in the VCM. While costs vary for each standard, in general, they include the cost of designing the project, registration, and initial and periodic third-party verifications. Thus, before certifying a project, developers conduct a feasibility study and estimate the number of offsets, costs, and benefits they can generate with a project, considering the methodology available that is most suitable to their activities. Benefits for project developers include obtaining additional financial resources or accessing different co-benefits of the projects (e.g., socio-economic or environmental) and adopting newer and cleaner technology.

4.2.3 Who Generates Offsets?

Offsets are issued to the project developers (who have implemented the specific activities) by the organizations managing the crediting mechanisms. Developers can sell the offsets to intermediaries, brokers, or the "final users" of the offsets in voluntary or regulated initiatives.

Project developers and buyers negotiate the prices of offsets between themselves. It is expected that payments received by project developers are at least enough to cover the transaction costs of participating in the VCM and associated implementation or opportunity costs.

Factors in the regulatory and voluntary markets determine the demand for offsets. ETSs and carbon taxes define a certain level of offsets that can be used to show compliance and thus induce specific demand. In the voluntary market, companies (and individuals) decide how much residual emissions they will offset. The highest demand for offsets will occur when all residual emissions are compensated. However, as a dynamic price mechanism, when a high demand for offsets is created and/or offset prices increase, this creates incentives for companies to implement their own mitigation strategies (with lower costs), reducing the demand for offsets.

4.2.4 Who Uses the Offsets?

Once a project generates offsets, project developers can trade them to brokers or buyers who integrate them into their carbon accounting. When final buyers want to "use" the offsets, they need to retire them from the market so they can no longer be traded. Thus, offsets are integrated into their internal carbon accounting (e.g., as part of environmental responsibility initiatives) or to comply with obligations derived from ETSs or carbon taxes.

As elaborated through the report, companies usually prepare an inventory of GHG emissions of their operations and a mitigation strategy before buying offsets; the inventory of residual emissions sets the bar for the theoretical demand for offsets. Also, individuals can estimate their carbon footprints as preliminary steps to purchasing offsets. It has been observed that individuals have made important voluntary purchases of offsets (Kainou, 2021).

4.2.5 Main Carbon Offsets/ Certification in Use

Table 3 presents 10 of the most used methodologies for implementing voluntary carbon standards to issue offsets at the time this report was produced. Businesses, governments, and individuals use these standards.

Table 3. Voluntary carbon standards and initiatives for carbon offset projects

Name	Key highlights
Clean Development Mechanism (CDM) By the UNFCCC Third-party verification: Required Credits: CER Source: UNFCCC, 2018, 2021a, 2022a	• The first carbon finance and offset mechanism was established to allow a country with an emission-reduction or emission-limitation commitment under the Kyoto Protocol to implement an emission-reduction project in developing countries. • Establishes standards and methodologies to quantify, monitor, and certify emissions reductions from projects. Each CDM project can earn saleable CER credits, each equivalent to 1 tonne of CO_2.
Verra-Verified Carbon Standard (VCS) By the civil society organization Verra Third-party verification: Required Credits: Verified Carbon Units Source: Verra, 2022a, 2022b, 2022c	• This global voluntary GHG program allows VCS-certified projects to convert GHG emissions reductions and removals into tradeable credits. • It is a main instrument in voluntary carbon markets, in part due to the integration of quantitative and qualitative indicators into its verification protocols. • It focuses mainly on renewable energy; forest, wetland conservation and restoration projects; and transport efficiency improvement.
The Gold Standard By WWF, International Union for Conservation of Nature, and other international organizations Third-party verification: Required Source: Gold Standard, 2022a, 2022b	• The Gold Standard framework monitors, reports, and verifies emission-reduction projects in eligible sectors, including land use, nature-based solutions, renewable energy, energy efficiency, and waste and water management. • It prioritizes the environmental and social co-benefits of the project to contribute to the Sustainable Development Goals. • It certifies emission-reduction projects based on the requirements of the CDM.
The American Carbon Registry (ACR) By the civil society organization the ACR Credits: Emission reduction tonne Source: ACR, 2020, 2022a, 2022b	• The ACR operates in voluntary and regulated carbon markets (e.g., California's cap-and-trade market). • The ACR receives and certifies project proposals that adhere to the standard to ensure emissions reductions and removals. • It has experience overseeing offset project verification, offset issuance, and retirement reporting through its online registry system.

Name	Key highlights
The Plan Vivo System By Plan Vivo Foundation Third-party verification: Required Credits: Plan Vivo Certificates Source: Plan Vivo, 2022c	• It implements projects to manage and monitor verifiable emissions reductions from community-based land-use projects with small-scale producers. • The projects focused on establishing sustainable land-management plans, with additional eligible activities, including afforestation and reforestation, agroforestry, forest restoration, and avoided deforestation.
Climate Action Reserve (CAR) By the civil society organization CAR Third-party verification: Required Source: CAR, 2022b	• CAR is a carbon offset program and registry for voluntary carbon markets in North America. • It establishes standards to qualify and verify GHG emission-reduction and removal projects. It issues, registers, and monitors carbon offset credits but does not sell them directly; CAR offsets can be purchased through over-the-counter sales or retail. • It is a registry that supports compliance with carbon markets and serves as an approved Offset Project Registry for the State of California's Cap-and-Trade Program. • CAR's protocols, verifier accreditation, and oversight program can be used with the Verra VCS program.
BioCarbon Registry (BCR) By Biocarbon Registry Third-party verification: Required Based on ISO 14064 Source: BCR, 2022a	• The BCR is a voluntary public registry of GHG emission-reduction and removal projects that comply with the BCR standard and methodology. • It allows projects to issue verified carbon credits across various sectors, including energy, waste, transportation, agriculture, forestry, and other land use. • Carbon credits are issued if previously verified and validated following ISO 14064 series guidelines and BCR Standard criteria. • BCR projects emphasize social and environmental co-benefits, including linking activities to fulfill the Sustainable Development Goals and implement REDD+ projects.
The Architecture for REDD+ Transactions (ART) By the civil society organization, ART Third-party verification: Required Credits: TREES Source: ART 2021a, 2021b	• This crediting program incentivizes governments to reduce emissions from forestry and land use. It also serves to increase finance from the private sector and donor countries. • ART issues credits solely at the jurisdictional level to national governments and large subnational jurisdictions to achieve results at scale, including environmental, social, and governance requirements in line with the UNFCCC guidelines for REDD+ activities.

Name	Key highlights
The Global Carbon Council (GCC) By the Gulf Organization for Research and Development Third-party verification: Required Middle East and North Africa Source: GCC, 2020	• An international carbon offset program allowing businesses to submit their GHG emission-reduction and removal projects according to GCC's rules, procedures, and standards. • It focuses on the Middle East and North Africa. It targets two project categories: those not registered under another GHG program and de-registered CDM projects. As projects are approved, the GCC issues carbon credits for a specific monitoring period.
Puro.earth Majority owned by Nasdaq Third-party verification: Required Source: Puroearth, 2022a, 2022b	• This is a business-to-business offset standard and international public offset registry. • It focuses solely on verified technologies that remove carbon at an industrial scale and store it for a minimum of 50 years, creating net removals. • Projects include those using biochar, construction materials, and soil amendments, as well as engineering approaches such as direct air capture.

4.3 Type 3: Platforms for reporting the progress of voluntary climate actions

4.3.1 What Are These Initiatives and Platforms?

These are initiatives in which different entities, such as local or regional governments or companies (the private sector or non-governmental entities), share and disclose their information on climate action. This information can include inventories of GHG emissions and removals, mitigation targets, action plans, implementation reports, and investments.

4.3.2 What Are These Platforms for?

Platforms to report climate action are used to monitor and track the evolution of climate action by different organizations on a voluntary basis. This helps to increase the transparency of the contribution and exposure of businesses to climate change. Participants sharing their information may respond to the interests of diverse actors (i.e., customers and environmental groups) and stakeholders, as well as the requirements of financing institutions.

4.3.3 Who Uses These Platforms?

Reporting entities that share their information on climate action in the platforms include private sector companies, non-governmental organizations, and local and subnational governments. The specific users of the information of each platform vary according to the specific objectives of the initiatives but usually include the international community, investors, public officers, and the general public.

4.3.4 Main Platforms in Use

Table 4 includes some of the most used platforms and initiatives by companies, governments, and other actors at the time of producing this report. Many companies report information associated with their carbon management strategies using other platforms—for instance, those associated with the GRI Standard; however, here, we focus on platforms defined exclusively to report climate mitigation action.

4.4 Type 4: Carbon-neutrality certification standards[11]

4.4.1 What Is Carbon Neutrality Certification?

These standards define a systematic approach to measuring, reducing, and compensating for the impact that a given product, activity, facility, or service has on GHG emissions. These standards also control the use of certain brands, labels, or claims that registered or certified entities can use to communicate their participation in the initiative and associated results.

Table 4. Voluntary initiatives and platforms for reporting climate action

Platform	Key highlights
CDP – formerly Carbon Disclosure Project Third-party verification: Required Source: CDP, 2020	• This platform enables and provides support (i.e., resources and strategies for supplier engagement) to investors, companies, cities, and states to disclose environmental information about their operations and those of their suppliers related to climate change, water security, and forests. • It is one of the world's largest, most comprehensive datasets on environmental action.
Race to Zero By the UNFCCC Source: UNFCCC, 2022	• This initiative was launched at the UN Climate Action Summit 2019 to encourage state and non-state actors to commit to and implement actions toward net-zero. • Actors wanting to participate in the initiative must comply with five requirements related to their climate mitigation efforts (the five P's): pledge, plan, proceed, publish, and persuade.

[11] In this section, carbon and climate neutrality standard are described. Carbon neutrality is used to refer to both types of standards for simplicity.

Platform	Key highlights
Science Based Targets By the World Resources Institute & UN Global Compact Third-party verification: Required Source: SBTi, 2021, 2022, 2023	• This initiative defines and promotes best practices for defining science-based GHG emission-reduction targets. • It independently assesses and approves companies' targets in line with its criteria before these are communicated externally. • Participants are required to disclose progress against the targets annually.
Global Climate Action Portal By the UNFCCC Source: UNFCCC, 2022b	• On this online platform, state and non-state actors can share their commitments, implementation efforts, and progress to tackle climate change. • The portal receives climate action data from other platforms, such as the Carbon Disclosure Project and the Carbon Climate Registry.

Companies can choose what they would like to certify (e.g., entire operations or a specific product, facility, or event). To achieve carbon neutrality, GHG emissions are first estimated via an inventory, and mitigation strategies are implemented to lower these emissions. Residual emissions (which cannot be reduced or are cost-prohibitive to reduce) are addressed by purchasing carbon offsets of certified projects. Each standard defines specific rules about which emissions are included and how they are reduced and compensated (i.e., Scopes 1, 2, and 3).

Carbon-neutrality certification standards are created and managed by crediting organizations that specify how their brands or labels associated with the certification can be used. Compliant companies usually pay a registration fee to these crediting organizations. Certified third parties or crediting organizations carry out verification. Some crediting organizations offer carbon accounting tools for a fee to assist the compliant company in the process. Crediting organizations may also restrict the purchase of offsets to pre-selected projects.

4.4.2 What Are Carbon-Neutrality Labels Used for?

Participating parties can earn the right to use a carbon-neutrality label to communicate their actions and achievements to various stakeholders, including other businesses, regulators, and end consumers. These labels are used to demonstrate compliance with climate change mitigation targets and contribute to net-zero pledges. They are used to distinguish the participants from their competitors.

4.4.3 Standards for Carbon Neutrality Certification

Table 5 presents 11 of the most widely used and recognized voluntary carbon-neutral standards. Users of these standards are companies and governments around the world. While most of the developers of these

standards are located in North America or Europe, their applicability is international. These standards can target products, companies, activities, events, and, to some extent, value chain activities.

Table 5. Voluntary carbon standards for certification as carbon/climate neutral

Standard and developer	Key highlights
Carbon-Neutrality Standard and Certification Publicly Available Specification (PAS) 2060 By the British Standards Institution Subject of certification: activities, products, services, organizations, communities, regional or local governments, clubs or social groups, families, individuals, travel, events, projects, buildings. Source: BSI, 2022	• This is an internationally recognized certification for organizational carbon neutrality. • It provides a standard definition and methodology to achieve carbon-neutral status, which is a reference for other carbon-neutral standards included in this table, as they follow or are aligned with the PAS 2060 set of requirements. • The British Standards Institution also offers support to entities during their carbon-neutrality journey.
Carbon Neutral Standard By Climate Impact Partners Subject of certifications: entities (companies, buildings), products, activities. Source: Natural Capital Partners, 2022	• The Carbon Neutral Protocol provides a framework and a standardized process to a diverse range of actors for making carbon-neutral claims. • The protocol is updated annually and establishes the requirements for the Carbon Neutral certification. • The certification can be awarded to organizations, products, and activities.
Climate Neutral Now By the UNFCCC Subjects of certification: Organizations Source: Climate Neutral Now, n.d.	• This initiative promotes voluntary action for climate mitigation (i.e., pledges to net-zero, measurement of GHG, and reduction measures) and the use of carbon market mechanisms (i.e., trading and crediting of emissions). • As it is not a certification scheme, members cannot claim carbon neutrality but are rewarded based on their progress. It also helps them to advance on their journey to comply with climate-neutral certifications. • The UNFCCC has decided to phase out the initiative starting in July 2023 and ending in December 2024.
Climate Neutral By South Pole Subjects of certification: companies, products, events, facilities, business activities. Source: South Pole, 2022	• This is a well-known certification program to obtain carbon neutrality aimed at companies and governments. • The initiative develops and implements its emission-reduction projects and strategies as business opportunities.

Standard and developer	Key highlights
Carbon Neutral By Carbon Trust Subject of certification: products, organizations. *Based on PAS 2060 Source: Carbon Trust, 2022	• This is a flexible and widely used certification program for carbon neutrality. • It targets organizations, sites, products, activities, and value chains (Scope 3).
Carbon Neutral Standard By Scientific Certification Systems (SCS) Global Services Subject of certification: entities, buildings, products, services, operations, supply chains. *Based on PAS 2060 Source: SCS, 2022	• This is a carbon-neutral standard that aligns with PAS 2060. • It considers Scope 1, Scope 2, and relevant categories of Scope 3. • It certifies numerous subjects, from products to buildings, entities, services, and activities.
Climate Neutral Certification By Climate Neutral Group Subject of certification: products, organizations, services, business activities. Source: CNG, 2022	• This is the only carbon-neutral standard following the code of Good Practice of ISEAL; it is also a community member of the ISEAL Alliance. • It offers certification for organizations, products, and services, with reduction targets different for each category.
Climate Neutral By ClimatePartner Subject of certification: product company, site, business activities. Source: ClimatePartner, 2022	• This is a certification program used to achieve carbon neutrality and a label. • It covers Scope 1 and 2 emissions and specific categories of Scope 3 (i.e., employee commuting, business travel, upstream electricity, heating/cooling, and fleet). • It operates globally but mostly in Europe.
Climate Neutral Certified By Climate Neutral Subject of certification: Products, organizations. *Based on GHG Protocol and SBTi. Source: Climate Neutral, 2022	• It is a certification standard of carbon neutrality and a label. It considers Scopes 1 and 2 and certain categories of Scope 3. Certification requirements can vary depending on the company's size. • Annual certification is required, and there are checkpoints to track progress.
Airport Carbon Accreditation By Airports Council International Europe Subject of certification: airports Source: ACI Europe, 2020	• It is a global carbon management certification program for airports that independently assess their efforts to manage and reduce carbon emissions. • It defines six levels of accreditation: mapping, reduction, optimization, neutrality, transformation, and transition.

As seen in the previous section, most carbon-neutral standards are the most comprehensive type of VSICMs and initiatives, as they encompass steps that the other three typologies of standards cover. To obtain carbon-neutral certification, entities must calculate their GHG inventories, implement a reduction strategy, purchase offsets to compensate for the residual emissions, and communicate their emissions and other related climate change mitigation activities through platforms. While all carbon-neutral standards propose a similar journey for entities to obtain certification, we have looked deeper into their specific requirements, including third-party verification. This additional benchmarking analysis can be found on the publication page of the State of Sustainability Initiatives (SSI) website on a series of scorecards for each carbon-neutral standard.

5.0 Conclusions

The negotiation of international legal agreements under the UNFCCC has driven climate mitigation action. Stemming from this development, countries have advanced at different paces to create legal obligations for companies in their jurisdictions to reduce emissions. However, current levels of action are not enough to prevent a dangerous change in climate and limit the global temperature increase to 1.5°C. Voluntary standards and initiatives operate in a partial void created by regulations that are still under construction: civil society and private actors have established VSICMs faster and more flexibly than legally binding initiatives. This has led to co-existence and competition among multiple initiatives, often with overlapping and complementary scopes and goals. This organic evolution of the landscape of VSICMs has created different situations that imply challenges for the governance of comprehensive climate action.

Many different standards and initiatives have emerged since the UNFCCC was created 30 years ago. Appendix A provides a timeline of the relevant events and dates related to the gestation and formation of the different VSICMs presented in this document. These initiatives have different purposes and functions and have created a complex landscape. While there is no unifying typology between and across different types of VSICMs and initiatives to facilitate understanding, we have grouped them in this report into four main types according to their goals:

- VSICMs for preparing GHG inventories and measuring carbon footprints
- VSICMs for issuing carbon offsets
- VSICMs for disclosing climate-related information
- VSICMs for certifying carbon/climate neutrality.

This classification offers new practitioners in the private sector an initial guide to navigate their way through the world of VSICMs. Indeed, some of these processes are already partially regulated in some countries for some companies and in specific sectors. Examples include requirements to prepare GHG inventories (mainly for emissions of Scopes 1 and 2) and the (voluntary) possibility to purchase offsets when participating in some ETS or in combination with carbon taxes. However, the actions associated with the four processes we propose remain largely voluntary for most companies, particularly micro, small, and medium-sized enterprises. This is especially true for initiatives that disclose information related to emissions reductions and mitigation efforts and pursue carbon-neutrality certifications. Still, there are no legal requirements for carbon neutrality, though the drive to reach net-zero emissions has boosted interest in these schemes.

The adoption of VSICMs has the potential to engage and initiate comprehensive action. Each company and entity must undertake its own journey to advance climate action as soon as possible. Managers should be aware of the different implications of climate change and its impacts. Their climate mitigation objectives should be based on science and technical information generated from their GHG inventories. This information is critical to identifying the required mitigation actions. Companies can work toward achieving net-zero by initially concentrating on reducing their emissions consistently with 1.5°C pathways and taking additional steps to compensate for any remaining emissions (UN, 2022); results should be periodically

evaluated. They can use platforms to disclose information on climate action and use carbon-neutral certification schemes to show and communicate their results.

Challenges arise when specific VSICMs are used, however. There can be differences in completeness when preparing GHG inventories because there are different options to define the boundaries of the inventories. Usually, the most critical factor is whether all relevant emissions processes of Scopes 1, 2, and particularly Scope 3 are integrated into the inventories. Another aspect relates to the quality of information used to document emissions factors, activity data, and estimate uncertainties. If GHG inventories are not similar regarding processes covered, they are hardly comparable. Incomplete GHG inventories undermine the prospects for practical climate action and comprehensive efforts toward 1.5°C. Technical and methodological issues remain to measure Scope 3 emissions in and across sectors and supply chains.

Another important challenge is how mitigation and emission-reduction plans are set. It is critical to understand how BAU is portrayed, whether claimed emissions reductions imply net increases or decreases of real yearly net emissions, and how far efforts are from net-zero and net removals. Scenarios consistent with a temperature increase below 1.5°C require a quick and deep reduction of emissions (e.g., 45% by 2030 compared to those observed in 2010 [IPCC, 2018b]). Investments in available emission-reduction technologies and infrastructure should not be delayed. In terms of scopes covered, if targets to reduce emissions and decarbonization efforts are limited to cover only Scope 1 or 2 emissions, contributions will also be limited. Mitigation actions must be defined for processes included in Scope 3 through collaborative action and insetting.

The participation of organizations in disclosure initiatives or the start of carbon-neutral certification processes can work as entry points for including climate action in their private agendas. If the strategies implemented are aligned with science and follow 1.5°C pathways, their contribution to climate change mitigation can be meaningful and verifiable. Therefore, and due to the requirements of these two types of initiatives, the companies will adopt other VSICMs to prepare their GHG inventories and mitigation plans and to take part in the VCM by purchasing offsets. Thus, carbon/climate-neutrality certification can be understood as "a standard of standards" (Whitman, personal communication, December 18, 2022) as it may motivate the use of the other type of standards described here.

