GREENHOUSE GAS PROTOCOL

Land Sector and Removals Guidance

Part 1: Accounting and Reporting Requirements and Guidance

Supplement to the GHG Protocol Corporate Standard and Scope 3 Standard

DRAFT FOR PILOT TESTING AND REVIEW (SEPTEMBER 2022)

WORLD RESOURCES INSTITUTE

wbcsd

This is the Draft for Pilot Testing and Review.

This draft is not yet final and does not represent official Greenhouse Gas Protocol guidance.

This Guidance has been under development through the Advisory Committee and Technical Working Group since early 2020. The draft is now available for pilot testing by the Pilot Testing Group and review by the Review Group. The Review Group is open to any interested stakeholder that wants to participate in the public consultation by reviewing this draft. The pilot testing phase will last 4 months and the review phase will last 2 months.

Following the pilot testing and review phase, the Guidance will be finalized in consultation with the Advisory Committee and Technical Working Group and published in 2023.

If cited, this draft should be referred to as the
"Greenhouse Gas Protocol *Land Sector and Removals Guidance*
(Draft for Pilot Testing and Review, September 2022)".

A full list of contributors, including members of the Advisory Committee, Technical Working Group, Pilot Testing Group, and Review Group, as well as funders, will be provided in the final publication. Members of the Pilot Testing Group and Review Group will be acknowledged based on completion of either pilot testing or review.

DRAFT

Table of Contents

1

Introduction

Chapter 1: Introduction

Requirements and Guidance

The global scientific consensus is clear that the world needs to radically reduce greenhouse gas (GHG) emissions and remove carbon dioxide (CO_2) from the atmosphere to avoid a 1.5°C (or even 2°C) rise in temperature. Inaction could have catastrophic impacts including the loss of entire regions to rising seas, extreme droughts and food shortages, and the potential displacement of hundreds of millions of people.

The Intergovernmental Panel on Climate Change (IPCC) identifies pathways to limit warming to 1.5°C that require significant and rapid emission reductions across all sectors. Globally, the agriculture, forestry and other land use (AFOLU) sector alone is responsible for approximately 25% of net anthropogenic greenhouse gas emissions.[1,2] 1.5°C pathways also require CO_2 removal on the scale of 100 billion to 1 trillion tonnes over the course of the 21st century.[3]

Achieving these goals requires halting deforestation and facilitating a significant amount of afforestation and reforestation. This in turn requires improving land management and using land more efficiently as the global population grows toward 10 billion people by 2050. It also requires new technologies to remove and permanently store atmospheric CO_2. Companies can contribute to these goals with their own GHG targets, strategies, and actions, underpinned by robust GHG accounting and reporting.

Sections in this chapter

Section	Description
1.1	About the Greenhouse Gas Protocol
1.2	Purpose of the Guidance
1.3	Scope of the Guidance
1.4	Intended audience
1.5	Relationship to other standards and guidance
1.6	Terminology: shall, should, and may
1.7	Requirements for reporting under the Greenhouse Gas Protocol
1.8	Calculation tools and resources
1.9	Guidance development process
1.10	Open questions included in this draft

[1] Roe et al., 2019

[2] IPCC, 2019a (Summary for Policymakers)

[3] IPCC, 2018

Checklist of accounting requirements in this chapter

Section	Accounting requirements
1.7	• Companies[4] reporting a corporate- or organization-level GHG inventory in conformance with the Greenhouse Gas Protocol **shall** follow the *Land Sector and Removals Guidance* if the company has land sector activities in its operations or value chain or if the company is reporting removals. • Companies reporting a GHG inventory in conformance with the *Land Sector and Removals Guidance* **shall** also follow and meet all the requirements of the *Corporate Standard* and *Scope 3 Standard*.[5]

1.1 About the Greenhouse Gas Protocol

The Greenhouse Gas Protocol (GHG Protocol) is a multi-stakeholder partnership of businesses, non-governmental organizations (NGOs), governments and others convened by the World Resources Institute (WRI) and the World Business Council for Sustainable Development (WBCSD). The mission of the GHG Protocol is to develop internationally accepted greenhouse gas (GHG) accounting and reporting standards, guidance, and tools, and promote their adoption to achieve a net-zero emissions economy worldwide.