Offsets can serve to transition to net-zero, but a viable solution in the long-term urges deep and quick cuts in emissions. As mentioned, if GHG inventories are incomplete, offsetting and claims of these certifications may also be incomplete and possibly misleading. In addition, different types of offsets can compensate for residual emissions under different initiatives. Therefore, it is important to ensure the quality of offsets and move toward the use of verifiable carbon removals and long-term removals.

VSICMs can be used internally for management and follow-up or externally as part of legal compliance requirements or to position a company or product among consumers, investors, and stakeholders as "climate friendly." In this context, integrity

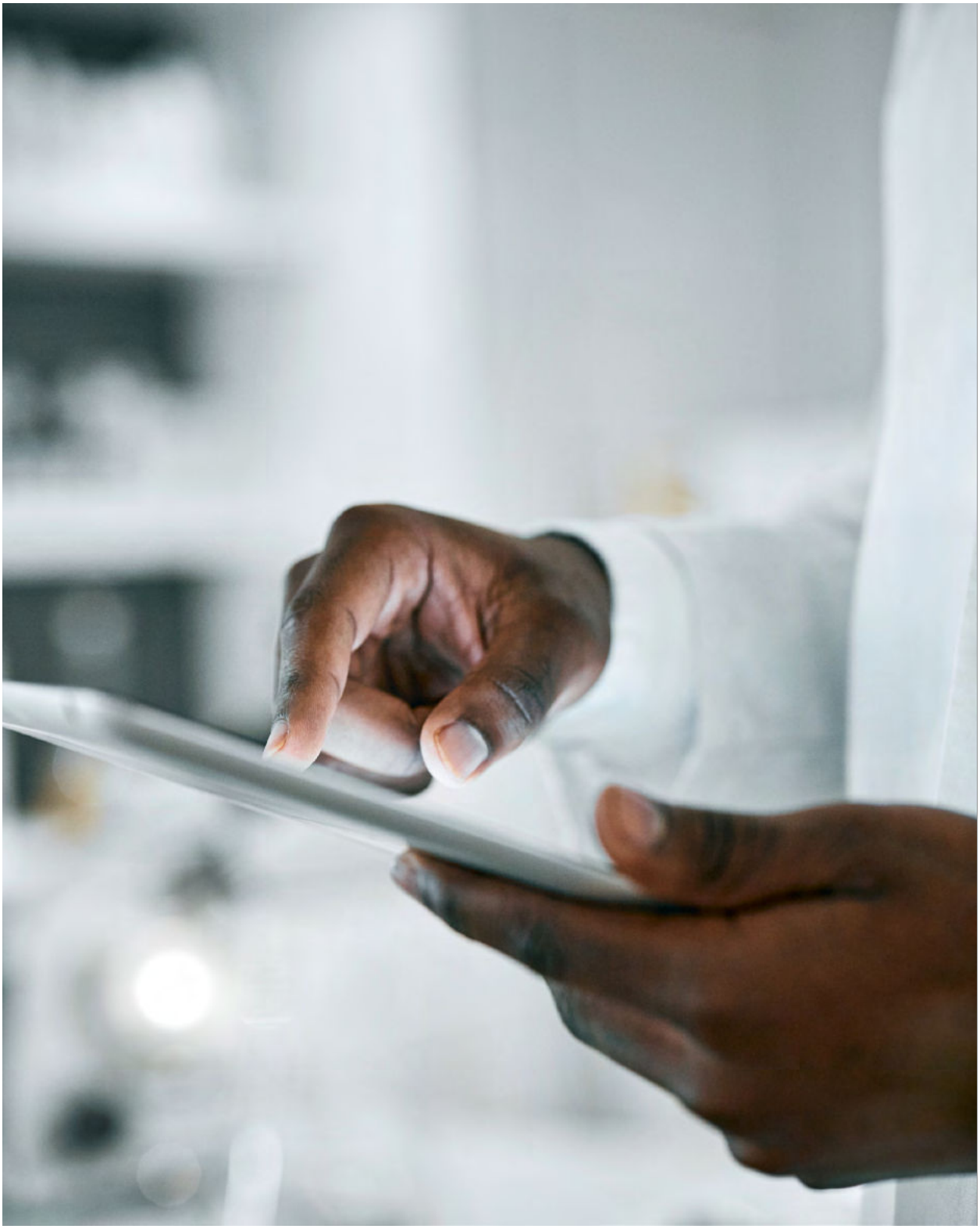
matters, as pointed out by the UN High-Level Expert Group on the Net-Zero Emissions Commitments of Non-State Entities at COP 27. Therefore, private and public sector actors—companies, investors, cities, and regions—must report the progress of their mitigation efforts with verified information that can be compared with peers (UN, 2022).

Nevertheless, comparing actions undertaken by different organizations can be difficult. This is partly because different definitions and considerations when different actors adopt different VSICMs can shape the limits and scopes of interventions that might undermine straightforward comparability. It is necessary to understand if we are comparing "apples to apples" or not—especially when these messages reach consumers and other corporate and social stakeholders. It is therefore imperative to keep working to ensure transparent and reliable claims and to educate consumers about the meaning of these claims.

The problem, however, is not only the lack of data or standardization of methods but also a lack of a clear governance framework, which hinders bolder actions with repercussions for investors and end consumers. Each type of VSICM has its own actors who operate in more or less structured governance systems. When looking at the four types of VSICMs together, though, there is no common initiative promoting coordination and collaboration among them toward a common end. The lack of effort to strengthen the governance around VSICMs, including multiple initiatives and levels, is a factor behind many of the challenges previously described. Strengthening governance would make it possible to increase transparency; set common definitions (e.g., for carbon or climate neutrality and how it is achieved); set common requirements or guidelines to define what information should be publicly available; define criteria to specify in which cases third-party verification is required; and establish best practice and guidance for making high-integrity claims, among others. This is an urgent task that must be addressed to show the effectiveness of implemented actions and the use of VSICMs, and to increase the credibility, clarity, and transparency of voluntary efforts.

A clear, growing, and urgent interest and demand for ambitious climate change mitigation exists. This interest and drivers go beyond compliance with legal regulations and include societal and consumer awareness, requirements of the financial sector, and corporate/private policies. In this context, when there are no legal requirements for specific and necessary action, VSICMs work as lighthouses and show roadmaps, presenting methods, steps, and considerations available to companies to move forward and initiate or increase the ambition of their climate change mitigation strategies. Voluntary action can help to bridge the gap. For this, however, it is necessary to eliminate any flaws and greenwashing of voluntary action that might hinder achieving climate goals. Furthermore, VSICMs must keep evolving and establish a more robust multilevel governance system (including the four types of VSICMs) and a practical agenda that can eventually transition into regulated environments to ensure a level playing field (UN High-Level Expert Group, 2022).

6.0 Limitations and Future Research



Science, policy, and the regulatory environment regarding the VSICMs included in this report are quickly evolving. Indeed, this document is just a snapshot of the current landscape as of March 2023. Standard-setters and organizations developing standards or providing services to companies to comply with some type of certification are also rapidly emerging. The list of VSICMs presented here is not intended to be an exhaustive and complete catalogue or even a list with the best standards but rather a list with some of the most widely known and used standards and initiatives according to our research and consultations with eight experts on the topic.

In addition, our intent with this report is not to provide a deep analysis of each VSICM, but a general description of their background, operation, and uptake. However, we have considered it necessary to look for more information about the requirements of carbon-neutrality standards (Type 4 in this report). Therefore, in addition to this document, we have produced a report that benchmarks nine carbon-neutral standards using a comprehensive list of indicators included in IISD's State of Sustainability Initiatives CARE (coverage, assurance, responsiveness, and engagement) methodology.

Future research could focus on expanding the list of 33 VSICMs included in this report, as well as the benchmarking of other VSICMs, adapting the methodology for that purpose. These efforts can support and lead to better harmonization, particularly focusing on standards and initiatives operating in specific sectors and products. To work toward harmonization of these standards and initiatives, future research could explore how to integrate voluntary mechanisms into regulatory and financing measures.

Finally, as Scope 3 emissions are increasingly included among VSICMs requirements, we recommend a deeper look into the different approaches regarding the inclusion of these supply chain-level emissions. This a complex task, but it is very relevant if the world is committed to reaching net-zero by 2050.

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Appendix A. Timeline of the development of VSICM

Table A1. Timeline of relevant events related to the development of different VSICMs

Date	Event	**Actor and location** (if applicable)	Type
Late 1970s	Introduction of the concept of "offsets"	United States	Standards background
1992	Earth Summit	United Nations [UN], Rio de Janeiro	Regulatory development
1994	United Nations Framework Convention on Climate Change (UNFCCC) entered into force	UN	Regulatory development
1994	Launch of Plan Vivo	Plan Vivo	Offset standard
1996	Launch of American Carbon Registry	Environmental Resources Trust	Offset standard
1997	Adoption of the Kyoto Protocol	UN	Regulatory development
1997	Launch of the Clean Development Mechanism	UN	Offset standard
1998	Launch of the Greenhouse Gas (GHG) Protocol	World Resources Institute (WRI), World Business Council for Sustainable Development (WBCSD)	GHG inventory
1998	Establishment of the Task Force on National GHG Inventories (TFI)	Intergovernmental Panel on Climate Change (IPCC) and UNFCCC	GHG inventory
2000	Carbon Disclosure Project founded	Carbon Disclosure Project	Platform
2001	Publication of the Renewable Energy Directive (RED)	European Union	Regulatory development
2001	Launch of GHG Protocol Corporate Accounting and Reporting Standard	WRI, WBCSD	Standards background

Date	Event	**Actor and location** (if applicable)	Type
2001	Launch of Carbon Neutral Certification	Carbon Trust	Carbon-neutrality standard
2002	Launch of Carbon Neutral Certification	Climate Impact Partners	Carbon-neutrality standard
2003	Launch of Gold Standard	Worldwide Fund for Nature (WWF) and others	Offset standard
2004	Development of the Bilan Carbone method	French Environment and Energy Management Agency	GHG Inventory
2005	Ratification of Kyoto Protocol at UNFCCC 3rd Conference of the Parties (COP 3)	UN	Regulatory development
2006	Launch of Verra – Verified Carbon Standard	Verra	Offset standard
2006	South Pole founded	South Pole	Carbon-neutrality standard
2006	ClimatePartner founded	ClimatePartner	Carbon-neutrality standard
2006	IPCC Guidelines for National GHG Inventories	IPCC	GHG Inventory
2007	IPCC report declares that the current climate variability is, without a doubt, the result of human activity.	IPCC	Standards background
2007	Establishment of The Climate Registry	California Climate Action Registry	GHG inventory
2007	Launch of Confederation of European Paper Industries (CEPI) Ten Toes	CEPI	GHG inventory
2007	United Kingdom enacts climate change law	United Kingdom	Regulatory development
2008	Mexico enacts climate change law	Mexico	Regulatory development
2008	Launch of Publicly Available Specification (PAS) 2050	British Standards Institution (BSI)	GHG Inventory

Date	Event	**Actor and location** (if applicable)	Type
2008	Creation of International Carbon Reduction and Offset Alliance (ICROA)	ICROA	Initiative
2008	Establishment of the Climate Action Reserve	California Climate Action Registry	Offset standard
2009	Launch of the Airport Carbon Accreditation (ACA)	Airports Council International Europe	Carbon neutrality standard
Late 2000s	Voluntary carbon market (VCM) emerges	Private sector and partners	Standards background
2009	Launch of PAS 2060	BSI	Carbon-neutrality standard
2012	End of Kyoto's first commitment (reduce 5% of emissions from 2008 to 2012)		Standards background
2012	Establishment of U.S. Environmental Protection Agency Inventory Guidelines	U.S. Environmental Protection Agency, Center for Corporate Climate Leadership	GHG inventory
2013	Launch of the European Union Environmental Footprint	European Commission	GHG inventory
2014	Launch of the Global Climate Action Portal	UNFCCC	Platform
2015	Paris Agreement	UNFCCC	Regulatory development
2015	Launch of the Climate Neutral Now initiative	UNFCCC	Carbon-neutrality standard
2015	Science-Based Targets Initiative founded	WRI, WWF, and the UN Global Compact	Platform
2016	Enforcement of carbon tax in Colombia	Colombia	Regulatory development
2016	ISO 14000 series for environmental management	International Organization for Standardization (ISO)	GHG inventory
2016	Establishment of the Global Carbon Council	Gulf Organization for Research and Development, North Africa	Offset standard

Date	Event	**Actor and location** (if applicable)	Type
2018	Revision of the ISO 14000 series	ISO	GHG inventory
2018	Puro.earth founded	Puro.earth, Finland	Offset standard
2018	Revision of the GHG Protocol Corporate Accounting and Reporting Standard	WRI and WBCSD	GHG inventory
2018	IPCC Special Report established 1.5°C as the limit. Emissions need to be reduced by 50% by 2030.	IPCC	Standards background
2018	Revision of RED becomes RED II	European Commission	Regulatory development
2018	Launch of Arcitecture for REDD+ Transactions (ART)- The REDD+ Environmental Excellence Standard (TREES)	Architecture for REDD+ Transactions Registry	Offset standard
2019	Climate Neutral founded	Climate Neutral, California	Carbon-neutrality standard
2019	Establishment of BioCarbon Registry	ProClima, Colombia	Offset standard
2019	IPCC Refinement of Guidelines for National GHG Inventories	IPCC	Standards background
2020	Launch of Race to Zero platform	UNFCCC Climate Champions	Platform
2021	Enforcement of European Union's RED II	European Commission	Regulatory development
2021	Glasgow Climate Pact at COP 26 called on parties to create more ambitious nationally determined contribution NDCs	UN	Standards background
2021	Launch of Carbon Neutral Standard	SCS Global Services, California	Carbon-neutrality standard
2021	21% of the world's largest public companies are committed to net-zero	Public sector	Standards background

Appendix B. An Overview of Selected Voluntary Standards and Initiatives for Carbon Management

This chapter presents an overview of 35 voluntary standards and initiatives for carbon management (VSICMs) and initiatives that can support private sector actors in their climate mitigation journey. It provides main characteristics, background, operation, results, and uptake.

B1 Methodology and Selection Process

We consulted eight experts and practitioners on different aspects of VSICMs. With this consultation, we wanted to identify the leading carbon standards and methodologies used by the private sector in the four categories identified.

We asked survey participants about the uses of the leading methodologies, standards, or initiatives—preparing greenhouse gas (GHG) inventories, generating carbon offsets, reporting advances in climate action, and offering carbon-neutrality certification. Participants were asked to list five main methodologies based on their perceived frequency of use, and then we calculated how often each specific methodology was mentioned. In the sections below, we present the summary information for the 10 methodologies most frequently cited for each type of action.

B2 Greenhouse Gas Emission Inventories

B2.1 Intergovernmental Panel on Climate Change's (IPCC's) Methods and Guidance for National GHG Inventories

Background

The World Meteorological Organization and the United Nations Environment Programme (UNEP) established the IPCC in 1988. The IPCC leads the effort to develop and refine internationally agreed methodologies for GHG inventories, which is overseen by the IPCC Task Force on National Greenhouse Gas Inventories (TFI), created in 1998.

TFI, in collaboration with the Organisation for Economic Co-operation and Development, the International Energy Agency, and the Institute for Global Environmental Strategies, developed methodologies to calculate and report national GHG emissions and removals and encourages

their widespread use in the energy, industrial processes and product use, agriculture, forestry, and waste sectors. The IPPC prepared the first set of methodologies for national inventories in 1998; these were updated in 2006 and refined in 2019 (IPCC, 2023). In 2000, it published its guidance for uncertainty management (IPCC, 2000) and in 2003, specific methodologies and guidance for land use, land-use change and forestry (IPCC, 2003).

According to the decisions of the United Nations Framework Convention on Climate Change (UNFCCC) Conference of the Parties (COP), under Annex I, parties must submit annual GHG inventories based on methodologies in the 2006 IPCC guidelines. These submissions are reviewed annually to assess the implementation of the convention, help Annex I parties improve their inventories, and enable countries to access climate finance mechanisms. The TFI updated the IPCC methodology and guidelines in 2019 (IPCC, 2019a). The product of 5 years of scientific work by 280 experts from 47 countries, the 2019 refinement is to be used in conjunction with the 2006 guidelines to enhance transparency and reporting based on the latest science (IPCC, 2019a). The IPCC is funded by regular contributions from its founding organizations, the World Meteorological Organization and UNEP, and voluntary contributions from its member countries and the UNFCCC.

Operation

The 2006 IPCC guidelines include steps to develop a national inventory and guidance on estimating GHG emissions and removals, including for different economic sectors. The guidelines also provide advice to ensure data collection is representative and time series are consistent; estimate uncertainties at the category and inventory level; facilitate quality assurance and quality control procedures during inventory compilation; and offer information to facilitate review and assessment of inventory estimates. Methodologies, separated into three tiers, are classified according to the accuracy of available data on emissions factors (IPCC, 2006).

Based on the IPCC guidelines, Annex 1 parties to the UNFCCC are required to submit national inventories composed of GHG emission and removal estimates, the quality of which depends on reliable emission factors and activity data. To this end, the IPCC Emission Factor Database, managed by TFI, was established in 2002 to develop inventory methodologies and practices to help inventory developers compile, document, and archive GHG emissions based on IPCC guidelines (IPCC, 2021a). The database provides users, particularly inventory compilers in UNFCCC member countries, with well-documented references for emission factors. It also establishes a web-based platform to disseminate research and measurement data and import emission factor data in bulk, which is accessible on a web-based platform managed by the Institute for Global Environmental Strategies with the support of Japan (IPCC, 2020). Emission factors characterize the potential of a given activity, material, waste, or wastewater to generate certain GHGs (IPCC, 2019a). Using IPCC sectoral source and sink categories, the inventory agency enters information about each gas into the database, with three default parameters for the type of emission (i.e., measured, modelled, or compiled). Authors of guideline documents are nominated by governments and selected by TFI.

To prepare their national inventories, countries decide the tier for the different emission factors required based on the availability of information. Tier 1 values correspond to information from international datasets and IPCC default values and are more conservative. Tier 2 values are generated through studies and with national-level information specific to the country, while Tier 3 values are produced from local or regional studies and/or models.

National governments directly and officially used IPCC methodologies and guidance to comply with obligations under the UNFCCC. Given the scientific rigour, however, the guidelines are a key reference for estimating GHG emissions in different sectors and at different scales globally (e.g., Gillenwater, 2020).

Results/Uptake

The IPCC guidelines are considered the foundational reference for GHG measurement, reporting, and verification. All GHG programs, methods, and policies are considered to be rooted in the IPCC guidelines, including nationally determined contributions (NDCs) under the Paris Agreement, project methods from VSICMs, corporate reporting under the GHG Protocol, and carbon-neutral claims (Gillenwater, 2020).

B2.2 The Greenhouse Gas Protocol

Background

The GHG Protocol is a widely used standard used to measure and manage GHG emissions from private and public sector operations and value chains, as well as mitigation actions. The protocol—a partnership between the World Resources Institute, a U.S. environmental non-governmental organization (NGO), and the World Business Council for Sustainable Development, a coalition of more than 200 leading companies—was launched in 1998 (GHG Protocol, 2022a). It operates in close collaboration with governments, industry associations, businesses, and NGOs. While many protocol standards focus on consistent GHG measurement, the Mitigation Standard goes one step further to train countries and cities on how to evaluate and report emissions reductions, including those related to NDCs under the Paris Agreement. Funding for the protocol comes from private and public sources, such as Environment Canada, Microsoft, the U.S. Environmental Protection Agency, Shell, UN-Habitat, and the Walmart Foundation (GHG Protocol, 2022b). GHG Protocol standards adhere to an inclusive, consensus-based multistakeholder process with balanced participation from government, the private sector, NGOs, and academia.

Operation

The GHG Protocol develops standards, tools, and online training to support countries, cities, and companies to measure and track progress toward their climate goals, including under the

Paris Agreement. The Corporate Accounting and Reporting Standard, the first GHG Protocol standard, released in 2001 and revised in 2018, serves as an international benchmark for establishing GHG emission inventories.

The GHG Protocol has three additional standards for companies and organizations: the Corporate Value Chain Standard, outlining accounting for indirect emissions (Scope 3); the Product Standard, covering life-cycle emissions for products; and the Project Protocol, providing principles, concepts, and methods for climate change mitigation projects. The GHG Protocol built on the initial Publicly Available Specification (PAS) 2050 method to develop its Product Standard, and PAS 2050, in turn, built on the Product Standard experience for its 2011 revision. This cross-collaboration has ensured consistency between the key methodological elements underpinning quantification in both standards (GHG Protocol, 2022a).

Participants and users are cross-sectoral, as the standards, tools, and online training are used to support countries, cities, and companies.

Results/Uptake

The GHG Protocol is among the most widely used GHG accounting standards. Since the publication of the first edition of the *Corporate Accounting and Reporting Standard* in 2001, more than 1,000 businesses and organizations worldwide have developed their GHG inventories using the protocol. In 2019, the protocol launched the Partnership for Carbon Accounting Financials to develop a global standard for the financial industry to report GHG emissions from investments based on recommendations by the Taskforce on Climate-Related Climate Financial Disclosures (TCFD). Nine out of 10 Fortune 500 companies reported using the GHG Protocol directly or indirectly in 2016 (GHG Protocol, 2022a). It is considered a milestone that the ISO used the Protocol's Corporate Standard as the basis for developing the ISO 14064 series specifications to quantify and report GHG emission removals, including requirements for the design, development, management, reporting, and verification of an organization's GHG inventory (Chartered Professional Accountants of Canada & Institute for Sustainable Finance, 2022).

B2.3 ISO-14064

Background

The International Organization for Standardization (ISO), an independent NGO with a membership of 167 national standards bodies, was established in 1947 to foster commercial relations among countries, with standards continually reviewed in light of changing knowledge (ISO, 2022a). The ISO 14060 series for environmental management, published in 2006 and

updated in 2018, is widely used to establish quality, consensus-based international standards to quantify, verify, and report GHG emissions (ISO, 2022b). Application of the ISO 14060 series of standards includes corporate decisions, such as identifying emissions-reduction opportunities and increasing profits by reducing energy consumption; carbon risk management, such as identifying and managing risks and opportunities; voluntary initiatives, such as for use in voluntary GHG registries or on GHG markets; and national regulatory GHG programs, such as to gain credits for early action or reporting purposes. ISO is financed by national members' subscription fees, proportional to gross national income and income from the sale of standards, with proceeds shared with members and national standards bodies.

Operation

The ISO 14064 standard is a set of tools for programs to quantify, monitor, report, and verify GHG emissions. ISO standards are consensus-based, rigorous, and current, offering baselines for policy-makers to create climate mitigation strategies and regulations involving consultations with public and private stakeholders and experts.

ISO 14064-1 sets out organizational requirements to qualify and report GHG emissions and removals, including the design, development, management, reporting, and verification of a GHG inventory. ISO 14064-2 is used to quantify the amount of GHG emissions reductions or removals, while ISO 14064-3 serves as a framework to verify and validate GHG emission reports developed using 14064-2 and other project-level GHG quantifications. Since it was first published in 2006, the 14064 series has been widely used in voluntary carbon markets (ISO, 2018). The new ISO 14064-3 has been expanded to apply to product-level carbon footprint reports. ISO 14064-2 and ISO 14064-3 apply to any project in any sector, region, or organization, with new principles, validation tools, and the ability to address indirect emissions and product life cycles (ISO, 2019). ISO is working to develop a specific standard for carbon neutrality (ISO, 2022b).

Users of the ISO 14064 family are global, including governments, businesses, regions, and other organizations.

Results/Uptake

ISO standards continue to evolve and expand to support the development of emissions reporting, particularly to guide NDCs submitted under the Paris Agreement (Hamrick, 2018). In the coming decades, ISO climate-related standards, from energy management systems to GHG measurement, are being prepared to provide a foundation and ensure best practices (ISO, 2022c). ISO standards ensure quality and consistency of monitoring, reporting, and verification for GHG emissions. For example, the European Union (EU) Emissions Trading System specifies ISO requirements to verify GHG emissions and accredit verifiers. The International Carbon Action Partnership 2020 annual report and KPMG survey of sustainability, for example, amply reference ISO standards and their role in enabling GHG emissions reductions (International Carbon Action Partnership, 2020; KPMG Impact, 2020).

B2.4 The Climate Registry

Background

The Climate Registry (TCR) is a U.S.-based, non-profit, private organization that operates a voluntary GHG reporting program providing services and tools to help North American organizations report and reduce their GHG emissions, showcase subnational leadership, and build strategic partnerships. Established in 2007, TCR was formed to continue the work of the California Action Registry, created by the State of California in 2001, to promote early actions by the private sector to reduce GHG emissions based on consistent data in an integrated system (TCR, 2022a). TCR expanded from California to cover North America.

TCR partners with the Climate Action Reserve, its sister organization, for training on emissions reporting. The California Environmental Protection Agency sponsors TCR, which is also funded by membership and event fees. A Council of Jurisdictions that includes representatives from different U.S. states, Native Nations, and Canadian provinces and territories advises TCR. TCR created a global, cross-sectoral platform called the Net-Zero Portal, a digital database for tracking and comparing information about net-zero and carbon-neutral pledges, reports, and research based on stakeholder consultations with more than 60 organizations (TCR, 2022a).

Operation

TCR designs and operates GHG reporting programs that operate in the voluntary and compliance markets globally and helps organizations measure, report, and verify carbon emissions and reductions in their operations. The TCR proprietary GHG calculation and reporting tool uses verified GHG data from leading public and private members, publicly available through its online portal, the Climate Registry Information System (TCR, 2022b).

Public and private members, ranging from small businesses and local communities to institutions and government agencies, use TCR to calculate and publicly disclose annual carbon footprints and work toward reducing GHG emissions to reach net-zero goals.

Results/Uptake

In 2021, TCR reached a total of 1,664 GHG emission inventories reported and verified through The Climate Registry Information System, representing 320 organizations and 24 Climate Leadership Award winners, including 3 TCR members (TCR, 2022a). Companies, universities, electric utilities, and government agencies have used TCR to register more than 1.8 billion tonnes of carbon dioxide equivalent (CO_2e). Success stories include the California Department of Water Resources, which achieved its 2020 goal to reduce GHG emissions by 50% measured against a 1990 baseline (5 years ahead of schedule, in 2015), with 65% of its power portfolio sourced from its own carbon-free hydroelectric generation and renewable energy purchases; and the California

Public Employees Retirement System achieved its goal to reduce GHG emissions by 20% by 2020, measured against a 2010 baseline (TCR, 2022b). In partnership with the Climate Action Reserve and the Greenhouse Gas Management Institute, TCR trained third-party verification bodies on how to conduct verifications for the California Air Resources Board's Low Carbon Fuel Standard, including accurate data monitoring to track its effectiveness in reducing and removing GHG emissions in the transportation, energy, and industrial sectors. In 2021, TCR and the Center for Climate and Energy Solutions co-hosted a virtual Climate Leadership Series & Awards Showcase that engaged more than 2,000 sustainability professionals on a variety of topics, from climate risk and natural climate solutions to equity and transportation.

B2.5 PAS 2050

Background

The Publicly Available Specification (PAS) 2050, developed by the British Standards Institution (BSI) in 2008, is considered to be the first standard to take a life-cycle assessment approach to measuring GHG emissions associated with goods and services. PAS 2050 is a consensus-based, internationally applicable standard for product carbon footprinting, applied by companies worldwide to measure their GHG life-cycle emissions. The 2011 revision to PAS 2050 was developed in consultation with stakeholders and its user community. PAS 2050 focuses exclusively on GHG emissions generated during a product's life cycle; it does not consider other potential environmental, social, and economic impacts (e.g., biodiversity, water use, labour standards, and other product impacts) (BSI, 2011). PAS 2050 is broadly consistent with the GHG Protocol Product Standard. The GHG Protocol built on the initial PAS 2050 method in developing its Product Standard. In turn, PAS 2050 drew on lessons learned during the Product Standard's development process in its 2011 revision. As a result of this cross-collaboration, the key rules underpinning the methods in both standards are consistent (GHG Protocol, n.d.).

Operation

PAS 2050 includes the following steps to quantify the carbon footprint of goods and services through the development of a carbon footprint project (BSI, 2011):

1. Scoping: set objectives, select the product to be assessed, define boundaries for included life-cycle stages, and prioritize data-collection activities.
2. Data collection: engage with suppliers to collect activity data and calculate carbon footprint (e.g., check boundaries, set priorities, collect data, and calculate).
3. Validate and interpret the results, identify carbon-reduction opportunities, and reduce emissions associated with the assessed product or, more widely, at an organizational level.

4. Communicate/record the footprint and claim reductions.

PAS 2050 is widely used globally (but mainly in Europe and the United Kingdom) and is considered the first carbon footprint standard used internationally. The standard has been downloaded from the BSI (2023) website more than 35,000 times from around 80 countries.

Results/Uptake

Revisions in 2011 made the PAS 2050 methodology more relevant and accessible to a wider range of businesses by addressing key issues raised in the carbon footprinting community, as well as user experiences, since the standard's publication in October 2008. Some of the changes from the review are provisions for developing additional requirements to enable specific GHG emission assessments within sectors or product groups, the inclusion of emissions from biogenic sources (e.g., biomass), and greater clarity on the treatment of recyclable material.

B2.6 U.S. Environmental Protection Agency's (EPA's) Inventory Guidelines

Background

The EPA inventory guidance offers companies and organizations resources to develop GHG emission inventories (Center for Corporate Climate Leadership [CCCL], 2022). The CCCL, created in 2012, manages the inventory guidance, which is based on and aligned with the GHG Protocol Corporate Standard, the global standard for calculating corporate GHG emissions, as well as guidance on GHG accounting principles, defining inventory boundaries, identifying GHG emission sources, defining an inventory base year, and tracking emissions. To streamline GHG measurement and management, the CCCL develops inventory resources to complement the GHG Protocol Corporate Standard, providing specific guidance on GHG calculation methodologies and emission factors.

For example, based on Chapter 10 of the GHG Corporate Standard, the EPA has developed two target-setting resources: Corporate GHG Inventorying and Target Setting Self-Assessment permits for benchmarking GHG, based on an analysis of more than 500 publicly reporting companies in 2017, to help identify which inventorying and target-setting actions reflect common business practices and validate inventorying, target-setting, and cost-effective GHG emissions reductions (U.S. EPA, 2022c). The annual GHG Inventory Summary and Target Tracking is facilitated through Excel forms, setting emissions in terms of total CO_2e at an organization level, categorized by emission source type: Scope 1, direct (e.g., stationary combustion, process,

mobile sources); Scope 2, indirect (e.g., electricity, steam purchases); and Scope 3, indirect (e.g., employee commuting, business travel, product transport). The form also includes historical totals, a performance indicator to track progress toward reduction targets, data on reduction sources such as offset projects, and green power or renewable energy certificate purchases (U.S. EPA, 2015).

Operation

The GHG inventory development process consists of four key steps:

1. Review GHG accounting standards and methods for organizational reporting and choose a base year.
2. Collect data and quantify GHG emissions.
3. Develop a GHG inventory management plan to formalize data-collection procedures.
4. Set a GHG emissions-reduction target and track and report progress, with optional third-party verification. (EPA, 2022c)

A key component of developing a GHG inventory is the use of emission factors. Information on each step and complementary EPA guidance and resources are publicly available online (EPA, 2022c), as well as from the CCCL (2022). The GHG Emission Factors Hub provides organizations with a regularly updated, easy-to-use, and consolidated set of default emission factors with standardized units for organizational GHG reporting (EPA, 2022b).

The EPA Inventory Guidelines are designed for organizations and companies, including small businesses and low emitters.

Results/Uptake

The EPA guidelines for GHG inventories are seen as providing significant resources for businesses and organizations to compile GHG inventories using standardized methods, which has made it easier to manage GHG measurement risks and identify reduction opportunities, participate in voluntary and mandatory GHG programs and GHG markets, and recognize early voluntary action. The EPA GHG Reporting Program says that requiring large GHG emission sources and U.S. fuel and industrial gas suppliers to report GHG data means about 8,000 facilities must report their emissions annually (U.S. EPA, 2020). The program also offers resources to support the public use of and derive value from GHG data. For example, the Emissions & Generation Resource Integrated Database is a comprehensive source of data on the environmental characteristics of electric power generated in the United States typically used for GHG registries and inventories, carbon footprints, consumer information disclosure, emission inventories and standards, and avoided emission estimates (U.S. EPA, 2020).

B2.7 EU Environmental Footprint

Background

The EU Environmental Footprint, launched in 2013, is a common framework developed by the European Commission (EC) to calculate and communicate the life-cycle assessment (LCA) of goods and services as well as organizations across the EU. Together, the Product Environmental Footprint (PEF) and the Organization Environmental Footprint (OEF) form the basis for the EU Environmental Footprint. The PEF and the OEF, developed by the EC's Joint Research Centre, are multi-criteria methods covering the LCA of the entire value chain of products and organizations. First published in the EC's Single Market for Green Products initiative (EC, 2012), the directive includes product-specific, sector-specific, and organizational methodological guidelines called Product Environmental Footprint Category Rules (PEFCRs) or Organization Environmental Footprint Category Rules. The PEF and the OEF aim to provide information to reduce the environmental impacts of goods, services, and organizations, taking into account all value chain activities (from the extraction of raw materials, production, and the use to final waste management). These product-specific and sector-specific rules were piloted to explore options to communicate life-cycle environmental performance to business partners, consumers, and company stakeholders, involving more than 280 firms and organizations (EC, 2022b). The Environmental Footprint builds on existing approaches and international standards (such as ISO 14040, the ISO 14025 series, and International Life Cycle Reference Database Handbook guidelines).

The European Platform on Life Cycle Assessment was launched in 2005 in cooperation with the Joint Research Centre to promote life-cycle concepts in business and policy-making in the EU by focusing on data and methodology. The platform and Joint Research Centre technical reports represent the scientific basis of Environmental Footprint methods, which are then applied, tested, and improved with input from industry and other stakeholders.

Recommendation 2013/179/EU outlines the technical details of the Environmental Footprint methods, with additional guidance developed during the pilot phase (2013–2018) and the transition phase (2019–2022) (European Commission, 2013). PEF rules for a reference product and product ranking system to communicate information to consumers—for example, through a label—are based on an aggregation of LCA results into a system of three categories (climate, water, and resources), which is then combined into an overall ranking. The PEF aims to increase comparability between products by predefining certain requirements, thereby reducing the flexibility provided by ISO 14044, the internationally accepted LCA standard.

The PEF also aims to establish product declarations for specific applications—for example, to use LCA—in the product category rules, based on ISO 14025. PEFCRs are life-cycle-based rules that

complement the general PEF method by providing further specifications for product categories. PEFCRs are defined based on consensus and include stakeholders from industry, academia, and NGOs. The PEF uses publicly available data from databases, such as the European Life Cycle Database.

The PEF covers 14 impact categories. Businesses and organizations in the EU use this standard.

Results/Uptake

There are several important pending issues, including whether PEF will be mandatory or voluntary for companies and whether businesses will need to add a label on their product to certify that they are PEF-compliant (Gumbau, 2022).

B2.8 CEPI Ten Toes

Background

In 2007, CEPI was among the first to propose a standardized framework enabling companies to undertake carbon footprints for paper and board products. Since then, three major internationally recognized product-related carbon footprint protocols and frameworks have been published: ISO 14067 (2013), the GHG Protocol Product Standard (2011), and the EU PEFCRs for Intermediate Paper Products (2016). CEPI recognizes Scope 1 emissions under the GHG Protocol and under ISO14064:2006 (direct emissions), and Scopes 2 and 3 under the GHG Protocol and ISO 14064:2006. CEPI is aligned with the PEF, PAS 2050 category rules, PEFCR for intermediate paper products, and BPX 30-323 (French environmental footprint guidance) (CEPI, 2017).

The Ten Toes framework aims to highlight the attributes of paper and board products and illustrate measurable progress toward reducing emissions along the value chain. CEPI Ten Toes seeks to enable companies to address their individual needs in a way that is consistent and in alignment with guidance from ISO and the GHG Protocol. Offsets are not included in this framework. The CEPI Ten Toes common framework identifies 10 key elements of the carbon footprint of paper and board products (CEPI, 2017).

Operation

The framework consists of five general points of guidance, a proposal for a common approach, and a description of the 10 elements included in carbon footprint calculations for paper and board products (i.e., the toes of the footprint). The toes set out elements of the footprint and approaches, with specific requirements for calculating GHG emissions:

1. The first two toes describe key attributes of paper and board products: carbon removal and storage in forests and in products.
2. The next five toes outline emissions associated with processes required to transform wood from forests into final consumer products.
3. The eighth toe addresses the use phase of the product. The ninth deals with end of life, and the optimal tenth toe addresses avoided emissions from the use of non-recyclable paper and board products for bio-based, renewable energy (CEPI, 2017).

This methodology can be used globally, but it is mostly used in Europe.

Results/Uptake

The Ten Toes framework allows clear numbers to be generated in a common approach to deal with direct and indirect emissions, carbon sequestration in forests and products, the value of bioenergy, and the concept of avoided emissions.

B2.9 Bilan Carbone

Background

The Bilan Carbone method was developed in 2004 by the French Environment and Energy Management Agency (Agence de l'Environnement et de la Maîtrise de l'Energie [ADEME]) to measure GHG emissions for citizens, companies, public institutions, and territorial collectivities, administered since 2011 by the not-for-profit Association for the Low Carbon Transition (Association pour la transition Bas Carbone) (ABC, 2022). ABC and its partners build and disseminate methods and operational solutions to reduce GHG emissions and support the transition to a low-carbon society. Bilan Carbone and SM-GES are registered trademarks of Association Bilan Carbone, originally developed by Jean-Marc Jancovici of the Manicore consulting firm. While access to emission factors is public, using the Bilan Carbone method to calculate emissions requires a licence. ADEME published revised methodologies for emission reporting for use in 2023 (ADEME, 2022b). France carries out an annual national inventory of direct GHG emissions conducted by the Technical Reference Centre for Air Pollution and Climate Change (CITEPA), an independent body (CITEPA, 2022) created in 1961 to develop methods to monitor, quantify, and model emissions and mitigation and adaptation measures. In the 1990s, CITEPA was at the origin of European GHG inventory systems, Common Reporting Format (CRF) nomenclature, and monitoring, reporting, and verifying methods.

The Bilan Carbone method estimates GHG emissions by multiplying data for an organization's activity by an emission factor covering Scopes 1, 2, and 3. The Bilan Carbone website provides access to tools and methodologies to carry out and manage transition plans to reduce GHG emissions (Bilan Carbone, Bilan Carbone+, Bilan Carbone Territory, GES Management System,

ALDO), as well as training courses, studies, and publications (ADEME, 2022b). The Bilan Carbone method complies with ISO 14064 and the GHG Protocol, and aligns with the EU Directive No.2003/87/CE for GHG emission allowance trading (ABC, 2022).

Operation

Bilan Carbone includes environmental accounting to measure GHG emissions differentiated based on inventories for organizations and territories and to assess the carbon LCA of products and the carbon footprint of projects and investments, including direct and indirect GHG emissions (Bilan Carbone Scopes 1, 2, and 3). The Bilan Carbone method permits companies and territorial collectivities to carry out a global assessment of GHG emissions, whether direct or indirect, and to collect data and then apply the emission factors from the Bilan Carbone database (Version 8) (Association Bilan Carbone, 2017). Sectoral guides bring together sectoral stakeholders to complete and adapt the general methodology to undertake a GHG assessment for the organization in a specific sector; provide sectoral elements to enrich the Base Carbone, a public database of emission factors; propose examples of good practices for reducing GHG emissions; and benefit from a collective dynamic (Bilan Carbone, 2022). Industry experts and bibliographical sources have been used to develop the emission factors.

It is used in Europe, mainly in France. ABC works with public and private sector partners to develop the Bilan Carbone tool and GHG management system.

Results/Uptake

As of 2022, Bilan Carbone had 74,699 registered members, 5,311 validated emissions factors, 4,629 published GHG inventories, and 19 sector guides (ADEME, 2022a). Version 8 of Bilan Carbone is considered to have introduced a more flexible methodology, enabling users to develop GHG emission-reporting systems based on strategic analysis and best practices. Bilan Carbone tools have also evolved to better manage and monitor data (ABC, 2022).

B3 Voluntary Carbon Market Offsets

B3.1 Clean Development Mechanism

Background

The CDM is the first international carbon finance and offset mechanism adopted as part of the Kyoto Protocol in 1997 under the UNFCCC.

CDM projects aim to lower GHG emissions and support sustainable development in developing countries to achieve a "development dividend," particularly by incentivizing renewable energy and other projects (Cosbey et al., 2005).

Operation

Article 12 of the Kyoto Protocol permits industrialized countries and economies in transition (Annex I parties) to meet part of their obligations by implementing emission-reduction projects in developing countries and earning tradable certified emission-reduction (CER) credits (UNFCCC, 2022c). CERs are certificates issued for GHG reductions from CDM projects or programs of activities according to CDM requirements. The CDM issues one CER for each tonne of GHG emissions avoided or removed from the atmosphere, subject to verification. CERs serve as a standardized emission offset instrument, with the objective of stimulating sustainable development and emissions reductions while giving industrialized countries flexibility and cost-effectiveness in meeting their emissions-reduction targets (Cosbey et al., 2005; UNFCCC, 2022b). The first CDM project was registered in 2004, and the first CER credit was issued in 2005. The CDM has been self-financing through fees from projects since 2007, no longer relying on grants from the parties.