1.2 Purpose of the Guidance[6]

The *Land Sector and Removals Guidance* is intended to improve the accuracy, completeness, consistency, relevance, transparency, and comparability of companies' GHG inventories by providing clarity on the steps, methods and data needed to calculate GHG emissions and removals from land-based activities and technological CO_2 removal activities.

A GHG inventory is the foundation for companies to understand, track, report and manage their emissions and removals. Since the publication of the GHG Protocol *Corporate Accounting and Reporting Standard* in 2001 (revised in 2004), many companies regularly develop GHG inventories to meet a variety of objectives, including reporting to stakeholders, setting and tracking targets, managing risks, and more.

Since the publication of the *Corporate Value Chain* (*Scope 3) Standard* in 2011, companies commonly report on scope 3 emissions, in addition to their scope 1 and 2 emissions.

Due to a previous lack of agreed upon guidance, several important activities and associated GHG impacts have often been excluded from companies' GHG inventories:

- Land use and management
- Land use change

[4] Throughout this Guidance, the term "company" is used as shorthand to refer to the entity (i.e., company or other organization) developing a GHG inventory.

[5] The Greenhouse Gas Protocol plans to update the *Corporate Standard*, *Scope 2 Guidance*, and *Scope 3 Standard* to ensure alignment with this publication where any differences exist.

[6] This document is referred to as 'Guidance' in this draft, but a decision on whether the document will be called a 'Standard' or 'Guidance' under the Greenhouse Gas Protocol will be taken prior to publication.

- Biogenic products[7] across the value chain
- CO_2 removals, including biogenic and technological removals
- Carbon storage in land, product, and geologic carbon pools

These are increasingly important activities and impacts for companies to include in their GHG inventories and manage over time, given the urgent need to reduce emissions and increase removals in line with 1.5°C degree pathways identified by the IPCC.

The *Land Sector and Removals Guidance* builds upon existing GHG Protocol corporate-level standards and guidance including the *Corporate Standard* and *Scope 3 Standard*. It explains how companies should account for and report GHG emissions, CO_2 removals, and carbon storage from land-based activities and products across the value chain, as well as technological CO_2 removal and storage pathways, in a corporate GHG inventory across scope 1, scope 2, scope 3, and additional reporting categories identified in this Guidance.

1.3 Scope of the Guidance

This Guidance[8] addresses corporate-level accounting and reporting of emissions and removals across scope 1, scope 2, and scope 3. It can be used by any organization that has land sector activities or CO_2 removals and storage within its operations or value chain.

This Guidance is intended to be used to compile and report a company's annual GHG inventory and track performance over time. The focus of the Guidance is therefore on GHG inventory accounting rather than project accounting or GHG crediting.

Guidance structure and overview of steps

The Guidance is organized into two parts. Part 1 provides accounting and reporting requirements and guidance, while Part 2 provides supplementary calculation guidance on topics introduced in Part 1. Part 1 includes both requirements and guidance, while Part 2 includes guidance only.

The Guidance is organized according to the steps a company should follow when developing a GHG inventory that includes land sector activities and/or removals (summarized in figure 1.1):

In Step 1, companies define their business goals and understand key concepts. Chapter 1 explains the purpose and scope of the Guidance. Chapter 2 explains business objectives for developing a GHG inventory that includes land sector activities and/or removals. Chapter 3 outlines the principles underpinning the GHG inventory and the requirements contained in the Guidance, while chapter 4 provides an overview of key concepts. Step 1 applies to all companies following this Guidance.

In Step 2, companies compile their GHG inventory, as detailed in the following chapters:

- **Chapter 5: Setting the inventory boundary**, which provides requirements and guidance for defining the company's organizational and operational boundaries, including requirements for ensuring a complete GHG inventory.
- **Chapter 6: Removal accounting**, which includes requirements for removals to be reported in a GHG inventory.
- **Chapter 7: Land use change and land tracking**, which addresses accounting for emissions from land use change and land tracking metric(s).

[7] Such as forest products, crops, animal products, bioenergy, and other biogenic products.

[8] The *Land Sector and Removals Guidance* is referred to throughout as "this Guidance".