Actors use carbon offset projects under the CDM to facilitate voluntary purchases and track CERs through emissions registries, including the CDM registry operated by the UN Climate Change secretariat (UN Climate Change, 2022a, 2022b). While tradable credits from other schemes are not recognized under the CDM, other standards accept CERs, such as the EU Emissions Trading System (ETS) and the Verified Carbon Standard (VCS). The Gold Standard uses CDM methodologies for projects that also comply with its criteria.

The CDM establishes standards and methodologies to quantify and monitor emissions-reduction projects (UNFCCC, 2018). The designated national authority from each party (there are 172 such authorities in total) confirms the participation of the project in the CDM and its contribution to sustainable development. Public and private sector actors can acquire CERs from project developers or brokers—for example, in energy conservation and renewable energy projects in developing countries.

An executive board oversees the CDM; it is accountable to the governing body of the Kyoto Protocol, including all ratifying member countries, and supported by panels of experts. The methodologies panel reviews methodologies for the 100+ approved project types. The CDM establishes third-party verification of project proposals, results, and monitoring through authorized auditors.

The *CDM Methodology Booklet* is the guiding reference for activities and areas covered by projects. It covers 216 methodologies establishing the rules for designing projects and 39 standardized baselines in 15 sectors, such as energy and agriculture (UNFCCC, 2021a).

The CDM is international in scope and open to all countries that have ratified the Kyoto Protocol. Initially, CER purchases were motivated by buyers in Annex I countries that wanted

to comply with their targets under the Kyoto Protocol. However, any individual or organization in any country can buy CERs and use them as part of environmental responsibility efforts to offset emissions.

Results/Uptake

The CDM dominates the carbon offset market and is subject to the ongoing Paris Agreement negotiations (Kerschner et al., 2022). CER credits issued under the CDM are traded and priced in major global commodity exchanges. The market price for certified emission-reduction credits has ranged widely, from a high of EUR 25 in 2008 to a low of EUR 0.50 in 2012, given supply is potentially greater than demand. Prices vary on negotiations made on a project-by-project basis, and in 2022, on the UN Carbon Offset Platform, reached levels up to USD 15 to USD 27 per tonne of CO_2e (UN Climate Change, 2022b).

Since 2001, the CDM has facilitated more than 12,500 projects, with programs and activities in 111 countries reducing or avoiding 2 billion tonnes of CO_2e and incentivizing investment topping USD 300 billion in climate and sustainable development projects (Louhisuo & Takahashi, 2022). For example, more than 1 million efficient cookstoves were installed, reducing emissions while improving health; upwards of 840,000 people received access to clean drinking water; and more than 150 million trees were planted (UNFCCC, 2018).

B3.3 Gold Standard

Gold Standard®

Background

Gold Standard, established in 2003 by the World Wildlife Fund and other international NGOs, operates carbon offsets, prioritizing the environmental and social co-benefits that contribute to the Sustainable Development Goals (SDGs). Gold Standard certifies emissions-reduction projects based on the requirements of the CDM (Gold Standard, 2022b). Gold Standard Verified Emission Reductions were launched in 2006 for use in VCMs. The Gold Standard certification program is a non-profit foundation in Switzerland that employs local experts in Brazil, India, and South Africa.

Operation

The Gold Standard framework monitors, reports, and verifies projects in eligible sectors, including land use, nature-based solutions, renewable energy, energy efficiency, and waste and water management. Gold Standard has a well-developed stakeholder consultation process to verify GHG emissions-reduction projects and their certification to ensure high-impact climate resilience and streamline access to carbon credit markets, in line with the Paris Agreement. The focus is the environmental and socio-economic co-benefits of carbon projects for local communities in developing countries. Financing is through donors and income from fees.

Gold Standard certification requires a project to lower GHGs by supplying renewable energy, reducing end-user energy or waste use, or contributing to afforestation, reforestation, or agriculture, using clear documentation and addressing at least three SDGs for the co-benefit of local socio-environmental outcomes (Gold Standard, 2022a). Gold Standard has defined additionality rules, third-party auditing, and an approval body similar to the CDM. The Technical Advisory Committee, the Gold Standard secretariat, and supporting NGOs review verification reports. Once certification is approved, Gold Standard directly issues the credit (Verified Emission Reduction Unit) or certification of CERs with unique serial numbers. Gold Standard-certified projects are listed in a public registry (Gold Standard Foundation, 2014) managed by IHS Markit Environmental Registry, a private company that discloses project documentation and tracks credit issuance, transfer, and retirement (IHS Markit Environmental Registry, 2022a).

The latest version of the Gold Standard for the Global Goals was released in 2017. Gold Standard has activity requirements and associated impact qualification methodologies for renewable energy, land use and forest activity, and sustainable urban development. Certification criteria include on-the-ground implementation contributing to climate security, sustainable development, and the SDGs. SustainCERT reviews project proposals. An accredited validation/verification body assesses approved projects, including through a field visit. The project then submits the documentation and fees to apply for Gold Standard certification. Certified projects are monitored, including through third-party validation and SustainCERT performance reviews.

As a leading global player in green financing of GHG mitigation and carbon offset programs focused on delivering the SDGs, the Gold Standard can be applied to voluntary offset and CDM projects and is open to any community-based NGO.

More than 100 international NGOs consider the Gold Standard as the best practice standard for projects to develop, certify, and verify GHG emissions reductions. Gold Standard Climate+ also supports local communities and includes projects related to wind (accounting for 40% of its portfolio by number of credits, especially in Turkiye and China), domestic energy efficiency (cookstoves, biodigesters for household gas, and safe water provision), and protecting forests.

Results/Uptake

Gold Standard is applied to 2,600 projects in more than 98 countries and is estimated to have reduced 184 million tCO_2e and 17% of the carbon market (CarbonCredits.com, 2022) and created USD 31 billion in shared value since its inception. Gold Standard projects continue to grow in volume and breadth, with 44 million credits issued in 2021—for example, from the Yarra Yarra Biodiversity Corridor in Western Australia to the Hawaiian Legacy Hardwoods reforestation and biodiversity project.

B3.4 American Carbon Registry

Background

The Environmental Resources Trust founded the ACR in 1996 as a voluntary GHG registry. It became a non-profit enterprise of Winrock International in 2007. As the first private voluntary registry for carbon markets, ACR is a U.S.-based, international emission-reduction credit program focused on the Americas (ACR, 2022a). Their certified projects cover agriculture, forestry and other land-use projects, industrial processes, and waste.

Operation

Through its online registry system, ACR has developed environmentally rigorous, science-based offset methodologies, in addition to overseeing project-based verification, registration, offset issuance, and credit reporting. Since 2012, ACR has been an approved offset project registry issuing Registry Offset Credits and an offset program issuing Early Action Offset Credits for California's cap-and-trade program. Projects are transferrable between ACR and other registries as long as unsold, non-transferred, and non-retired credits are cancelled. ACR issues one Emission Reduction Ton (ERT) for each tonne of CO_2 emissions reduction or removal, verified against an ACR standard and methodology. ACR operations are overseen by Winrock's management team and board of directors.

ACR sets methodologies and verification requirements for the registration of projects to ensure offsets are additional to business-as-usual, permanent, net of leakage, accurately quantified, third-party verified, and used only once (ACR, 2020). ACR Standard v7.0 outlines registration requirements and methodologies developed by ACR and approved through public consultation and scientific peer review (ACR, 2020). It is based on the ISO 14064 series specifications, with sector-specific land requirements for agriculture, forestry, and other land-use projects. Project developers can use CDM standards if they match ACR standards. Projects from the Reducing Emissions from Deforestation and Forest Degradation in Developing Countries (REDD) initiative are excluded to decrease the risk of double-claiming credits. The ACR three-prong test requires projects to demonstrate that they (i) exceed current regulations and common practices in the relevant industry sector and geographic region; (ii) address at least one of three implementation barriers (financial, technological, or institutional); and (iii) in some cases, demonstrate additionality.

ACR also recognizes a performance standard approach, in which additionality is demonstrated by showing a proposed project activity goes beyond regulations and exceeds the expectations of a performance standard. Performance thresholds vary by industry, sector, geography, and practice. Agriculture, forestry, and other land-use projects must monitor activities for at least 40 years, in line with the Paris Agreement. ACR-approved validation and verification bodies verify projects to

issue ERT credits. ACR requires projects to conduct an impact assessment to ensure compliance with environmental and community best practices and that they contribute to the SDGs. ACR-approved carbon credits are listed on its public registry (ACR, 2022a).

ACR is open to projects worldwide, with some methodologies prescribed only for the United States. ACR projects include certification for improved forest management, recycling of transformer oil, and carbon capture and storage.

Results/Uptake

ACR accounts for an estimated 6% of credits issued in the VCM, equivalent to 63 million tCO_2e emissions and the potential to offset 2.6 billion tonnes of carbon over the next 14 years.

ACR works to facilitate projects to incentivize emissions reductions by curbing nitrogen-based fertilizer use through financial incentives to farmers. For example, ACR leads a recent U.S. Department of Agriculture project to inclusively increase access to markets for climate-smart commodities by enabling producers to obtain GHG certificates that can be issued and tracked on the ACR Registry to substantiate supply chain and net-zero claims (ACR, 2022b).

B3.5 Plan Vivo

Background

Plan Vivo was established in 1994 to support sustainable rural livelihoods through carbon finance as part of a framework to manage and monitor verifiable emissions reductions from community-based land-use projects with small-scale producers in developing countries (Plan Vivo, 2022b). Plan Vivo was initially developed as part of a U.K. Department for International Development-funded research project in the Chiapas region of southern Mexico, led by the Edinburgh Centre for Carbon Management, in partnership with El Colegio de la Frontera Sur, the University of Edinburgh, and other local organizations. In 2002, the development and governance of Plan Vivo were transferred to BioClimate Research and Development, an independent not-for-profit organization, and then to the Plan Vivo Foundation, a registered charity (Plan Vivo, 2022a).

The objectives of the plan are three-fold: protect and restore the environment, tackle climate change, and support climate-sensitive communities. The Plan Vivo system establishes sustainable land-management plans with additional eligible project activities: afforestation and reforestation; agroforestry; forest restoration; and avoided deforestation. The founding Plan Vivo project, Scolel'te ("the tree that grows" in the Mayan Tzeltal language), supported smallholder communities planting trees in Chiapas, Mexico. It is an international benchmark and the longest-running ecosystem services project on the VCM (since 1997). Plan Vivo has sold offsets for organizations, such as the World Bank, with more than 800,000 trees planted and notable contributions to local agrosystems and socio-economic well-being (Plan Vivo, 2022c). Plan Vivo

also represents the first Payments for Ecosystem Services project, ensuring that payments go directly to local community producers.

Operation

Plan Vivo projects are based on participatory approaches to ensure smallholder communities retain forest custodianship and offer income diversification. Projects are based on a methodology outlining the procedures, data, and parameters to estimate and monitor carbon emission benefits. The Plan Vivo Standard permits REDD+ projects to be certified as of 2008, with BioClimate assisting in project development for the newly registered Plan Vivo Foundation (Plan Vivo, 2022b). Plan Vivo certificates were registered on the IHS Markit Environmental Registry in 2009 to ensure transparency and accountability and published on the Plan Vivo website (IHS Markit Environmental Registry, 2022b).

Third-party experts independently validate projects before project registration. An external expert reviews projects, which are also assessed by the Plan Vivo Technical Advisory Panel (Plan Vivo, 2022a). Plan Vivo Certificates for ecosystem services are denominated in tonnes of carbon dioxide (tCO_2), with a serial code linking the certificate to a specific project entered in a central registry. Third-party verifiers regularly assess projects against Plan Vivo Standards approved by the Plan Vivo Foundation.

Results/Uptake

Plan Vivo continues to evolve and expand to help smallholders access finance and carbon markets to restore forests and transform communities around the world, supporting NDCs (Hamrick, 2018). Based in India, the Khasi Hills project became the first Plan Vivo-certified REDD project to conserve degraded community forests in 2009. Based in Kenya, the Plan Vivo-certified Mikoko Pamoja project (mangrove conservation) became the world's first blue carbon project and earned a UN Equator Prize award in 2014.

To scale up benefits from smallholder reforestation projects, Plan Vivo works with NGOs, such as Taking Root, to use technology and remote sensing to track project impacts (Taking Root, 2021). The estimated impact of Plan Vivo has been to move 265,000 hectares of land under sustainable management plans, certify 7 million tCO_2e planned emissions reductions, and involve 850 communities in Plan Vivo projects around the world.

B3.6 Climate Action Reserve

Background

Launched in 2008, CAR is a private, voluntary carbon offset program for North America that establishes standards to qualify and verify GHG emissions reductions and removal projects (CAR,

2022b). It also provides oversight for independent third-party verification bodies and issues and monitors carbon credits such as climate reserve tonnes (CRTs). The California State Legislature established the California Climate Action Registry (California Registry), CAR's predecessor organization, in 2001. Working with other regional NGOs, the California Registry established CAR as a U.S.-based registry for GHG reduction and removal projects in North America (CAR, 2022a). As a non-profit registry, CAR issues and registers carbon offset credits but does not sell carbon credits directly. CAR offsets can be purchased through over-the-counter sales or via retail, wholesale, and exchanges.

Operation

CAR issues carbon credits based on performance-based, project-specific protocols using industry benchmarks and climate impact assessment criteria. It also identifies co-benefits to contribute to the SDGs. Projects can be transferred from other offset registries, provided they are removed from the other registry before registration on CAR (CAR, 2022d). CAR's protocols, verifier accreditation, and oversight program are eligible for use with the Verra VCS program, with the exception of agriculture, forestry, and other land-use protocols. Carbon credits (CRTs) issued by CAR can be converted into Verified Carbon Units and transferred to a Verra registry (Verra, 2022a). Account holder fees, CRT issuance and transfer fees, grants, contracts, and sponsorships fund operations. Provision is made for expert and stakeholder input and public comment, with final approval by the board, which comprises representatives from the California state government, businesses, and NGOs (CAR, 2022c).

Having pioneered the approach of standardized offset protocol development, the CAR offset program aims to show that carbon offsets foster real GHG reductions, support activities that lower local air pollution, spur growth in green technologies, and permit emission-reduction goals to be met at a lower cost (CAR, 2021a, 2021b). CAR standards are developed based on a transparent, multistakeholder process to ensure registered emissions reductions are real, additional, verifiable, enforceable, and permanent. Carbon offset projects are based on CAR protocols, including for renewable energy development, capture and destruction of high-potency GHGs, and avoided deforestation (CAR, 2021a).

CAR protocols and the ISO 14064 series on GHG emissions reductions and removals require third-party verification of projects. CRTs are issued after the verification body submits emissions reductions that are accepted by CAR. CAR is a public, web-based system for owners and developers of carbon offset projects to register project information and verification reports (CAR, 2022a). Emissions reductions are certified as CRTs (equal to 1 tonne of GHG reduced/sequestered) to provide title assurance and a unique serial number. CAR is reviewing a standardized inventory methodology to pre-approve projects based on approved methodologies and a Climate Action Reserve Inventory Tool containing pre-verified approved biomass equations. To contribute to the financial viability of reforestation projects, CAR's Climate Forward Reforestation Methodology was revised to permit ex-ante crediting of reforestation projects (CAR, 2019).

Results/Uptake

CAR has adopted 22 carbon offset protocols across a wide range of economic sectors and registered carbon credits equivalent to 66 million tonnes of GHG emissions reductions to offset projects in North America (CarbonCredits.com, 2022b). CAR has been involved with the development of the State of California cap-and-trade regulation, which incorporates four of its protocols, issuing early action offset credits as a state-approved offset project registry and helping to create the initial credit supply for California's cap-and-trade program.

CAR is a leading global carbon registry, accounting for an estimated 8.3% share of credits issued in the VCM, with projects expanding in Mexico (Indigo, 2022). CAR has also advised national and subnational governments, including Canada, China, Kazakhstan, Mexico, and South Korea, on emissions trading, cap-and-trade, and offset program design (CAR, 2021b).

B3.7 BioCarbon Registry

Background

Founded in Colombia as ProClima in 2019, the BCR is a private international standard that registers and certifies projects to address climate change, biodiversity protection, and the SDGs (BCR, 2022b). Among the first commercial partners of the CDM registry, BCR provides science-based, certified carbon offsets and carbon-neutral certification. BCR projects emphasize social and environmental co-benefits, including linking activities to fulfill the SDGs and implement REDD+ projects.

Operation

The BCR aims to certify and register GHG projects that comply with the BCR Standard and methodologies for a wide range of sectoral activities to build confidence in the carbon market by promoting private sector participation, promoting good practices for the carbon market through the BCR Standard, and enhancing collaboration and consultation with NGOs and government stakeholders, as well as with other standards and countries. Since 2022, a strategic partnership with TransparenTerra, operated by Swiss blockchain company FCE, has provided BCR with blockchain verification and information security for certification while making the standard accessible to farmers, local communities, and smaller companies (FCE Group, 2022). BCR has also interfaced with a cloud-based platform, Carbon TradeXchange, since 2022, enabling a global digital carbon credit exchange for BCR-certified and registered projects to offer their credits as offsets to interested companies. BCR is financed through certification and registration fees.

BCR Standards for the VCM and biodiversity, revised in 2022, aim to ensure the integration of ecological and social co-benefits, including the SDGs (BCR, 2022a). Carbon credits are issued if previously verified and validated in accordance with ISO 14064 series guidelines and BCR

Standard criteria. BCR methodologies allow GHG projects to issue verified carbon credits across a wide variety of sectors, including energy, waste, transportation, agriculture, forestry, and other land use. Project holders ensure validation, and an accredited third party carries out verification, which is measured against BCR Standard requirements. Projects include activities on community-owned lands and must contribute to the SDG goals using a tool developed by BCR.

BCR is a voluntary public registry that assigns a unique serial code to verified GHG emissions reductions and removals. Through its platform, account holders can self-manage the registry of projects, make transfers, and retire carbon credits. TransparenTerra experts assess projects, BCR certifies and issues the credits, and the CTX Carbon Exchange acts as the platform for credit exchange. In this way, farmers and cooperatives worldwide can access carbon markets, supported by voluntary blockchain records of the receipt, purchase, and sale of each carbon credit (FCE Group, 2022). Projects applying for BCR may not be registered on another registry.

BCR Standards and methodologies cover GHG and biodiversity projects for voluntary and regulated carbon markets in South America and Turkiye.

Results/Uptake

As part of the UN Global Compact, the BCR is expanding its global reach and applying innovative technologies to manage its project platforms on carbon markets (UN Global Compact, 2022). BCR has 26 registered projects, with five more in process; it has issued 41.2 million verified carbon credits and retired 24.5 million verified carbon credits (BCR, 2022c). In 2021, BCR placed second after Verra's VCS in the Environmental Finance Awards for best GHG program.

In late 2022 BCR and web start-up Thallo created a two-way bridge between the registry and blockchain to include carbon credit tokenization as part of the BCR processes to reduce barriers for potential buyers of verified carbon credits. This means credits can efficiently be taken on and off the blockchain while ensuring transparency and traceability and avoiding double accounting. Credits are made available on the Polygon network (Thallo & BCR, 2022). The first tokenization is planned with a local partner, Biofix Consultoria, from the Delfines Cupica REDD+ conservation project to protect 103,022 hectares of tropical rainforest in Chocó on the Pacific Coast of Colombia. It will include co-benefits for several SDGs and engagement with the community councils of two local Afro-Colombian communities.

B3.8 The Architecture for REDD+ Transactions – The REDD+ Environmental Excellence Standard (ART-TREES)

Background

The Architecture for REDD+ Transactions Registry (ART) is a global voluntary crediting program that was established in 2018 to incentivize governments to reduce emissions from forestry and land use in line with the Paris Agreement (ART, 2021a). It also aims to serve as a quality benchmark for jurisdictional REDD+ and increase finance at scale from the private sector and donor countries for tropical forest protection and restoration. Winrock International Institute for Agricultural Development administers ART's standard for measurement, monitoring, reporting, and verification of offsets, the REDD+ Environmental Excellence Standard (TREES), and the ART system for GHG reduction and removal programs and credits.

Operation

As a standalone program, independent of governments or donor countries and with procedures for participating jurisdictions, ART is governed by a board of internationally recognized experts, operated by an independent secretariat, and supported by expert technical committees. TREES credit status (issuance, retirements, and cancellations) is publicly available on the ART Registry. ART issues credits solely at the jurisdictional level—to national governments and large subnational jurisdictions—to achieve results at scale, including environmental, social, and governance requirements in line with the UNFCCC guidelines for REDD+ activities. TREES credits are serialized and labelled as emissions reductions, removals, or high forest/low deforestation credits. The International Civil Aviation Organization (ICAO) approved ART to supply credits under its Carbon Offsetting Scheme for International Aviation (ICAO, 2022).

Countries and subnational jurisdictions can generate verified emission-reduction and removal credits by meeting comprehensive TREES requirements, including for accounting and crediting, monitoring, reporting, independent validation, and verification by a validation and verification body, including environmental and social safeguards (ART, 2021b). Credits are issued after the participating jurisdiction demonstrates ownership of the credit or the right to receive payment for credits. It must also conform to reporting indicators and adhere to safeguard requirements with third-party validation and verification. Under TREES, eligible removals must occur on lands that have not been forested for 5 years prior to the start of activities and where the conversion of natural ecosystems and forests is not allowed. ART-TREES 2.0, expanded in 2021, sets out how projects can be integrated under five scenarios. It also clarifies how small-scale projects can be incorporated into landscape-level programs and increases opportunities for large-scale forest solutions to support the Paris Agreement, including enhanced access to carbon market financing

through crediting for additional mitigation, as well as options to recognize Indigenous Peoples' contribution to forest conservation.

Organizations can buy TREES credits as part of their voluntary climate plans, and companies can purchase them (ART, 2021b):

- To contribute beyond net-zero commitments.
- To transfer them between countries to meet NDCs under the Paris Agreement.
- To use as a donor-for-performance mechanism.

As a voluntary cooperation mechanism under Article 6 of the Paris Agreement, ART is open to any tropical forest national or subnational jurisdictions that meet TREES requirements to implement REDD+ programs through bilateral partnerships with public donors or through multilateral programs, such as the Forest Carbon Partnership Facility or UN REDD+ (ART, 2021b). ART's target audience is government officials from tropical forest countries in the process of developing jurisdictional REDD+ programs, REDD+ buyers and funders seeking quality assurance, and donor countries using ART for results-based payments. While ART does not directly credit project-scale activities, projects can be implemented under a jurisdictional REDD+ program through various scenarios. ART is set up to drive countries toward mitigation efforts at a national scale; TREES subnational programs are generally large (in excess of 2.5 million ha of forests) and eligible to receive credit up to 2030, after which crediting transitions to the national level.

Results/Uptake

ART is evolving and expanding to support climate action in the forestry sector, including in support of NDCs submitted under the Paris Agreement. For example, the Lowering Emissions by Accelerating Forest (LEAF) Coalition, launched in April 2021, is a public-private initiative using ART carbon credits. With pledges topping USD 1 billion in financing for tropical forest countries that deliver REDD+ results, demand for ART-issued TREES credits is estimated to have the potential to reach several billion dollars (Winrock International, 2022). To date, nine jurisdictions have approved TREES concept documents: Colombia, Costa Rica, Ecuador, Ghana, Guyana, Vietnam, and three Brazilian states.

At the UN Glasgow Climate Change Conference (COP 26) in 2021, LEAF signed letters of intent for transactions of ART-certified TREES credits with Costa Rica, Ecuador, Ghana, Nepal, and Vietnam. These, along with proposals from another 23 jurisdictions, have the potential to protect up to a half-billion ha of forest, with estimated self-reported emissions reductions potentially exceeding LEAF's goal to achieve 100 million tonnes of emissions reductions (Emergent, 2021).

B3.9 The Global Carbon Council

Background

Created in 2016 and operational since 2019, the GCC is a voluntary international carbon offset program focused on the Middle East and North Africa, an initiative of the Qatar-based Gulf Organization for Research and Development (GCC, 2020). The GCC seeks to contribute to sustainable and low-carbon growth and achieve the SDGs in the region. The GCC program is project-based and designed to supplement existing carbon programs, such as the CDM, according to international best practices. The Doha-based GCC serves as the secretariat of the program, with decisions on projects or issuance of carbon credits taken collectively by an expert steering committee and based on a positive verification report by a GCC verifier.

The objectives of the GCC are to ensure transparency through stakeholder involvement; establish institutional structures for developing standards (e.g., baseline and monitoring methodologies); develop robust project cycles, including transparent and simplified project registration and credit issuance procedures, an international carbon registry, effective approval of project and emission-reduction verifiers, and an evaluation of project co-benefits; and provide a platform for results-based project financing.

Financing for the GCC includes fees from annual registration, projects, and credit issuance.

Operation

The two broad categories in the GCC program are projects not registered under another GHG program and de-registered CDM projects. The GCC framework allows businesses to submit their GHG emission-reduction projects based on GCC rules, procedures, and standards. Projects are approved through an independent, transparent evaluation process, after which the GCC issues approved carbon credits for a specific monitoring period following independent verification and based on GCC criteria. GCC verifiers approve projects using criteria set out in its Project Verification Standard. Accreditation and verification bodies accredited according to ISO 17011 or, for conformity assessment, ISO 14065 automatically qualify as GCC-certified projects or emissions-reduction verifiers. The implementation of the Environmental and Social Safeguards Standard and the Project Sustainability Standard is voluntary for GCC projects.

With an emphasis on local project owners and supporters, the GCC provides options for projects to invest in a low-carbon economy in their region. The GCC program has a stakeholder-based approach, including state and non-state stakeholders, to ensure projects contribute to the Paris Agreement and the SDGs, including a roster of experts (GCC, 2022). Project owners can open an account on the GCC online Carbon Registry, operated by IHS Markit, a third-

party organization, and accessible on the IHS Markit website (HIS Markit Environmental Registry, 2022a).

The GCC aims to assist organizations in the region in reducing their carbon footprints and diversifying sectoral economies through low-carbon projects by offering capacity-building and training programs for public and private stakeholders at all levels. In 2021, the Global Carbon Council was listed among eight international programs qualified to supply carbon credits to airlines under the International Civil Aviation Organization's Carbon Offsetting and Reduction Scheme for International Aviation (GCC, 2021).

Results/Uptake

The GCC is gaining ground in global carbon markets and continues to expand, including allowing large-scale renewable energy projects from middle-income countries such as China, India, and Turkiye (Quantum Commodity Intelligence, 2022). It has issued 133,000 credits since 2020 and, with a pipeline of more than 500 projects, expects to issue between 25 million and 40 million carbon credits in 2022 (CarbonCredits.com, 2022b).

B3.10 Puro.earth

Background

Nasdaq majority-owned Puro.earth is a business-to-business standard and international public offset registry that focuses on carbon removals. It was established in 2018, with carbon-removal credits active since May 2019. The Finnish-based company's goal is to mobilize the global economy to reward carbon net-negative emissions; it is open to any firm that wishes to reverse and remove carbon emissions and create carbon-neutral products (Puro.earth, 2022a). Based on Puro Standard methodologies, CO_2 Removal Certificates (CORCs) are issued to suppliers for sale in carbon markets.

Operation

Puro.earth aims to avoid double counting emissions and address the traceability of CO_2 removal initiatives by assigning a unique identifier to each CORC. It also partners with other market-based providers for carbon footprint calculations, LCAs, and other environmental services. Third parties have access to the registry, providing transparency and verification for carbon-removal projects. Projects included on the Puro Registry include those using biochar, construction materials, and soil amendments, as well as engineering approaches such as direct air capture. During the transition period from carbon offsets to removals, the Puro Registry will help verify corporate claims based on its CORC. Puro.earth is funded by fees from annual memberships and services to suppliers.

The Puro Standard and its methodologies are developed in collaboration with industry stakeholders and public consultations, with a two-step verification process including third-party auditing. Accredited third-party verifiers, trained by Puro.earth, audit projects. Developed by working groups of scientists and industry carbon-removal experts, methodologies cover CO_2 removal and storage in biochar, geologically stored carbon, biomass-based building materials, and carbonated materials.

Prior to being issued CORCs, carbon-removal suppliers must verify that their process is carbon net-negative, calculated using a Puro Standard carbon crediting methodology (Puro.earth, 2022b). Suppliers provide an LCA or an environmental product declaration indicating the product's embodied CO_2 based on laboratory evidence. Auditors verify compliance with Puro Standard methodologies, including carbon-accounting formulas for the net carbon-removal quantity for each method. For traceability, transparency, and to avoid double counting, CORCs are issued in the Puro Registry and managed throughout their life cycle from issuance to retirement, with crediting periods ranging from 5 to 20 years, depending on the project (Puro.earth, 2022a). CORCs are used to turn the CO_2 sequestration capacity of emission-negative products into tradable credits. Newly established pre-CORCs are digital credits for validated projections of future carbon-removal activities, which corporations can buy to prepay for projected carbon removal, providing revenue to scale projects that can be traded on the Puro Registry or other marketplaces. After the carbon removal has been realized and independently verified, credits are converted into CO_2 removal certificates.

Puro.earth focuses solely on verified net-negative technologies that remove carbon at an industrial scale and store it for a minimum of 50 years.

Results/Uptake

With the aim to create USD 300 billion on the global carbon-removal market by removing 10 gigatonnes of CO_2 annually by 2050 (EuropeanCEO, 2021), Puro.earth is emerging as a leading carbon-removal platform, particularly after Nasdaq acquired a majority stake to build on its environmental, social, and corporate governance credentials (Trendafilova, 2021). To ensure independent and transparent functioning, Nasdaq and Puro.earth established an advisory committee with scientists, industry representatives, and its market buyers and sellers.

The Puro Standard and system continue to develop certification methodologies. For example, a new type of CORC (CORC20+) was issued to incentivize the use of materials other than fertilizers to improve soil properties and increase carbon removal and storage by using organic industry biomass residues, requiring carbon storage in soils for a minimum of 20 years (Puro.earth, 2021). The first verified carbon-removal supplier under this new methodology, Finnish sustainable food chain Soilfood, is prepared to sell soil amendment CORC20+ certificates as a pilot project for the EU LIFE Carbon Farming Scheme, transacted on the Puro Registry. Revenue from the carbon credit sale will be divided among the farmer, the industrial operator, and Soilfood (EuropeanCEO, 2021). Another initiative, Puro Accelerate, provides for prepayment through the Puro Registry to scale carbon removals to raise equity and debt financing; as such,

pre-CORCs serve as an alternative source of project funding (Puro.earth, 2021). In 2022 Puro.earth and carbon purchase protection insurer Kita Earth announced a partnership to make carbon insurance available for biochar projects and carbon credit purchases through the Puro Registry, reducing transaction risks and accelerating upfront financing (Puro.earth, 2022a).

B4 Platforms for Reporting Progress of Voluntary Climate Actions

B4.1 CDP, Formerly Carbon Disclosure Project

Background

Founded in 2000, CDP is an international non-profit organization with a disclosure system for investors, companies, cities, states, and regions to manage their environmental impacts (CDP, 2022). CDP, now the world's largest, most comprehensive dataset on environmental action, is broken down into three different themes: climate change, water security, and forests. Based on the principle that "you can't manage what you don't measure," CDP supports initiatives to catalyze collective action.

Operation

CDP's climate change questionnaire can help companies set ambitious targets and transition to the low-carbon economy (renewable energy, science-based targets, carbon pricing, and more.) CDP supply chain membership does not focus solely on data disclosure; it also provides support throughout the entire disclosure process by sharing supplier engagement resources and strategies. Every year, CDP gives its members an analysis of their suppliers' data (CDP, 2020).

CDP has regional offices and partners across 50 countries. Organizations that disclose their information annually to CDP are located in 90 different countries. CDP works with companies, supply chains, cities, investors, private markets, governments, states and regions, and public authorities. Supply chain members include Walmart, L'Oréal, the Coca-Cola Company, and Kellogg Company (CDP, 2022).

Results/Uptake

More than 18,000 companies—and upwards of 1,000 cities, states, and regions—have disclosed their environmental information. In 2021, more than 280 supply chain members disclosed their information to CDP. From this, suppliers reported reducing 1.8 billion tonnes of CO_2e, representing savings of more than USD 29 billion (CDP, 2022).

B4.2 Race to Zero – United Nations Framework Convention on Climate Change (UNFCCC)

Background

Race to Zero is a UNFCCC initiative launched in 2020 after the UN Climate Action Summit 2019 (Data-Driven EnviroLab & NewClimate Institute, 2020; Morales & Shankleman, 2021; Race to Zero, 2022;). As part of the Climate Ambition Alliance, the UNFCCC Climate Champions of that year—Gonzalo Muñoz (from Chile) and Nigel Topping (from the United Kingdom)—led Race to Zero. The Climate Ambition Alliance asks countries for more ambitious nationally determined contributions (NDCs) while encouraging the participation of the private sector (businesses, sector-specific organizations) and other actors (such as cities, finance initiatives, universities, regions, and country-wide initiatives) (Ministerio del Medio Ambiente, n.d.). The Race to Zero initiative is a global campaign that encourages the implementation of voluntary actions from these state and non-state initiatives toward reaching net-zero. It also recognizes that the inclusion of their efforts is key to reaching the Paris Agreement goals.

The initiative is founded on the following principles: scientific integrity; fair share, equity, and justice; resilience and adaptation; 2030 sectoral breakthroughs; and responsible claims.

Operation

To be part of this initiative, participants must comply with a minimum set of requirements known as the Five Ps (UNFCCC, 2022a):

1. **Pledge:** Promise to reach net-zero as soon as possible and by 2050 at the latest. These targets must cover all greenhouse gas (GHG) emissions depending on the entity (for instance, firms must include emissions from all three scopes).
2. **Plan:** Within 12 months of joining, publicly disclose a plan detailing what actions will be taken in the short and long terms, until 2030.
3. **Proceed:** Start taking action to achieve net-zero emissions. If applicable, participants should contribute to sectoral breakthroughs.
4. **Publish:** Progress reports and documentation should be publicly available through platforms that feed into the UNFCCC Global Climate Action Portal.
5. **Persuade:** Within 12 months of joining Race to Zero, participants should align their external policy and engagement to halve emissions by 2030 and reach net-zero by 2050.

Results/Uptake

Almost a fifth of the Financial Times Stock Exchange's 100 companies have signed up for Race to Zero. The Energy and Climate Intelligence Unit says actors that have joined the initiative cover more than half of the world's GDP, are responsible for a quarter of global CO_2 emissions, and are home to more than 2.6 billion people, which represents a 66% increase in commitments between UNFCCC's COP 25 and COP 26.

As of 2022, 11,309 non-state actors (74% companies, 10% educational institutions, 10% cities, 5% financial institutions, 0.5% states and regions, and 0.5% healthcare institutions) had committed to net-zero by 2050. Cities that have signed the pledge are in Global South and Global North countries and include big metropolises as well as smaller towns, from Mexico City, Nairobi, and Delhi to Vancouver, Madrid, and Sydney. Companies that have signed the pledge—Adobe, Inditex, and Diageo, among many others—have combined revenues of almost USD 5,000 billion (UNFCC, 2020).

B4.3 Science Based Targets

Background

The Science Based Targets initiative (SBTi) is the result of a collaboration among the World Resource Institute, Worldwide Fund for Nature, and the UN Global Compact (SBTi, 2022; World Resources Institute, n.d.). SBTi defines and promotes best practices in science-based GHG emissions reduction target-setting. It offers a range of target-setting resources and guidance, and it independently assesses and approves companies' targets in line with its strict criteria.

The SBTi Net-Zero Standard was launched before COP 26. The standard is the world's first framework for corporate net-zero target-setting. Based on climate science and 1.5°C pathways, the standard requires companies to make quick and deep emission cuts through both near- and long-term science-based targets.

Operation

To enroll with SBTi, companies must (SBTi, 2022):

1. **Commit:** Apply, establishing the intent to set a science-based target.
2. **Develop:** Work on an emission-reduction target in line with SBTi's criteria.
3. **Submit:** Present the target to the SBTi for official validation.
4. **Communicate:** Announce the target and inform stakeholders.
5. **Disclose:** Report company-wide emissions and progress against targets on an annual basis.

Participants include companies across all sectors (aluminum, apparel and footwear, aviation, buildings, cement, chemicals, financial institutions, forest, land and agriculture, information and communication technology, oil and gas, power, steel, and transport). Companies with SBTi-verified targets include Amazon, AstraZeneca, Colgate-Palmolive, Concha y Toro, Dell, Kellogg's, Moody's, P&G, PepsiCo, Pfizer, Sony, and Tetra Pak.

Results/Uptake

More than 2000 companies across the world are committing to net-zero by setting emission-reduction targets grounded in climate science through SBTi (SBTi, 2023). The initiative has had great adoption rates through increasing ambition from more engaged companies (either through setting or committing to set targets). By the end of 2022, more than 5,000 companies covering more than a third of the global economy were working with SBTi.

B4.4 Global Climate Action Portal – UNFCCC

United Nations
Climate Change

Background

Launched in 2014 by UN Climate Change, the Global Climate Action Portal is an online platform where countries, regions, cities, companies, investors, and other organizations can share their commitments to tackle climate change (Global Climate Action NAZCA, n.d.-a, n.d.-b). The initial aim of this pre-Paris Agreement initiative was to display a comprehensive view of global climate action from different actors.

Following COP 26 in November 2021, the Global Climate Action Portal launched the tracking of voluntary climate action to show the commitments, implementation, and progress of individual actors registered in the portal.

Operation

The portal receives climate action data from CDP, the Carbon Climate Registry, the Climate Group, the Global Investor Coalition on Climate Change, UN Global Compact, Global Covenant of Mayors, Climate Bonds Initiative, and the United Nations Environment Programme's (UNEP's) Climate Initiatives Platform. This information is displayed on an interactive map.

The portal covers data shared by all registered actors that belong to a party of the UNFCCC.

Results/Uptake

As of November 2022, the portal had climate action information from almost 14,000 companies, 11,361 cities, 3,451 organizations, 1,462 investors, 286 regions, and 196 countries (Global Climate Action NAZCA, n.d.-a).

B4 Carbon/Climate-Neutrality Certification Initiatives

B4.5 CarbonNeutral® Certification by Climate Impact Partners

Background

In 2002, Natural Capital Partners partnered with Climate Care to become Climate Impact Partners. Originally from London, Climate Impact Partners is a global company with offices on all continents. The CarbonNeutral Protocol stemmed from this partnership, establishing the requirements for the CarbonNeutral certification. The protocol provides businesses with a single-source guide to make credible, transparent claims. As third-party standards are developed, the CarbonNeutral Protocol provides a framework that builds on the best guidance in the market and offers a standardized process for making carbon-neutral claims that are recognized internationally (Natural Capital Partners, 2022). The protocol is updated every year based on the most recent developments in climate science, international policy, standards, and business practice.

The most recent version of the protocol (2022) establishes three main principles as the foundation of CarbonNeutral certification: (i) to promote immediate action to support deeper and widespread transformation; (ii) to build on conservative estimation, best practices, transparency, and continuous improvement; (iii) to commit to pragmatism and impact (Natural Capital Partners, 2022).

Operation

CarbonNeutral certification can be awarded to organizations, goods, and activities. Firms must follow these steps (Natural Capital Partners, 2022):

1. **Define:** Understand what should be covered in the carbon footprint. To comply with this requirement, companies must follow the GHG Protocol Corporate Value Chain (Scope 3) Accounting and Reporting Standard (see Section 7.2.2 on GHG inventories for more information). As a best practice, the CarbonNeutral Protocol asks companies to include all applicable Scope 3 emission sources. However, firms may run into issues when determining Scope 3 emissions, as the definition of when a company's responsibility ends is still ambiguous. To address these issues, companies should consider the influence they have over abatement opportunities, the likely contribution those emissions make to the subject's carbon footprint, and the availability of reliable data. For products in particular, CarbonNeutral certification establishes that the boundary for required emission sources is "cradle-to-grave" emissions. This means the emissions from the use and disposal phases (phases after the product has reached the end customer).

2. **Measure:** Calculate accurately and conservatively. Companies must follow the GHG Protocol Corporate Standard, ISO 14064-1, or similar consistent measuring methodologies. An assessment partner/provider must conduct or check all GHG assessments. Third-party verification is at the discretion of the client; however, the CarbonNeutral certifier can request it if there are concerns about the quality of the data.
3. **Target:** Set goals to reduce the footprint and offset remaining emissions. This applies to companies with annual footprints exceeding 100,000 tCO_2e. The targets must be set in compliance with CDP, SBTi, or Race to Zero (see the platforms table for more information). CarbonNeutral certifications support net-zero ambitions through three main paths: annual carbon accounting and action on all unabated emissions, increasing removals through removal projects such as natural climate solutions, and increasing climate action on value chain emissions.
4. **Reduce:** Deliver internal reductions and offset all remaining emissions by financing verified emissions reductions and removals to achieve net-zero. The CarbonNeutral Protocol accepts carbon credits that are verified against the requirements of third-party standards, such as the ACR, ART-TREES, the Climate Action Reserve, and Gold Standard (see offsets table for more information).
5. **Communicate:** Demonstrate climate action and engage with teams, customers, and stakeholders. Organizations must conform to the CarbonNeutral certification logo guidelines.