- **Chapter 8: Land management accounting**, which addresses emissions and removals from land management, including emissions and removals from land carbon stock changes and other land management GHG emissions (occurring on lands associated with producing agricultural and forestry products).
- **Chapter 9: Accounting for product carbon pools**, which addresses accounting for emissions and removals associated with carbon of atmospheric origin that is physically contained in products.
- **Chapter 10: Accounting for geologic carbon pools**, which addresses accounting for emissions and removals associated with carbon storage in geologic reservoirs.

Chapter 5 applies to all companies following this Guidance. Chapter 6 applies to companies that choose to report removals. Chapters 7 and 8 apply to companies with land sector activities in their operations or value chains. Chapter 9 applies to companies with product carbon pool impacts. Chapter 10 applies to companies with geologic carbon pool impacts.

As part of Step 2, companies should follow the calculation guidance provided in Part 2 (chapters 16-21) to calculate GHG emissions and removals from each accounting category, as relevant to their company operations and value chain. Companies are also required to account for all other scope 1, scope 2 and scope 3 emissions, using other standards and guidance as applicable, including the GHG Protocol *Corporate Standard, Scope 2 Guidance, Scope 3 Standard,* and *Scope 3 Calculation Guidance.*

In Step 3, companies identify and evaluate the impact of actions, set targets and track progress, and account for credits (if applicable), as detailed in the following chapters:

- **Chapter 11: Evaluating the impact of actions**, in which companies evaluate the impact of their actions on GHG emissions and removals to determine whether actions they are implementing have overall positive or negative GHG impacts, not only within scopes 1, 2 and 3, but also more broadly, to ensure actions have net positive impacts and avoid implementing actions that have negative impacts.
- **Chapter 12: Target setting and tracking progress**, in which companies set GHG targets that include the activities covered in this Guidance and track progress over time.
- **Chapter 13: Accounting for credited emission reductions and removals**, in which companies account for transactions of GHG credits (if applicable), including adjusting emission and removal values for any sold credits when accounting for GHG targets to avoid double counting.

In Step 4, companies report the GHG inventory in conformance with the reporting requirements and undertake assurance of the GHG inventory. Chapter 14 provides reporting requirements, while Chapter 15 provides guidance on assurance.

Steps 3 and 4 apply to all companies following this Guidance.

Figure 1.1 Overview of steps and chapters

Part 1: Accounting and Reporting Requirements and Guidance

Step 1: Define business goals and understand key concepts

1. Introduction
2. Business Goals
3. Principles and Requirements
4. Overview of Key Concepts

Step 2: Compile GHG inventory

5. Setting the Inventory Boundary
6. Removal Accounting
7. Land Use Change and Land Tracking
8. Land Management Accounting
9. Accounting for Product Carbon Pools
10. Accounting for Geologic Carbon Pools

Step 3: Evaluate actions, set targets and track progress, and account for credits (if applicable)

11. Evaluating the Impact of Actions
12. Target Setting and Tracking Progress
13. Accounting for Credited Emission Reductions and Removals

Step 4: Reporting and Assurance

14. Reporting
15. Assurance

Part 2: Calculation Guidance

Step 2: Calculation guidance for compiling GHG inventory

16. Collecting Data and Quantification
17. Land Use Change and Land Tracking
18. Land Management Carbon
19. Land Management Non-CO_2 Emissions
20. Accounting for Product Carbon Pools
21. Accounting for Geologic Carbon Pools

Annexes: Sector-specific guidance

A. Technological Removals
B. Biomethane

Gases

This Guidance covers the following greenhouse gases: carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O) from land-based activities, as well as CO_2 removals and storage.

Companies following this Guidance are required to report a complete GHG inventory, covering the following greenhouse gases across their operations and value chains: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulfur hexafluoride (SF_6), and nitrogen trifluoride

(NF_3). The Greenhouse Gas Protocol website[9] provides standards, guidance, and tools for calculating other sources of emissions in a company's GHG inventory.