The CarbonNeutral Protocol is designed for businesses and organizations, technical partners, and the wider climate action community. This certification is cross-sectoral, with 300 clients in 33 countries. Companies with CarbonNeutral certification include Microsoft, ING, M&S, PwC, and Yorkshire Tea (Natural Capital Partners, 2022).

Results/Uptake

CarbonNeutral products have the potential to move from voluntary action by some progressive corporations to a mainstream response to regional compliance requirements.

Amazon selected CarbonNeutral as a Climate Pledge Friendly trusted certification, which will help customers shop more sustainably and help preserve the natural world (Climate Impact Partners, 2021).

Environmental Finance recognized Natural Capital Partners as Best Offset Retailer from 2011 to 2020 and Best Advisory Service from 2017 to 2020.

B4.6 Climate Neutral Now by UNFCCC

Background

Launched in 2015 (following the Paris Agreement negotiation), Climate Neutral Now is a UNFCCC initiative that promotes voluntary action on climate and the use of carbon market mechanisms recognized under the convention.

Participants are registered on UNFCCC's website as participants and can communicate that they take part in the program. However, it is not a certification scheme per se; therefore, members cannot make claims of carbon neutrality or net-zero. Nonetheless, participating in this UNFCCC initiative can help stakeholders advance on their path to comply with climate-neutral certifications (UN Climate Change, n.d.).

Operation

To be registered by the initiative, organizations must sign the Climate Neutral Now Pledge after completing the following steps (UN Climate Change, n.d.):

1. **Measure:** Quantify emissions and spot main sources. Climate Neutral Now gives participants the flexibility to choose which scopes to include in their GHG footprint and if this is self-declared or third-party certified. Based on their choice, a participant will receive a different level of recognition: bronze, silver, or gold. Gold level is given to those who have third-party verified their GHG inventory and have included full Scope 3 emissions.
2. **Reduce:** Identify potential reductions and plan and implement actions.
3. **Contribute:** Choose a project
4. **Report:** Assess results, revise, and communicate.

For each step from 1 to 3, organizations can get bronze, silver, or gold levels.

Results/Uptake

Participants from many different sectors have signed the Climate Neutral Now Pledge since 2015, from airports, schools, and college campuses to big companies such as Microsoft and Sony. The initiative had 625 participants as of 2021, half of them from Europe (UN Climate Change, 2022a).

B4.7 Carbon Neutrality Standard and Certification – PAS 2060

Background

The British Standards Institution (BSI) published the PSA 2060 standard in 2009, with an updated version in 2014. The standard aims to increase the transparency of carbon-neutrality claims by providing a common definition and recognized methodology to achieve carbon-neutral status. BSI offers training courses (at a cost) to companies that want to become certified and hosts a carbon-reduction hub to disseminate information about pathways to achieve carbon neutrality.

The development of the standards was backed up by different public and private organizations, including Carbon Clear, the Carbon Trust, EcoAct, and Marks & Spencer.

Operation

To obtain PAS 2060 certification, organizations must follow these steps:

1. **Assessment** of GHG emissions based on accurate data measurement. A firm must include 100% of Scope 1 and Scope 2 emissions and all Scope 3 emissions that contribute to more than 1% of its total footprint. It should be noted that the standard provides some flexibility in recognizing that it may not be feasible to accurately calculate emissions from all sources, in which case some sources may be excluded.
2. **Reduction** of emissions through a target-driven carbon management plan containing a public commitment to carbon neutrality. The plan should include a timescale, specific targets for reductions, means to achieve reductions, and an explanation of how residual emissions will be offset.
3. **Offsetting** excess emissions, often by purchasing high-quality carbon credits that meet the following criteria:
    - Credits are within one of the schemes approved by PAS 2060 (e.g., CDM or VCS)
    - Credits have additionality (i.e., carbon reductions that would not have occurred were it not for the project being financed)
    - Credits are third-party verified to ensure that reductions are permanent, avoid double counting, and prevent leakage (i.e., emissions do not rise in another area due to a project activity)
    - Carbon credits must be retired within 12 months of the declaration of neutrality, apart from events that can be retired within 36 months.

4. **Documentation and verification** through qualifying explanatory statements (QES) that standards have been met and public disclosures of all documentation (proof of emissions reductions, withdrawn compensation credits, a carbon footprint report, the carbon management plan, and the QES). Furthermore, once a company has achieved carbon neutrality, it can choose to validate its claim through self-validation, validation by other parties, or independent third-party validation.

South Pole certifies entire businesses or any uniquely identified subjects (specific activities, products, services, buildings, projects, or events). PAS 2060 certifies companies of all sizes, from large businesses such as Coca-Cola (two of its manufacturing sites) (Coca-Cola Europacific Partners, n.d.) to smaller firms, including coffee cooperatives in Costa Rica (Acampora et al., 2022).

Results/Uptake

PAS 206O is an internationally recognized certification for organizational carbon neutrality.

B4.8 Climate-Neutral Labels – South Pole[12]

Background

Founded in 2006 in Zurich, Switzerland, South Pole is a carbon finance consultancy that works with businesses and governments to find decarbonization pathways across industries through understanding climate-related risks and potential opportunities. Beyond carbon-neutral certification, South Pole also develops and implements emission-reduction projects and strategies as business opportunities.

Operation

South Pole requires clients to follow these steps to obtain carbon-neutrality certification:

1. **Measure** footprint and risks. South Pole offers this service to companies through a materiality matrix and reporting guidance. It goes beyond calculating a carbon footprint by quantifying the consumption of natural resources and emissions resulting from business operations, as well as water and plastics footprinting and product life-cycle assessments. In addition, South Pole prepares a climate risk analysis for its clients so they can understand how different climate change scenarios may affect supply chains or financial performance.
2. **Set a roadmap and create targets.** South Pole offers its clients competitive benchmarking through market analyses and scorecards, so firms know their position relative to their industry peers and competitors. South Pole also supports companies with strategy

[12] Information from standards was gathered between August 2022 and February 2023.

development through workshops, adaptation plans, internal carbon pricing, and renewable energy strategies. Companies can set ambitious and achievable targets based on targets such as SBTi (see more about SBTi in Section B4.3).

3. **Abate emissions.** To reduce a company's footprint, South Pole seeks to increase efficiency, procure renewable energy, and decarbonize supply chains. South Pole provides its clients with plans to start reducing emissions immediately and identify the level of unavoidable emissions.
4. **Compensate.** Firms can decarbonize their supply chains by developing or subscribing to projects that are designed to improve climate, forests, and/or water practices. Companies are urged to go climate-neutral or beyond by investing in projects to lower or remove emissions. They can also capitalize on investment opportunities that generate verified environmental and/or social impacts.
5. **Communicate and review.** This last step is about disclosing and reporting to share progress on meeting requirements with compliance and/or voluntary schemes (such as CDP). This step also encourages stakeholder engagement by enabling them to demonstrate leadership in their sector and the sustainability agenda.

South Pole is active in the financial sector and capital markets, the public sector (e.g., the Government of Belize), philanthropic partnerships, and the private sector. Companies certified by South Pole include eBay, Nando's, and Nestlé.

Results/Uptake

The company, which has received multiple awards, has 37 different locations and works in more than 20 countries. With its clients, South Pole has helped reduce more than 170 million tonnes of CO_2e, developed upwards of 700 projects, and mobilized more than USD 15 billion in clean energy investments.

B4.9 Carbon Neutral – Carbon Trust

Background

Carbon Trust is an independent certification body for carbon footprints founded in 2001 in the United Kingdom. The British government initially set up Carbon Trust to move toward a low-carbon economy by helping both the public and private sectors cut their carbon emissions (Carbon Trust, 2020a)

Carbon Trust's certification process follows the internationally recognized carbon-neutral standard, PAS 2060, and builds on the PAS 2050 environmental standard. Carbon Trust

launched the world's first certification for supply chain emissions reductions in 2015 (Carbon Trust, 2022).

Carbon Trust has helped develop important standards and initiatives tackling Scope 3 emissions, such as the GHG Protocol and the SBTi (Carbon Trust, 2020a). It focuses on communicating the carbon footprint, which can be done through three main pathways: communicating internally (with the aim of lowering energy costs, engaging employees, and optimizing processes); business-to-business (with the purpose of engaging the upstream and downstream of their supply chain); and business-to-consumer (with the purpose of distinguishing themselves from other companies, creating product differentiation, and enhancing brand reputation) (Carbon Trust, 2020b).

Operation

Carbon Trust certifies organizations, sites, and events that have (Carbon Trust, 2022):

1. Measured their footprint. Carbon Trust offers organizational footprinting, verification, and certification aligned with the GHG Protocol Organizational Footprint Standard. A company may choose to become certified in accordance with ISO 14064-3 or PAS 2060. At the value chain level, Carbon Trust also aligns its services with the GHG Protocol Value Chain (Scope 3) Standard.
2. Committed to year-on-year emissions reductions, evidenced in a plan demonstrating how reductions will be met. Carbon Trust urges companies to go the extra mile by setting science-based and net-zero targets. These should be aligned with SBTi (see Section B4.3 for more information). Carbon Trust is the only standard that certifies an organization's progress on its route to net-zero by independently verifying carbon reductions and the recommended steps toward decarbonization.
3. Offset their remaining footprint with verified carbon sinks and/or carbon credits. Offsetting emissions is in accordance with PAS 2060.

Carbon Trust certifies organizations, products, events, and selected Scope 3 categories to PAS 2060. Companies with Carbon Trust certification include Bentley Motors and Danone.

Results/Uptake

The most recent Carbon Trust carbon footprinting guide shows that it has given more than 1,700 organizational assurances following ISO-14064 and PAS 2060 (Carbon Trust, 2022). While Carbon Trust has certified upwards of 27,000 footprints, these are not all carbon-neutral (compliant with PAS 2060) (Carbon Trust, 2022). However, Carbon Trust offers labels more flexibility, for instance, CO_2 – Measured or Reducing CO_2 labels. Carbon Trust has offices in Amsterdam, China, Mexico, Singapore, South Africa, and the United Kingdom.

B4.10 Carbon Neutral Standard by SCS Global Services

Background

SCS Global Services was founded in 1984 in California. Since then, SCS has been a pioneer in the field of sustainability standards and third-party certification in many sectors. However, its Carbon Neutral Standard was not published until 2021, with an expanded version in 2022. SCS Carbon Neutral Certification aligns with PAS 2060. SCS Global Services seeks to partner with companies, government agencies, NGOs, and stakeholders to advance the SDGs through independent assessment, the application of science, and innovative solutions (SCS Global Services, 2022).

Operation

To obtain SCS carbon-neutral certification, organizations must follow these steps (SCS Global Services, 2022):

1. **Define the subject and certification claim.** SCS will help the client define the type of claim and the subject of the carbon-neutral certification (e.g., company, product, event).
2. **Measure the GHG inventory for the 12-month assessment period.** For companies, the inventory should include Scopes 1 and 2 and only relevant categories of Scope 3. SCS will conduct an life-cycle assessment for products.
3. **Develop a GHG management plan.** For the first year of certification, companies can only buy carbon offsets. For subsequent years, certification should include carbon offsets and reductions.
4. **Optional third-party verification** of the GHG inventory.
5. **Purchase and retire carbon offsets.** To be valid, carbon offsets must have been third-party verified against an established protocol; generated from GHG reduction or removal enhancement projects; meet criteria of additionality, leakage, and double counting as defined in the GHG Protocol for Project Accounting or ISO-14064-2; come from emissions reductions that are permanent; and be retired on a public registry. These offsets can be procured from the CDM, Gold Standard, VCS, ACR, Climate Action Reserve, or California Cap-and-Trade Compliance Offset Program (see the table of GHG inventories for more information).

6. **Carbon-neutral assessment.** The client will only be granted carbon-neutral certification when it has retired carbon offsets that match the GHG emissions inventory.
7. **Annual certification renewal.** To maintain carbon-neutral status, companies must comply with the process on an annual basis.

SCS works with multinational organizations and small to mid-sized national, regional, and local organizations that can choose to certify entities, services, products, and buildings. Companies certified by SCS include AERA, Axiom Materials, FatTire, and Primo Water Corporation.

Results/Uptake

With 30 years of experience in footprinting and carbon offset verification, SCS offers insight to its clients about third-party objectivity to credibly claim carbon neutrality. Amazon selected the SCS standard for its Climate Pledge Friendly program, which helps customers discover sustainable products (SCS Global Services, 2021).

B4.12 Climate Neutral Certification Standard by Carbon Neutral Group

Climate Neutral Group

Background

Founded in 2002 in the Netherlands by Triodos Bank and DOEN Participates, CNG has a global presence in 23 countries, supporting everything from large multinationals to small firms in the climate journey. It requires clients to set and achieve ambitious reduction targets. In 2022, CNG merged with Anthesis Group, a global sustainability consultancy (CNG, 2023a).

CNG is a founding partner of ICROA and an approved community member of ISEAL. Its carbon-neutral standard is the one that follows ISEAL's Codes of Good Practice. The standard ensures continuous improvement, impartiality, monitoring and evaluation, transparency, assurance, stakeholder involvement, and innovation (CNG, 2023a).

CNG operates as a business-to-business partner, helping organizations on the road to net-zero CO_2 by 2050.

Operation

To obtain Climate Neutral Certification, organizations must follow these steps (CNG, 2023a):

1. **CO_2 Footprint:** The organization starts by mapping the carbon footprint, for which CNG provides suitable tools for every type of company.
2. **Reduction:** After measuring the CO_2 footprint, organizations establish goals and a reduction strategy that address mobility, energy, air travel, and the chain of the

organization's products. CNG ensures that the organization monitors the CO_2 emissions to reach net-zero by 2050.

3. **Offsetting:** CNG has a variety of climate projects that companies can use to compensate for their emissions and use as a greater contribution toward the Paris climate goals and the SDGs. The projects meet strict criteria and are certified by Gold Standard or VCS. CNG also develops projects for insetting.
4. **Certification:** After the previous steps have been independently tested, organizations (or their products) are eligible for Climate Neutral Certification and the label to communicate the efforts.

Companies certified include PLUS Fyffes retail bananas, Arla Netherlands (dairy), Brabant Water (drinking and industrial water), Bunzl Green Ambitions (packaging), CONO Cheesemakers (dairy), Heerema Marine Contractors, and KNVB The Green Club.

Results/Uptake

CNG has engaged with more than 3,500 organizations that together have sold upwards of 40 million certified products and compensated more than 15 million tonnes of CO_2 (CNG, 2023b).

B4.13 Carbon Neutral Label by ClimatePartner

Background

ClimatePartner was founded in Munich in 2006 (ClimatePartner, 2023a). Its goal is to embed sustainable climate action into corporate activity. Effectiveness, transparency, and credibility are key. ClimatePartner designs solutions that are suitable for a company, though it is up to the company to adopt the entire range of measures—from a long-term climate action strategy to offsetting of total emissions—or simply to select individual building blocks, such as carbon balance auditing or consultancy around CDP participation (ClimatePartner, 2023a).

Operation

To obtain ClimatePartner certification, organizations must follow these steps (ClimatePartner, 2021; 2023b):

1. **Measure the corporate carbon footprint:** Understand the organization's emissions and climate risks. Company emissions are accounted for based on the GHG Protocol Corporate Accounting and Reporting Standard. Organizations must include all Scope 1 and Scope 2 emissions. For Scope 3 emissions, the following should be included: employee commuting, business travel, upstream electricity, heating/cooling, and the company fleet.

2. **Measure the product carbon footprint:** Conduct a life-cycle assessment of the company's products' carbon emissions. Product emissions are accounted for based on the GHG Protocol Product Life Cycle Standard, and it is required to report all emissions from "cradle-to-costumer" and "end-of-life" emissions.
3. **Reduce carbon emissions:** Define a roadmap to reduce emissions continuously. After calculating a carbon footprint, clients can use this as baseline data to set carbon-reduction targets (ideally, science-based targets).
4. **Offset unabated emissions:** Support a certified offset project to balance remaining emissions. Accepted projects are certified according to high standards such as Gold Standard or VCS. ClimatePartner develops and invests in a wide project portfolio, from nature-based solution projects to social impact and green energy. ClimatePartner provides some flexibility by giving its clients the option to invest in non-certified projects (such as soil carbon sequestration and regional afforestation), which can be combined with a certified offset project for additional commitment.
5. **Communicate climate action:** Transparently communicate climate action efforts to maximize impact. ClimatePartner helps organizations communicate with multiple stakeholders, from reporting to investors to press releases and product labelling. ClimatePartner is also committed to helping certified organizations avoid greenwashing through the use of the correct terminology, comply with local regulations, and effectively back up climate claims. In addition, to improve transparency and credibility, ClimatePartner assigns a unique tracking ID along with a webpage specific to the company. The webpage will contain the company's total GHG emissions, its climate action strategy, measures, and contributions made to carbon offsetting projects.

ClimatePartner is global, but mostly in Europe. Companies certified as carbon neutral (at the organization, product, or packaging level) by ClimatePartner include Schneider, Superzero, Minor Figures, Canon, Selecta, Mindful Chef, Hartmann, SympaTex, Bionatic, and Faber-Castell.

Results/Uptake

More than 5,000 companies across the world have certified carbon-neutral products (ClimatePartner, 2023a).

B4.15 Climate Neutral Certified Standard by Climate Neutral

Background

Climate Neutral is an independent non-profit founded in 2019 in San Francisco, California (Climate Neutral, 2020). The organization was born out of a partnership between PeakDesign and BioLite. The goal of Climate Neutral is to make sure that carbon neutrality is more than just marketing and to eliminate carbon emissions by making carbon neutrality a priority for both businesses and consumers (Climate Neutral, 2022).

Operation

Companies must follow the most recent version (2022) of the Climate Neutral Certification Standard to receive the Climate Neutral Certified label (Climate Neutral, 2022).

1. **Measure** (based on the GHG Protocol), including Scope 1 and Scope 2, and 8/15 categories of Scope 3 (purchased goods and services, capital goods, upstream emissions from fuel and energy, upstream and downstream transportation and distribution, waste from operations, business travel, and employee commuting). The verification process differs based on a company's size, from small to medium-sized and large brands (small brands are those with revenue below USD 5 million, while large brands are those with revenue exceeding USD 100 million).
2. **Reduce:** Requirements to invest in value chain reductions include target-setting requirements and checkpoint year requirements. Entities must provide a reduction action plan where they can show their progress toward reducing emissions from products and services. Climate Neutral allows small companies to exclude Scope 3 emissions from their reduction plan. Large companies are required to include reduction measures for Scope 3 emissions and to create a science-based target approved by SBTi. Climate Neutral is set to have a checkpoint year in 2025 and 2028 to evaluate the progress of the certified entities.
3. **Compensate:** Emission compensations must be third-party verified. Carbon credits must also represent avoided emissions or removals from either the last 4 or 7 years (depending on the project type; for forestry and land-use projects, the 7-year window applies). Furthermore, carbon credits must represent emissions from vintage years (years before certification). Finally, Climate Neutral will track carbon credits based on different project types. Entities are required to procure and document carbon credits and clean energy purchases.
4. **Disclosure:** Companies must publicly disclose information on the total annual GHG footprints of Scopes 1, 2, and 3 (if applicable, based on the brand's size), total annual

investment in carbon-removal avoidance credits, and project types supported. The information will be disclosed on the Climate Neutral website.

5. **Advocacy:** Companies are strongly urged to engage in lobbying, education, and stakeholder mobilization efforts. If entities are to be certified again, they must provide a report with these activities.
6. **Transition period:** All entities certifying for the first time must comply with the version of the Climate Neutral Standard for the applicable certification year. The standard is revised annually.

After meeting all the requirements outlined above, the certified entity will receive a Climate Neutral label to be used in marketing and communications. Companies must complete the process every year to remain carbon neutral.

With a global presence across sectors, Climate Neutral has certified more than 300 companies, including Monos, Nuun, and REI (Climate Neutral, 2023).

Results/Uptake

The companies that Climate Neutral has certified account for more than 1 million tonnes of carbon emissions (Climate Neutral, 2022).

B4.15 Airport Carbon Accreditation

Background

Airports Council International Europe launched the ACA, a global carbon management certification program for airports, in 2009 (Airport Carbon Accreditation, n.d., 2023a, 2023b). It independently assesses the initiatives that airports undertake to manage and reduce their carbon emissions. ACA is the only global, airport-specific carbon standard that uses internationally recognized methodologies to provide a common framework for airports to manage and reduce CO_2 emissions (ACI Europe, 2022).

Operation

ACA has identified different levels at which airports can access the accreditation (ACI Europe, 2022):

1. **Mapping:** Carbon footprint measurement

2. **Reduction:** Reduction of the airport operator's carbon footprint
3. **Optimization:** Engaging others on the airport site to lower their CO_2 emissions
4. **Neutrality:** Offsetting any residual CO_2 emissions from the airport operator
5. **Transformation:** Transforming airport operation to achieve CO_2 reduction in line with global climate goals
6. **Transition:** Offsetting residual CO_2 emissions from an extended list of sources at the airport site

ACA requires independent, third-party verification for each level. The verified application is then sent to Williams Sales Partnership, the independent administrator of ACA.

By September 2022, 424 airports across 86 countries were engaged at least at level 1 of the accreditation system. As a reference, it is estimated that there are 2,600 airports worldwide (ACI Europe, 2022). The accredited airports are listed in an online portal (https://airportco2.org/).

Results/Uptake

The 424 airports that are part of this initiative account for almost 50% of global air passenger traffic. Only 6% of these airports have achieved the highest level (transition), most of them located in Europe. The transition level means that airports have fulfilled all the requirements of previous levels and that they have also compensated for their residual CO_2 emissions with high-quality carbon credits (ACI Europe, 2022).

Appendix C. Background on the Emergence of VSICMs

C1 Context on Climate Change

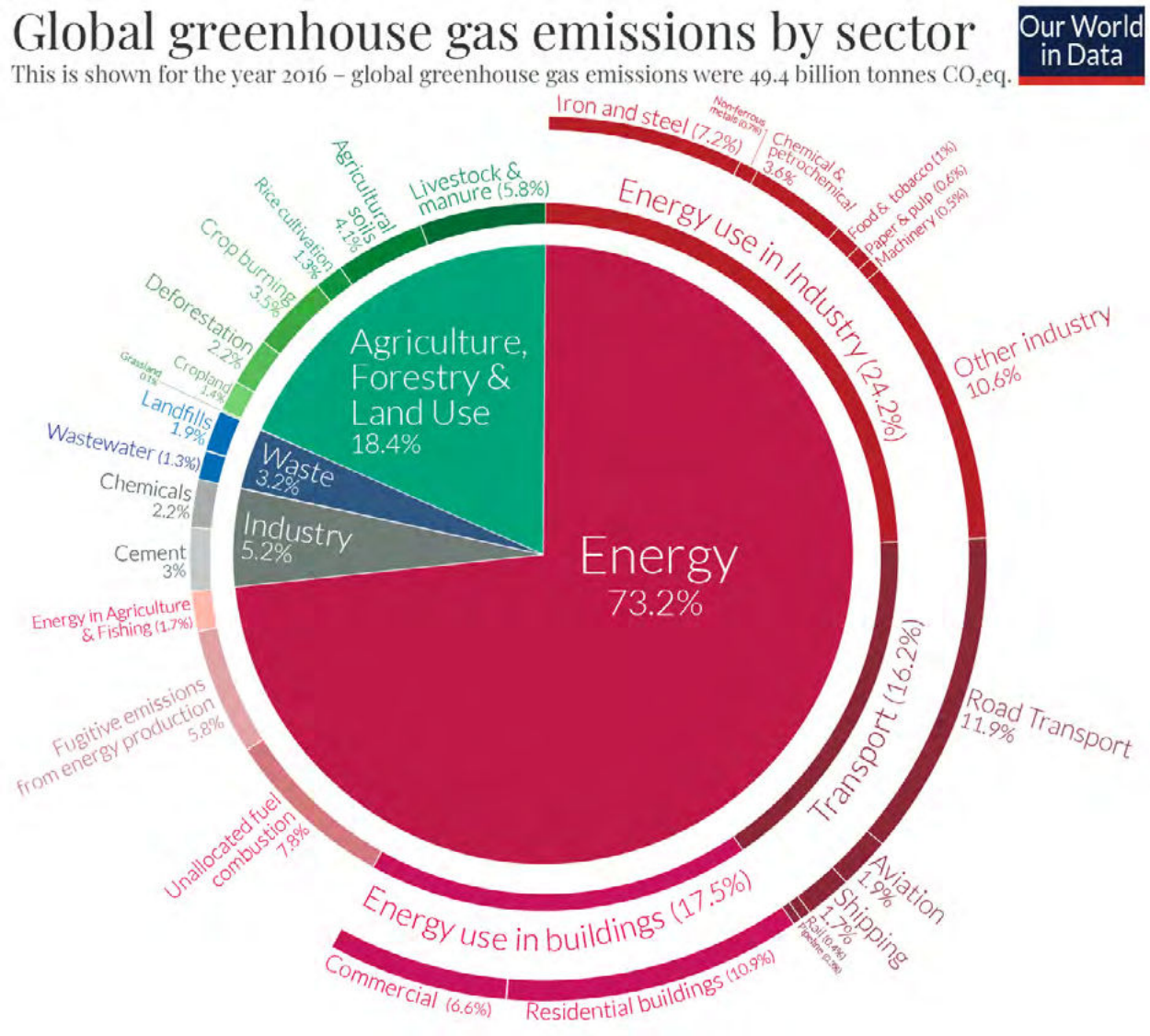
The imbalance between emission and removal rates modifies atmospheric concentrations of GHGs. Since the Industrial Revolution, carbon emissions have exceeded the natural capacity of the biosphere to sequester them, and thus, their concentration has built up (Figure C1). Measurements of GHG emissions on the island of Mauna Loa started in the 1960s and have illustrated a sustained increase in atmospheric carbon dioxide (CO_2). Pre-industrial concentrations of CO_2 ranged from 180 parts per million (ppm) to 280 ppm; however, current levels have reached 420 ppm.

Other research has created historical registries to analyze the correspondence between GHGs and global temperatures in ice cores (e.g., Petit et al., 1999) and to reconstruct the historical concentration of CO_2 from sediment. The evidence shows a correspondence between rising concentrations of GHGs and global temperatures. This correspondence has been confirmed consistently by the scientific reviews of the IPCC, with increasing levels of statistical confidence in its periodic and updated reports. The IPCC is the UN scientific body created in 1988 that provides governments with scientific information to formulate climate policy (IPCC, 2022c).

The Earth system hosts different natural cycles. The carbon cycle is the movement of carbon between reservoirs. Some of these reservoirs include the ocean, fossil fuels, biomass, rocks, soils and sediments, and the atmosphere. The increased presence of carbon and other GHGs in the atmosphere is what causes warmer temperatures (Box C1).

Through chemical reactions resulting from natural events, including rain, volcano eruptions, photosynthesis, or respiration, carbon moves between vegetation, rocks, soil, ocean, and atmosphere. When carbon concentrations change, however, a domino effect occurs. Today, humans are disturbing the fast cycle in multiple ways, from land-use change practices (i.e., clearing forests for agriculture) to the burning of fossil fuels. The exponential accumulation of carbon in the atmosphere through human perturbation on the carbon cycle is what is causing the current climate emergency (Riebeek, 2011). Observed warming is already around 1.15°C in 2022 (WMO, 2023). If more ambitious mitigation actions are not taken, the increase in temperature by the end of the century will be around 2.7°C (UNEP, 2021b).

Figure C1. Main sector and subsectors producing carbon emissions



Source: Ritchie et al., 2020. (Reprinted under CC-BY licence).

Box C1. Main GHG and global warming potentials

GHGs are gases that trap heat in the atmosphere, creating a greenhouse effect. While carbon in the form of CO_2 is the most abundant GHG, there are others, such as water vapour, methane, nitrous oxide (N_2O), hydrofluorocarbons, perfluorocarbons, nitrogen trifluoride (NF_3), and sulphur hexafluoride (SF_6). The increasing presence of methane and N_2O in the atmosphere is associated with agricultural activities (for instance, raising livestock and the use of synthetic fertilizers). The direct source of carbon, in the form of CO_2, is the combustion of fossil fuels (such as coal, oil, and gas). CO_2 is the reference for evaluating global warming because it is the most important anthropogenic GHG in quantity and in total impact. Therefore, GHG emissions are often referred to as carbon emissions, and it is what we can refer to as carbon footprinting (Boukherroub et al., 2017).

Each of these GHGs has an associated global warming potential (GWP). The carbon footprint calculation quantifies emissions (expressed as carbon equivalent units) and considers the GWP of different GHGs. The GWP is the recommended metric to compare future climate impacts of emissions, which accounts for the heat trapped in the atmosphere by a given amount of GHG over a given time period relative to that trapped by an equivalent amount of CO_2 during the same period. For instance, 1 tonne of methane in 100 years traps the same amount of heat as 28 tonnes of CO_2 in those same 100 years. Using the GWP enables us to aggregate GHG emissions into a single metric commonly expressed in carbon dioxide equivalent (CO_2e) or carbon equivalent. The ratios are revised periodically because the models used in the calculation for GWP evolve.

C2 The UNFCCC and the Emergence of National Inventories of Emissions and Removals

Following the Earth Summit in Rio de Janeiro in 1992, three international conventions were created to address pressing environmental programs associated with biodiversity loss, land degradation and desertification, and climate change. The UNFCCC entered into force in 1994, and since 1995, countries have met at the annual Conference of the Parties to the convention to negotiate actions to implement it.

The convention aims to achieve the stabilization of GHG concentrations at levels that prevent dangerous anthropogenic interference with the climate system (Article 2) (UN, 1992). One of the initial mandates for countries is to periodically prepare and submit national inventories of emissions by sources and removals by sinks (Box C2) using the methodologies agreed by the COP (Article 4) (UN, 1992).

Box C2. Carbon sources and sinks

A carbon source is anything that releases more carbon into the atmosphere than it absorbs. Examples of natural carbon sources are the burning of fossil fuels or volcanic eruptions. Expanding carbon sinks is essential for climate mitigation. A carbon sink is defined as anything that absorbs more carbon from the atmosphere than it releases. Examples of natural carbon sinks are plants, the ocean, and soil. Together, these natural sinks have absorbed more than half of the carbon released by human activities. The other half has remained in the atmosphere (Anderson, 2023).

Carbon emissions are presented in two general metrics. *Gross emissions* refer only to the processes generating emissions of GHGs. *Net emissions* present the balance of emissions and removals (removals are subtracted from emissions), and thus include the contribution of carbon sinks to absorb carbon. Therefore, net-zero emissions depict a scenario in which the amount of GHG removed from the atmosphere equals the emissions generated. The goal is to achieve carbon neutrality—that is, when emissions associated with human activities are balanced with anthropogenic removals over a specified period (IPCC, 2018a).

The IPCC has prepared and refined methodologies for national inventories (IPCC, 2015). National inventories present information on emissions and removals in four different sectors: energy; industrial products and product use; agriculture, forestry, and other land uses; and waste (IPCC, 2006). National inventories are elaborated from a territorial and production approach, accounting for processes that result in emissions or removals that are located in specific jurisdictions. Countries have created domestic frameworks to collect information for the inventories and implementation of the convention, including the requirement for certain sectors and companies to report their carbon emissions.

The energy sector encompasses other subsectors, from transportation to different uses of energy, and accounts for about 73% of total GHG emissions. It is important to acknowledge the cross-sectoral nature of value chains. For instance, the food system relies on all sectors, and it is responsible for generating 21% to 37% of total emissions coming from anthropogenic activities (IPCC, 2019b).

Storage in carbon sinks can be temporary, particularly in vegetation, as there is a risk of reversals through mortality, decay or disturbances, including fires, meteorological events (such as hurricanes), or pests.

C3 The Need for GHG Inventories

Non-governmental hands-on actors are keen to develop solutions and have realized that the problem must first be measured. Thus, they started adopting methodologies for GHG inventories or carbon footprints to measure GHG emissions at subnational and organizational levels, and even for specific products, services, or the operations of entire value chains (Box C3).

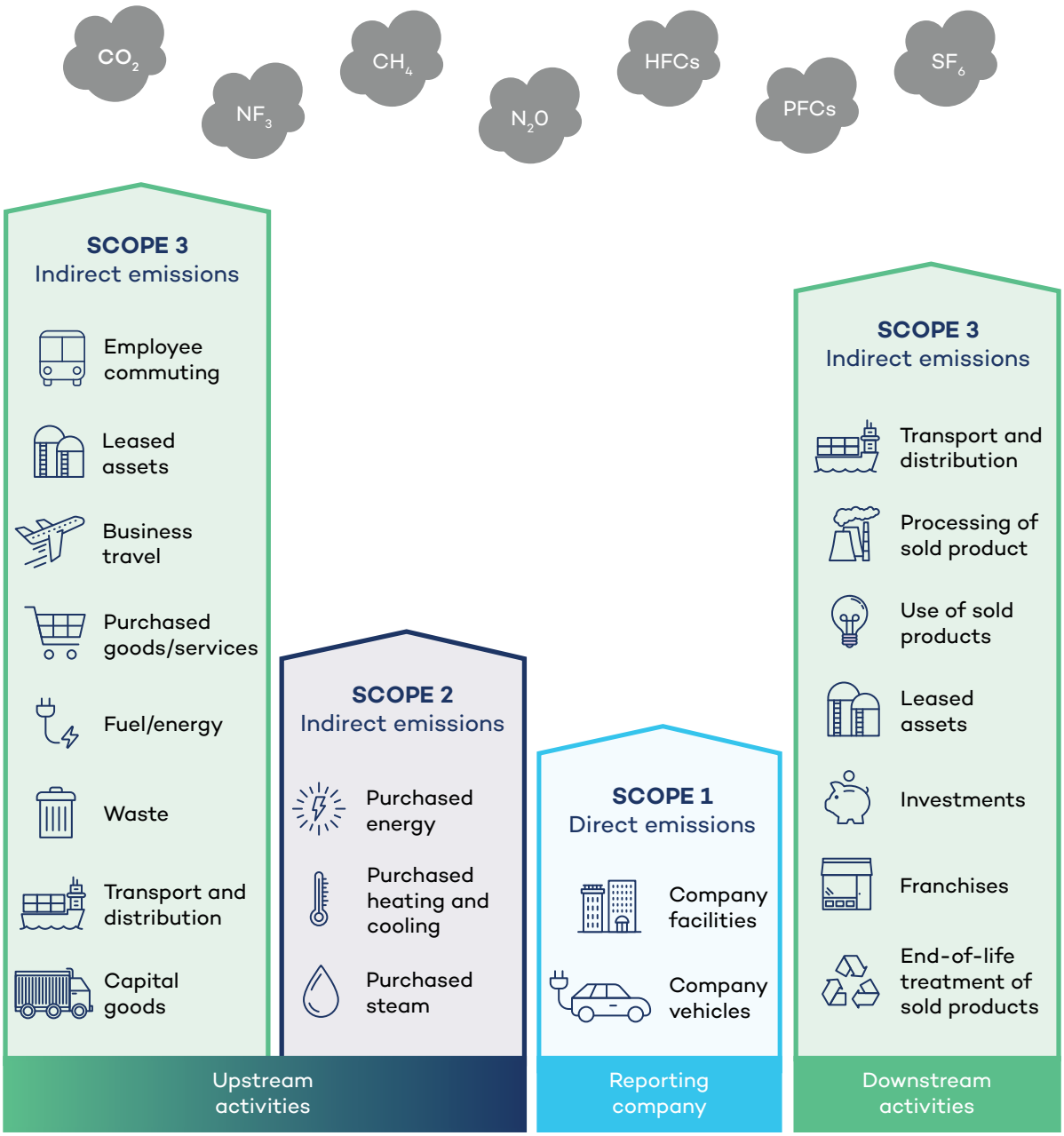
Box C3. The GHG Protocol

The GHG Protocol initiative emerged in 1998 from a collaboration between the World Resource Institute and the World Business Council for Sustainable Development. The GHG Protocol was convened as a multistakeholder partnership of businesses, NGOs, and governments. Three main factors drove demand from industry for an internationally accepted, standardized, and credible approach to measuring GHG emissions. The first was an increase in understanding of the risks and opportunities of carbon management in supply chains. Second, there was a proliferation of GHG accounting initiatives and regulations by the private and public sectors. Third, stakeholders increased their requests for supply chain and product GHG information (World Business Council for Sustainable Development, 2010). The GHG Protocol establishes comprehensive global standardized frameworks to measure and manage GHG emissions from private and public sector operations value chains, as well as mitigation actions. The GHG Protocol developed the Corporate Value Chain (Scope 3) Accounting and Reporting Standard, which enables companies to assess their entire value chain emissions' impact and identify where to focus activities to reduce emissions. Other initiatives come from Carbon Trust, whose Standard for Supply Chain rewards organizations that commit to a target by reducing emissions every year.

Some changes have been made as methodologies have adapted to different uses. A life-cycle approach has often been introduced in the case of the operations of companies and products. This differs from standard GHG national inventories in the sense that emissions are not restricted to a jurisdiction or territory but to those appearing in the supply chain, which can include different countries or continents (i.e., consumption-based carbon accounting [Wood et al., 2019]). At the organizational level, for instance, carbon footprints account for emissions from all activities across the organization—from the energy used by its buildings to the industrial processes that support daily operations. A product carbon footprint refers to the emissions over the whole life cycle (from cradle to grave) of a given product or service (extraction of raw materials, manufacturing, use and final reuse, transportation, recycling, disposal). Finally, a carbon footprint for value chains is the measurement of emissions from the organization's own operations, which account for emissions from both suppliers and consumers (and for product use and end-of-life emissions).

To create common terminology and ease comparability of emissions processes for corporate inventories, in the early 2000s, the GHG Protocol introduced the classification of direct and indirect emissions into three different scopes (Figure C2). This approach has been widely adopted by different initiatives promoting private climate action.

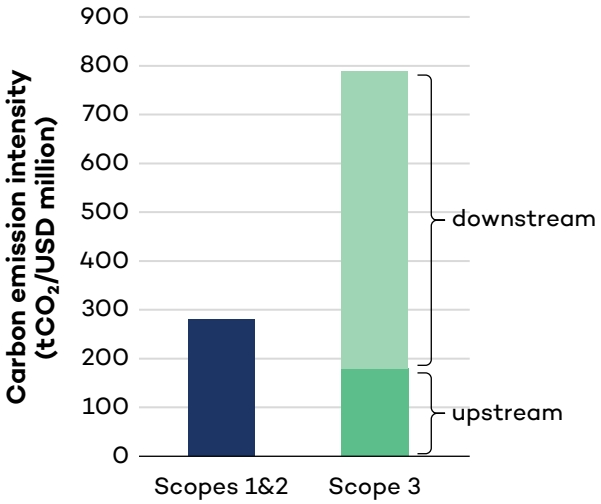
Figure C2. A representation of emission processes by Scopes 1, 2, and 3



Source: GHG Protocol, 2019.

As can be imagined, determining the carbon footprint of a value chain is a complex task because it requires multiple efforts. First, organizations must collect data about the GHG emissions of their own activities. Second, these data need to be shared across value chain actors, which is challenging due to the lack of standardization or good practices in data measurement and reporting. Nonetheless, this is a worthwhile task for any company advancing its climate agenda, as most of its emissions may come from its downstream and upstream operations. These account for 70% to 90% of total emissions, according to some sources (Greenhouse Gas Protocol, 2016; Carbon Trust, 2020b).

Figure C3. The contribution of emissions by scope



Source: Baker, 2020.

C3.1 Key Elements of GHG Inventories

This section presents the basic steps and information usually required to prepare a GHG inventory. It is first necessary to define the spatial and temporal boundaries of the inventory and its scope. The inventory can be prepared for the overall operations of a company, a specific facility, or given products or activities. The year of analysis must be defined. The inventory then identifies different processes producing emissions and can classify them as Scope 1, 2, or 3. For each of the processes identified, in general, emissions are estimated using two fundamental sources of information: activity data and emissions factors.

Activity Data

Activity data describe the scale of the type of processes producing emissions and can be expressed in different units (e.g., physical or monetary units). For instance, when estimating emissions from transportation, activity data can include information on the number of litres of fuel burned or the information required to estimate it. Activity data can be measured directly (e.g., by metering devices) by collecting information from purchase/consumption receipts, estimated based on a census of all activities or processes producing the emissions, or estimated through a statistical sampling/survey. They can also be estimated considering proxy information (e.g., using total km travelled in a vehicle and fuel usage per km to obtain the consumption of fuel). Usually, the companies own and have already generated the information that can be used to characterize activity data of the different emissions processes.

Emission Factors

Emission factors define the amount of specific GHGs that are emitted by each corresponding unit of the activity data. Following the previous example of the transport sector, the emissions factor indicates the amount of GHGs produced per litre of fuel burned. As there are different GHGs, emissions factors must be generated/selected for each one separately; these factors are expressed in mass units of each GHG (that is, methane, N_2O, or specific hydrofluorocarbons). Global warming potentials are then selected to obtain figures in units of carbon dioxide equivalent (CO_2e). Emission factors can be obtained by the organization or, most commonly, selected from datasets published by governmental offices, scientific bodies (e.g., IPCC), or organizations associated with different VSICMs, and from the scientific or technical literature.