Impacts beyond greenhouse gases and climate change mitigation

This Guidance focuses on developing a GHG inventory to enable companies to measure performance on addressing climate change mitigation. Companies should supplement this Guidance with methods and standards for measuring, managing, reporting and setting targets on other environmental, social and economic impacts relevant to the land sector and CO_2 removal. This will enable companies to develop coordinated and effective strategies for achieving a variety of sustainable development objectives to maximize positive impacts and avoid or minimize any potential negative impacts.

These may include climate adaptation and resilience, food security, biodiversity, zero-deforestation supply chains, land degradation, soil quality, water quality and access, waste, protecting human rights, poverty reduction, health, access to land, income of small-scale food producers, protection of poor and negatively affected communities, agricultural productivity, and more, such as those included in the United Nations Sustainable Development Goals.

1.4 Intended audience

This Guidance applies to companies and other organizations following the GHG Protocol *Corporate Standard* and *Scope 3 Standard* that have land sector activities or removals in their operations or value chain (see Table 1.1).

Table 1.1 Intended audience of this Guidance

Type of value chain	Types of companies
Agricultural, forestry, or other land-based value chains	• Companies that own or control land (such as agricultural or forestry producers) • Companies that supply to producers • Companies that purchase, consume, process, or sell food, fiber, feed, forest products, bioenergy, or other biogenic products – such as food and beverage companies, consumer goods companies, bioenergy producers and consumers, biomaterial producers and consumers, or retailers • Companies that store biogenic CO_2
Technological CO_2 removal value chains	• Companies that own or control technological CO_2 removal operations • Companies that purchase, consume, process, or sell technological CO_2 removal products • Companies that store technologically removed CO_2

This Guidance also applies to companies that buy or sell GHG credits from land sector or removal activities (covered in chapters 12 and 13).

This Guidance is relevant for companies of any size, at any point in the value chain. While the Guidance is primarily focused on companies, it can also be used by other types of organizations and institutions, both public

[9] Available at https://ghgprotocol.org/

and private, such as government agencies, non-profit organizations, assurers and verifiers, certification bodies, GHG programs, and universities. Policymakers and designers of GHG reporting or target setting programs can use relevant parts of this Guidance to develop accounting and reporting requirements.

1.5 Relationship to other standards and guidance

The *Corporate Standard* and *Scope 3 Standard* provide the foundation for producing a corporate GHG inventory for all sectors. The *Land Sector and Removals Guidance* builds upon this by providing additional sector-specific accounting and reporting guidance and requirements that supplement the existing standards. Companies should use this Guidance in combination with the GHG Protocol *Corporate Standard* and *Scope 3 Standard*.

This Guidance also builds upon the GHG Protocol *Agricultural Guidance*, which has a narrower scope and provides guidance for agricultural producers to account for scope 1 and 2 emissions related to agricultural production. The *Land Sector and Removals Guidance* provides comprehensive guidance for all land-sector activities across the value chain (scope 1, scope 2, and scope 3) covering both agriculture and land-sector activities beyond agricultural production.

The *Product Life Cycle Standard* provides requirements and guidance on removals, land use, and land use change impacts in the context of product life cycle accounting. Companies should use the *Product Standard* for product-level GHG accounting and reporting.

1.6 Terminology: shall, should, and may

This Guidance uses precise language to indicate which provisions are requirements or recommendations, and which are permissible or allowable options:

- The term "shall" is used to indicate what is required for a GHG inventory to conform to the Guidance.
- The term "should" is used to indicate a recommendation, but not a requirement.
- The term "may" is used to indicate an option that is permissible or allowable.
- The term "required" is also used in the Guidance to refer to requirements (i.e., "shall" statements) in other chapters.

1.7 Requirements for reporting under the Greenhouse Gas Protocol

Reporting a GHG inventory based on the Greenhouse Gas Protocol (or GHG Protocol) requires following all relevant GHG Protocol standards and guidance.

Accounting requirement
Companies[10] reporting a corporate- or organization-level GHG inventory in conformance with the Greenhouse Gas Protocol **shall** follow the *Land Sector and Removals Guidance* if the company has land sector activities in its operations or value chain or if the company is reporting removals.

[10] Throughout this Guidance, the term "company" is used as shorthand to refer to the entity (i.e., company or other organization) developing a GHG inventory.

Accounting requirement
Companies reporting a GHG inventory in conformance with the *Land Sector and Removals Guidance* **shall** also follow and meet all the requirements of the *Corporate Standard* and *Scope 3 Standard*.[11]

1.8 Calculation tools and resources

To help companies implement the *Land Sector and Removals Guidance*, the GHG Protocol website[12] provides a database of relevant tools and resources created by other non-profit organizations, academic institutions, and companies.

The database is organized by sector, country, and other factors that companies can use to identify resources that are most relevant. This Guidance does not mandate the use of a specific tool or method. Instead, it provides guidance to help companies select the most relevant calculation resources based on factors such as sector, geographic location, and data availability.

1.9 Guidance development process

The Greenhouse Gas Protocol follows a broad and inclusive multi-stakeholder process to develop GHG accounting and reporting standards with participation from businesses, government agencies, NGOs, and academic institutions from around the world.

In 2020, WRI and WBCSD launched a three-year process to develop the GHG Protocol *Land Sector and Removals Guidance*. The first draft of this Guidance was developed through the Technical Working Group and Advisory Committee, together comprised of over 100 participants from businesses across industry sectors, NGOs, governments, and academic institutions.

The draft is now available for pilot testing by the Pilot Testing Group and review by the Review Group. The Review Group is open to any interested stakeholder that wants to participate in the public consultation by reviewing this draft. The pilot testing phase will last 4 months, and the review phase will last 2 months.

Following the pilot testing and review phase, the Guidance will be finalized in consultation with the Advisory Committee and Technical Working Group and published in 2023.

A full list of contributors, including members of the Advisory Committee, Technical Working Group, Pilot Testing Group, and Review Group, as well as funders, will be provided in the final publication. Members of the Pilot Testing Group and Review Group will be acknowledged based on completion of either pilot testing or review.

This is the Draft for Pilot Testing and Review. This draft is not yet final and does not represent official Greenhouse Gas Protocol guidance.

[11] The Greenhouse Gas Protocol plans to update the *Corporate Standard*, *Scope 2 Guidance*, and *Scope 3 Standard* to ensure alignment with this publication where any differences exist.

[12] Available at https://ghgprotocol.org/land-sector-and-removals-guidance

1.10 Open questions included in this draft

This draft for pilot testing and review includes three open questions. During the pilot testing and review phase, we would like to determine whether the current approach on each issue should be maintained or whether alternative approaches should be pursued in the final Guidance.

The three open questions are:

- ***Open question #1:*** **Biogenic CO_2 and technologically removed CO_2 accounting and reporting**. For more information, see chapter 5, box 5.2.
- ***Open question #2:*** **Removals with product storage**. For more information, see chapter 6, box 6.3 (and repeated in chapter 9, box 9.2).
- ***Open question #3:*** **Traceability for land management removals**. For more information, see chapter 8, box 8.3.

During the pilot testing and review phase, we would like to gain practical experience with data and methods needed to implement the approaches and understand the implications of the options. We invite pilot testers to pilot test different approaches in order to learn about the feasibility and implications of each approach to inform the final decision on each issue. Decisions will be taken in consultation with the Advisory Committee and Technical Working Group.

2

Business Goals

Chapter 2: Business Goals

Guidance

This Guidance enables companies to account for and report land related emissions and removal activities, and understand and manage their related risks and opportunities associated with their GHG emissions and removals. Companies can plan and set credible targets to reduce direct and value chain GHG emissions and also account for and set targets for increased removals.

There are several business goals supported by accounting for land sector activities and removals. To focus accounting efforts, companies should consider which business objectives they intend to achieve.

This chapter provides examples of goals that companies should consider when accounting and reporting land sector activities and CO_2 removals in their GHG company inventories. These goals include 1) identifying and understanding climate impact risks and opportunities; 2) setting GHG targets and tracking performance; 3) informing strategies to reduce emissions and increase removals, and 4) enhancing transparency and stakeholder information.