Estimate of Emissions

Inventories contain a summary table or section where emissions are presented for each of the processes included, along with a description of the information used and assumptions made. Emissions are estimated by multiplying each of the values of the activity data by the corresponding emissions factors.

Uncertainty Management

Different sources of uncertainty are associated with estimating GHG emissions. Uncertainty is linked to the information used to obtain activity data and emission factors. It can be described quantitatively and qualitatively. It is necessary to consider whether the information comes from a full census or direct metering or if data are collected through a survey. In the latter case, some estimates can be expressed as central values and statistical confidence intervals. The IPCC uses percentage uncertainty to quantitatively monitor the uncertainty in inventories. It is defined as 50% of the width of confidence level at 90% (IPCC, 2000). When quantitative methods are introduced, an uncertainty propagation analysis can be made in combination with modelling techniques such as Monte Carlo analysis (IPCC, 2000). The qualitative description can illustrate the major sources of uncertainty, whether the information is complete or not, the assumptions followed and their effects, and strategies to reduce it.

C4 Kyoto Protocol, the Emergence of Carbon Markets and Offsets

The Kyoto Protocol became the landmark international effort aiming to reduce GHG emissions quantitatively. It was adopted in 1997 at COP 3 and ratified in 2005. It established agreed individual emission-reduction targets for developed countries by defining the authorized emissions or assigned amount units (i.e., emissions allowed) (Shishlov et al., 2016). These countries, listed in Annex I of the UNFCCC, correspond to the countries that were members of the Organisation for Economic Co-operation and Development (OECD) when the convention entered into force in 1994 (Gupta, 2010). Overall, the mitigation targets aimed to reduce

emissions by 5% for the first commitment period (from 2008 to 2012) compared to 1990 emission levels.

As part of these commitments, countries were asked to adopt mitigation measures and report continuously. One important element of the Kyoto Protocol was the inclusion of flexible market-based mechanisms (Box C4). The rationale behind these mechanisms was that it does not matter where or how emissions are reduced, as long as they are reduced or removed from the atmosphere. This is aligned with the principle of the convention, which aims to produce climate benefits cost-efficiently and at the least possible cost (Article 3) (UN, 1992). Economic theory indicates that market-based mechanisms offer the opportunity to reduce emissions cost-efficiently (e.g., Kosolapova, 2021). However, one cannot overlook factors that may hinder efficiency, such as transaction costs or other hidden regulation costs (Voss, 2007).

Box C4. The Kyoto Protocol and flexibility instruments

The Kyoto Protocol allowed the use of flexibility mechanisms, including market-based instruments, namely emissions trading systems (ETSs), joint implementation, and the CDM. The rules to implement the Kyoto Protocol allowed Annex I countries to opt to create an ETS to reduce their emissions and reduce costs, including setting the cap and allowing the trade of permits or allowances among regulated entities. Joint implementation allowed the use of offsets (or certified emission reductions) from projects developed in Annex I countries to demonstrate emissions reductions or to be used instead of emission allowances (i.e., offsets). Additionally, the CDM could be used to develop projects in non-Annex I countries—that is, developing or non-OECD countries by 1994—to produce offsets that could be sold to Annex I countries to demonstrate compliance with their emission-reduction targets (Kainou, 2022).

Flexibility mechanisms opened the way for the creation of regulated carbon markets. Annex I countries could use them to show compliance with their commitments under the Kyoto Protocol. Flexibility mechanisms incorporate ETSs and the concept of "offsets," developed in the United States in the late 1970s when introducing ETSs as part of clean air regulations (Voss, 2007).

Under an ETS, the governmental regulator sets a limit on the total emissions that can be generated in a year in each jurisdiction where the regulated companies are located. The original principle established in the ETS stated that if there were participants who emitted less than they were allowed, other actors could surpass their limits, and total emissions would still be within the desired limits. Trading could be implemented after assigning property rights to emissions allowed (i.e., permits). By extension, if an entity—regulated or not—can reduce emissions or, in this case, remove additional carbon from the atmosphere, it creates additional room to compensate for emissions from other actors. These additional "permits" were identified as offsets (Voss, 2007).

Under the Kyoto Protocol, methodologies were created to incentivize projects that result in an additional reduction of emissions. These methodologies are used to quantify the benefits of individual projects and issue tradable units that could be used by Annex I countries to show compliance (i.e., emission-reduction units for joint implementation projects and certified emission reductions for CDM). These tradable units are equivalent to the reduction of 1 tonne of CO_2e (OECD, 2009).

Mitigation projects and methodologies cover different sectors and activities, such as renewable energy, afforestation/reforestation, and waste management. Third-party certified auditors must verify projects. The main difference between the CDM and joint implementation is that projects are implemented in Annex I countries in the latter, while CDM projects are developed in non-Annex I countries, which do not have emission-reduction commitments under the Kyoto Protocol (UNFCCC, 2022e). In theory, these mechanisms fulfilled two purposes: reducing emissions and attracting investment for sustainable development initiatives, particularly in developing countries in the case of CDM.

The Kyoto Protocol established mitigation targets for the first commitment period, which ended in 2012. At COP 15 in Copenhagen, there were difficulties negotiating the terms for long-term cooperative action for all countries and defining further commitments under the Kyoto Protocol for Annex I countries (UNFCCC, 2023). **Annex I countries were reluctant to negotiate legally binding mechanisms if developing countries with high levels of emissions were not included and had no mitigation obligations.** Provisions for the Kyoto Protocol post-2012 were adopted in 2012 in Doha (the Doha Amendment, which was only ratified in 2020). The Doha Amendment states that countries participating in the Kyoto Protocol from 2012 to 2020 have committed to reducing their emissions by 18% in comparison to 1990 (UNFCCC, 2023).

After the difficulties increasing the ambition of the emission-reduction targets of Annex I countries for the second commitment period (post-2012), demand for and interest in carbon offsets from CDM dropped. **By this time, the EU had made it clear that it would not allow CDM offsets in its ETS, and Japan opted not to include a numerical target for the Kyoto Protocol or allow the use of the CDM.** As a result, prices of offsets fell from an initial EUR 25/ tCO_2e to EUR 0.5 per tCO_2e (Kainou, 2021).

Voluntary Carbon Market

The VCM emerged in parallel to regulated carbon markets under the Kyoto Protocol and started carbon trading around the late 2000s (Hamrick & Gallant, 2018). As its name implies, it is a market-based mechanism in which a performance-based economic incentive is created to stimulate the implementation of projects that reduce carbon emissions or increase carbon removals by sinks to produce offsets.

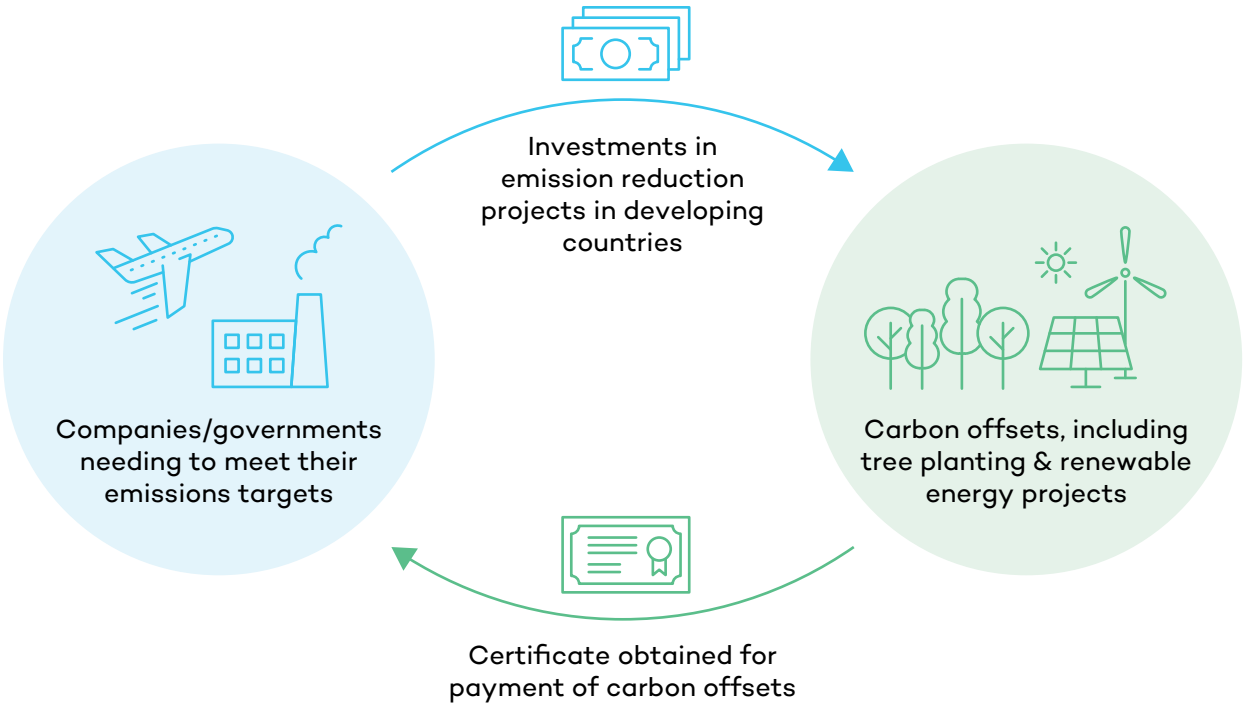
The trading of offsets in the VCM provides additional and more flexible options to project developers and offers options to citizens and companies to advance mitigation actions. Transaction costs to develop projects and initiatives in the VCM are lower, and this market offers

room to innovate and prepare for future regulations (Benessaiah, 2012). Unlike the compliance market, which was limited to specific jurisdictions as part of the Kyoto Protocol that is, Annex I countries—the VCM and its credits are significantly more fluid, without boundary constraints set by nation-states or political unions. In addition, the VCM can be accessed by every sector of the economy instead of a limited number of industries.

There are four important groups of actors in the life cycle of offset projects: project developers or providers of carbon offsets, the buyers of the offsets, the entities regulating the crediting mechanisms, and independent verifiers or auditors.

Project developers and buyers trade certified emissions reductions or carbon removals; this can be done bilaterally and over the counter (Favasuli & Sebastian, 2021). Sometimes, offsets created in the VCM can be used in an ETS or to reduce carbon taxes; there is an interstice between voluntary and compliance markets depending on the specific rules of the latter. Companies or people can use each offset—which corresponds to 1 tonne of reduced, avoided, or removed CO_2 or equivalent GHG—to counterbalance their GHG emissions.

Figure C4. The general cycle of offset generation and use



Source: UNEP, 2019.

The offices of each certification regime issue carbon credits with individual identification numbers or codes to prevent double counting and fraud. The codes are linked to the year they were generated and verified; this is called the credit's vintage. Offsets can be traded many times,

though they can only be "used" when they are retired from the market. Once companies or individuals decide to include their offsets as part of their carbon balance for a given year, they need to retire them from the market. The user of the offsets needs to notify the administrator of the corresponding certification regime of their desire to retire them, indicating the corresponding identification codes. Once retired and cancelled, offsets cannot be traded again.

In addition to the CDM and joint implementation, some NGOs have created different crediting initiatives to issue offsets. This has increased the number of actors in the landscape of carbon. Each initiative prepared its own standards and methodologies and issues its own offsets. They are expressed in different units, which take different names depending on the specific standard and crediting mechanism (e.g., verified emissions reductions, climate reserve tonnes, and Verified Carbon Units) (Table 2).

One of the challenges with offsets relates to their quality and credibility. A group of service providers for emissions reductions and offsets created the International Carbon Reduction and Offsets Alliance in 2008 to provide a framework for private climate action based on the integrity, quality, and impact of carbon offsets (International Carbon Reduction and Offset Alliance, 2023). It has defined a Code of Best Practice and an accreditation program for organizations providing offsetting services and for endorsing offset standards in the VSICMs. The key principles of the Code of Best Practice indicate that offsets should be real, measurable, permanent, independently verified, additional, and unique.

Carbon removals by sinks are potentially reversible. There are nature-based sequestration projects, such as afforestation projects, that could, in theory, be permanent. Nonetheless, forests are susceptible to disturbances that may cause the stored carbon to be released back into the atmosphere. These are called reversals, a relative reduction in carbon storage (for instance, carbon loss due to fire). Unavoidable reversals refer to the inherent vulnerability of a carbon stock to go back to the atmosphere from uncontrollable natural agents such as fire, insects, disease outbreaks, hydrometeorological events, and wind (Murray et al., 2012). Avoidable reversals result from controllable agents or human activities such as land conversion and over-harvesting (Murray et al., 2012). Reversals can undermine the permanence of climate mitigation actions, so they must be addressed through policies and carbon-accounting procedures.

Companies can participate in the VCM individually or as part of an industry-wide scheme. For instance, the aviation sector set up the Carbon Offsetting and Reduction Scheme for International Aviation to offset its GHG emissions. Members have pledged to offset all the CO_2 emissions they produce above a baseline 2019 level.

Public Reporting and Disclosure Platforms

Different non-governmental actors—particularly in the financial sector—began different initiatives to promote the disclosure of climate-related information that led to the development of public reporting and disclosure platforms.

The scientific information is clear when signalling a restricted carbon budget, meaning only a certain level of emissions can be made to limit the increase of temperature at safe levels (i.e., 1.5°C or even 2°C). This has tremendous implications for each country, the private sector, and especially for the oil and gas industry because, to comply with the carbon budget, some of the proven reserves of fossil fuel simply cannot be burned (Carrington & Taylor, 2022). If these reserves have a financial value when evaluating the profitability and expected revenues of these companies, it is, in fact, a financial carbon bubble, as these are stranded assets (Carrington & Taylor, 2022).

In this context, there is a movement to withdraw investments from companies that contribute to carbon emissions the most (Clifford, 2021), notably in the oil and gas sectors (Clere, 2022), based on investors' environmental and ethical responsibility. These movements have demanded more transparency and disclosure on where the capital flows and who are the investment recipients.

Investors and financial institutions aim to lower the risk of projects in which they invest, so they increasingly require companies to disclose the climate-related risks to which they are exposed. This includes information on their vulnerability to climate impacts, but also on the contribution to carbon emissions and mitigation efforts. These initiatives are usually aligned with the Equator Principles for banking, which have become the financial industry standard for environmental and social risk management in projects (Equator Principles, 2023).

Furthermore, national and subnational governments usually struggle to access additional sources of finance, particularly to implement climate policies. Governments and companies can also issue green bonds and reduce the cost of accessing capital. To issue these instruments, it is necessary to demonstrate the environmental benefits that will be achieved; many of these instruments highlight the potential to reduce carbon emissions.

As a result of these dynamics and pressure from financial-service providers, platforms were created in which public and private actors could communicate and disclose their information on carbon emissions, their climate vulnerability, and policies and strategies implemented to address climate risks.

The international non-profit organization CDP has led the way in helping companies and cities disclose their environmental impacts in three different realms: climate change, forests, and water security. In 2021, almost 14,000 organizations disclosed their environmental information through the CDP. As part of the project, the Carbon Action Initiative[13] asks companies in heavy-emitting industries to take action on carbon emissions reductions every year by setting emission targets and implementing reduction measures while simultaneously generating returns on investment (CDP, 2014, in Boukherroub et al., 2017). As of November 2018, more than 1,800 companies had pledged nearly 3,000 individual actions and 600 cooperative actions to reduce emissions,

[13] The Carbon Action Initiative is a UNFCCC project that accelerates company action on carbon reduction through the use of investor pressure, in order to enable sustainable business models and reduce the environmental footprint of companies all over the world.

according to the UNFCCC's Global Climate Action Portal NAZCA (Global Climate Action NAZCA, n.d.-a, n.d.-b).

C5 The Paris Agreement and the Emergence of NDCs

The Paris Agreement was signed in 2015 in Paris, with 196 countries adopting it as part of the work for long-term cooperative action. The agreement aims to keep the rise in mean global temperature below 2°C and preferably below 1.5°C. Each party to the Paris Agreement is required to prepare an NDC and update it every 5 years. An NDC is defined as a climate action plan set by a country to cut emissions and adapt to climate impacts (UN, 2020). NDCs are a holistic tool that can support efforts or initiatives that benefit more vulnerable populations, such as women, youth, and Indigenous communities, and address environmental concerns, including land management or access to energy sources. Governments are expected to integrate NDCs into their development plans and therefore create synergies with other priorities, such as ending poverty or food security. Article 6 of the Paris Agreement describes the framework for international mitigation actions. This is the general basis and framework for regulating compliance carbon markets and incorporating the VCM to prevent issues such as double counting and threats to the delivery of verifiable emissions reductions (e.g., environmental integrity).

The Paris Agreement was successful in providing a common ground to integrate the contributions and pledges of all countries (Annex I and non-Annex I countries). In the context of carbon markets, this implies that the divide between countries buying and selling offsets is more dispersed. Under the Kyoto Protocol, it was clear that Annex I countries were the buyers and non-Annex I countries were only providers of carbon offsets in the regulated market. As negotiations under the UNFCCC moved forward, non-Annex I countries began to pledge their own mitigation targets, which implied the transition to become potential buyers of offsets.

As all countries, including non-Annex I ones, communicate their goals and targets to reduce emissions in the Paris Agreement, it is possible for them—and companies and citizens in their territories—to purchase offsets from projects in other countries to contribute their goals. Conversely, countries may reconsider the convenience of selling offsets to other countries as these may count toward the target of the buying country. As it is expected, the most cost-efficient options may be developed first. If the most cost-efficient offsets in a developing country are generated and sold abroad, offsets would count toward the goals of the buyer, and the country selling the offsets may end up facing higher mitigation costs in the long run. Negotiations in COP 26 concluded the Paris Rulebook to regulate internationally transferred mitigation outcomes, including the necessary adjustments when international transfers of mitigation outcomes take place. This creates the international framework for carbon markets and increases certainty in the VCM, which is expected to unlock potential finance (Klacynzska Lewis & Burzec, 2021). It is estimated that trading in carbon credits could reduce the cost of implementing countries' NDCs by more than half—or as much as USD 250 billion by 2030.

Race to Zero and Carbon Neutrality

In 2018, the IPCC presented a special report on the 1.5°C target that describes what is needed to limit the temperature increase to the Paris Agreement's ambitious goal of 1.5°C (IPCC, 2018b). The report indicates that countries must reduce emissions and achieve net-zero by 2050. To stay below 1.5°C, emissions need to be cut by 50% by 2030. This implies that ambition in NDCs submitted needs to increase, as current pledges (if fully implemented) would lead to a scenario of 2.7°C (UNEP, 2021b). Recent submissions of revised NDCs have raised the ambition, which in turn has slightly boosted the probability of achieving the Paris Agreement objectives (Ou et al., 2021). Nevertheless, global mitigation efforts need to increase threefold to limit the increase in temperature to 2°C and sevenfold to limit it to 1.5°C (Elzen, 2022). In 2021, the Glasgow Climate Pact called on all countries to revisit targets in their NDCs. Thus, ambition is needed to reach net-zero emissions, and it requires the wide participation of the private sector.

Box C5. General steps in the carbon/climate-neutral certification process

The first step is quantification, which requires carbon footprint measurement through the development of inventories and at the level of the three scopes.

The second step, reduction, requires a plan to reduce emissions and achieve carbon neutrality with clear targets and strategies.

The third step, offsetting and insetting, requires companies to take action to reduce their remaining emissions. To compensate for their emissions, companies can buy offsets from projects that generate credits. In addition, they can inset their emissions by reducing them in their own value chain through, for instance, renewable energy infrastructure.

Finally, there is validation and declaration of carbon neutrality, where a company states its commitment and achievement of carbon neutrality. To be entitled to make this claim, the company should provide supporting documents that are publicly available (Acampora et al., 2022). Ideally, the claim should also be validated by a third party, but claims are also often self-validated or from another party. Additionally, companies usually need to disclose information on their contribution to GHG emissions and exposure to climate risks, as this has been increasingly required by financial institutions; this opens opportunities for companies to participate in different voluntary reporting or disclosure platforms.

IPCC's 2018 special report galvanized interest in more ambitious efforts to reach net-zero emissions. This period also coincides with the global awakening of younger generations to demand effective climate action. In this context, initiatives to achieve carbon neutrality at different scales have multiplied. The definition of carbon neutrality is still widely debated due to the complexity of setting emissions scope boundaries, trajectories, and approaches to address residual emissions. However, this usually involves four general processes:

1. Quantification of GHG emissions
2. Strategies to reduce emissions
3. Offsetting and/or insetting of GHG emissions
4. Validation and declaration of carbon neutrality.

Specific VSICMs have emerged to certify activities, products, or organizations as carbon- or climate-neutral. By engaging in this process, a company will have to decide what types of VSICMs to choose, particularly for integrating its GHG inventory and buying offsets (Section 4).

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