Sections in this chapter

Section	Description
2.1	Identify and understand climate impact risks and opportunities
2.2	Set GHG targets and track performance
2.3	Inform strategies to reduce emissions and enhance removals
2.4	Enhance transparency and stakeholder information through public reporting

2.1 Identify and understand climate impact risks and opportunities

Traditional business risk concerns (financial and regulatory, social, reputational, and business continuity risks) are heightened by the climate crisis. Land sector activities can be drivers behind many of these risks, since use of land can lead to deforestation and land degradation, soil degradation, biodiversity loss, increased heat exposure, zoonotic disease spillover, and food insecurity, among other issues. Increased attention to land sector activities with company accounting provides a path to understanding and reducing these risks.

Including land sector activities in a GHG inventory provides a more comprehensive assessment of company's value chain environmental impact. For many companies, land sector activities may be a materially large portion of a company's environmental footprint, because deforestation and other land management activities produce emissions. By understanding land sector activities within their value chains, companies can prevent deforestation and identify mitigation opportunities such as protecting existing ecosystems, improving management on working lands and restoring degraded ecosystems. Emerging CO_2 removal technologies such as direct air capture and storage can also contribute to removing CO_2 from the atmosphere.

2.2 Set GHG targets and track performance

Companies face consumer, investor, and stakeholder pressure to develop and show progress towards reaching ambitious climate targets, such as near-term and long-term net-zero targets, and to set emission reduction targets aligned with a 1.5-degree pathway under the Science-Based Targets initiative (SBTi).

This Guidance helps companies to set targets to reduce land-based emissions and enhance CO_2 removals as well as track progress toward those targets. It recommends which metrics should be included for target setting and progress towards the targets to incentivize the right value-chain behaviors and provides a foundation for other target setting programs, such as the Science Based Targets Initiative (SBTi)[13] and SBTi Forest, Land and Agriculture project (FLAG).[14]

2.3 Inform strategies to reduce emissions and enhance removals

This Guidance supports the design and implementation of effective mitigation strategies that reduce emissions and increase removals across the value chain, by considering land sector and carbon removal impacts.

Table 2.1 provides an overview of GHG mitigation and removal enhancement opportunities and maps their tradeoffs with other environmental and socio-economic impacts. Companies should assess the potential tradeoffs between their mitigation strategies with ecosystem services and the UN Sustainable Development Goals (SDGs). In other words, to implement strategies that co-benefit other environmental or socio-economic priorities and ensure no significant adverse environmental or socio-economic effects. In doing so, companies should consider the specific regions and contexts of their corporate activities. Chapter 11 provides further guidance on identifying mitigation actions, as well as guidance for evaluating the impacts of actions within and beyond a company's value chain.

[13] Available at https://sciencebasedtargets.org/

[14] Available at https://sciencebasedtargets.org/sectors/forest-land-and-agriculture

Table 2.1 Examples of activities that reduce emissions or increase removals

	Land based opportunities		
Mitigation potential	**Land-based mitigation options that do not increase the competition for land, and with low or no other significant adverse environmental and socio-economic impacts**	**Land-based mitigation options that can increase the competition for land with other potential adverse environmental socio-economic impacts**	**Other carbon dioxide removals**
High	• Reduced deforestation and forest degradation • Increased soil organic carbon content • Reduced post-harvest losses • Dietary change • Reduced food waste (consumer or retailer)	• Bioenergy and BECCS	• Direct air capture carbon and storage (DACCS) • Incorporating atmospheric carbon into long-lived products/ materials through technological solution
Medium	• Agro-forestry • Improved cropland management • Improved livestock management • Improved grazing land management • Forest management • Fire management	• Afforestation • Reforestation and forest restoration	
Low	• Agricultural diversification • Integrated water management • Reduced landslides and natural hazards • Improved food processing and retailing • Improved energy use in food systems	• Biochar addition to soil	

Source: Adapted from Mbow et al., 2017

Box 2.2 provides examples of company strategies to incorporate land-based emissions and design GHG reduction strategies.

Box 2.2 Example of combatting deforestation and reducing land sector emissions through supply chain management

Mars includes emissions from land use change in its corporate GHG inventory, which account for approximately 40% of its full value chain GHG impact. For comparison, scope 1 and 2 emissions made up only 5% of Mars' total company impact in 2020.

Mars has a science-based target (SBT) to reduce scope 1, 2 and 3 emissions 27% below 2015 levels by 2025. Meeting the target relies on several activities covered by this Guidance. One important strategy is working to eliminate deforestation in its supply chains and to achieve zero-deforestation goals for key at-risk supply chains.

To achieve its SBTs, Mars increasingly sources cocoa that can be traced back to farms that are not linked to recent deforestation and whose boundaries have been mapped. Mars has a proactive approach to supply chain management, working with its suppliers to monitor deforestation on its farms.

Applying the accounting principles in this Guidance, Mars calculated its GHG emissions from direct land use change on the mapped farms using satellite data on tree cover loss. For volumes that cannot yet be traced to mapped farms, Mars calculated statistical land use change emissions using a "shared responsibility" approach (further detailed in chapter 7). Being able to more accurately calculate direct land use change emissions allows Mars to see the benefits of supply chain management activities in GHG terms.

Mars is working with farmers across its different supply chains to reduce agricultural emissions and remove and store carbon. The accounting clarity around these actions provided by the GHG Protocol will encourage companies to continue to invest confidently in activities that reduce emissions and increase carbon removals across the value chain, and account for them in a robust and consistent way.

See chapter 13 for guidance on accounting for credited GHG emission reductions and removals. Consistency and coordination across GHG inventory and crediting approaches is paramount to ensuring that emission reduction and removals solutions in the value chain are incentivized, while ensuring quality criteria are met and double counting is avoided between GHG inventories and GHG credits across the value chain.

2.4 Enhance transparency and stakeholder information through public reporting

Investors, customers, NGOs, and other stakeholders are increasingly demanding transparency and accountability on corporate GHG emissions and how GHG reduction targets are being achieved. Reporting against this Guidance enables transparent and credible reporting of land sector and removal activities as it applies the GHG accounting and reporting principles (section 3.1).

Accounting in conformance with the Guidance supports disclosure under other sustainability reporting and regulatory frameworks, such as:

- ISO 14064 series of standards on quantification, reporting and validation of Greenhouse gases emissions and removals[15]

[15] Available at https://www.iso.org/standard/66453.html

- Sustainability reporting initiatives, such as carbon disclosure project (CDP),[16] CDP Supply Chain,[17] and Accountability Framework Initiative (AFi)[18]
- Target setting initiatives, such as Science Based Targets initiative (SBTi)[19] and SBTi Forest, Land and Agriculture (SBTi FLAG)[20]
- Voluntary carbon market standards
- National and regional regulations

Note that each of these frameworks may have their own individual requirements which companies will need to follow.

[16] Available at https://www.cdp.net/

[17] Available at https://www.cdp.net/en/supply-chain

[18] Available at https://accountability-framework.org/

[19] Available at https://sciencebasedtargets.org/

[20] Available at https://sciencebasedtargets.org/sectors/forest-land-and-agriculture

3

Principles and Requirements

Chapter 3: Principles and Requirements

Requirements and Guidance

This chapter provides a list of the GHG accounting and reporting principles and a checklist of requirements that must be followed for a GHG inventory to be in conformance with this Guidance.

Sections in this chapter

Section	Description
3.1	GHG accounting and reporting principles
3.2	Checklist of requirements

Checklist of accounting requirements in this chapter

Section	Accounting requirements
3.1	Companies **shall** follow the principles of relevance, completeness, consistency, transparency, accuracy, conservativeness and permanence when compiling a GHG inventory that includes land sector activities and/or removals.
3.2	Companies **shall** follow the requirements listed in table 3.2.

3.1 GHG accounting and reporting principles

As with financial accounting and reporting, generally accepted GHG accounting principles are intended to underpin and guide GHG accounting and reporting to ensure the reported inventory represents a faithful, true, and fair account of a company's GHG emissions and removals. The principles described below are adapted from the GHG Protocol *Corporate Standard* and *Scope 3 Standard* and are intended to guide the accounting and reporting of a company's GHG inventory.

Accounting requirement
Companies **shall** follow the principles of relevance, completeness, consistency, transparency, accuracy, conservativeness, and permanence when compiling a GHG inventory that includes land sector activities and/or removals.

The following list provides definitions for each GHG accounting and reporting principle.

- **Relevance:** Ensure the GHG inventory appropriately reflects the GHG emissions (and removals, if applicable) of the company and serves the decision-making needs of users – both internal and external to the company.

- **Completeness:** Account for and report on all GHG emissions (and removals, if applicable) from sources, sinks, and activities within the inventory boundary. Disclose and justify any specific exclusions.
- **Consistency:** Use consistent methodologies to allow for meaningful performance tracking of GHG emissions (and removals, if applicable) over time. Transparently document any changes to the data, inventory boundary, methods, or any other relevant factors in the time series.
- **Transparency:** Address all relevant issues in a factual and coherent manner, based on a clear audit trail. Disclose any relevant assumptions and make appropriate references to the accounting and calculation methodologies and data sources used.
- **Accuracy:** Ensure that the quantification of GHG emissions (and removals, if applicable) is systematically neither over nor under actual emissions (and removals, if applicable), and that uncertainties are reduced as far as practicable. Achieve sufficient accuracy to enable users to make decisions with reasonable assurance as to the integrity of the reported information.
- **Conservativeness:** Use conservative assumptions, values, and procedures when uncertainty is high. Conservative values and assumptions are those that are more likely to overestimate GHG emissions and underestimate removals.
- **Permanence:** Ensure mechanisms are in place to monitor the continued storage of reported removals, account for reversals, and report emissions from associated carbon pools.

Companies should also follow the principle of comparability where relevant:

- **Comparability:** Apply common methodologies, data sources, assumptions, and reporting formats such that the reported GHG inventories from multiple companies can be compared.

Chapter 13 provides principles specific to accounting for credited emission reductions or removals (including additionality, permanence, avoiding leakage, etc.).

3.2 Checklist of requirements

This Guidance includes accounting and reporting requirements to help companies prepare a GHG inventory including land sector activities and/or removals that represents a true and fair account of their GHG impact. Standardized approaches and principles are designed to increase the consistency and transparency of GHG inventories.

Some chapters contain requirements and guidance, while other chapters contain guidance only. As explained in chapter 1, the term "**shall**" is used throughout this Guidance to indicate what is required in order for a GHG inventory to be in conformance with the GHG Protocol *Land Sector and Removals Guidance.* The term "shall" is used to indicate a recommendation, but not a requirement. The term "shall" is used to indicate an option that is permissible or allowable. The term "required" is used in the Guidance to refer to requirements (i.e., "shall" statements) introduced in other chapters.

Table 3.2 provides a checklist of all the requirements included in this Guidance. The requirements are further explained in the corresponding chapters where each requirement appears. Accounting requirements are also compiled in a box at the beginning of each chapter that contains accounting requirements. All reporting requirements are listed in Chapter 14.

Some chapters contain both requirements and guidance. Other chapters contain guidance only (i.e., recommendations but no requirements), as noted in table 3.2.

Table 3.2 List of requirements in this Guidance

Chapter	Requirements
Part 1: Accounting and Reporting Requirements and Guidance	
1. Introduction	• Companies[21] reporting a corporate- or organization-level GHG inventory in conformance with the Greenhouse Gas Protocol **shall** follow the *Land Sector and Removals Guidance* if the company has land sector activities in its operations or value chain or if the company is reporting removals. • Companies reporting a GHG inventory in conformance with the *Land Sector and Removals Guidance* **shall** also follow and meet all the requirements of the *Corporate Standard* and *Scope 3 Standard*.[22]
2. Business goals	*Guidance only*
3. Summary of principles and requirements	• Companies **shall** follow the principles of relevance, completeness, consistency, transparency, accuracy, conservativeness and permanence when compiling a GHG inventory that includes land sector activities and/or removals.
4. Overview of key concepts	*Guidance only*
5. Setting the inventory boundary	• Companies **shall** define their organizational boundaries (using equity share, financial control, or operational control) consistently across the GHG inventory, including all accounting categories. • If scope 1 removals are reported from an asset (or set of assets) owned or controlled by multiple companies, the multiple companies **shall** specify the exclusive right of one company to claim scope 1 removals from the asset or **set** of assets, or specify how the scope 1 removals will be apportioned between the companies, to avoid double counting scope 1 removals. • Companies **shall**: ○ Account for all scope 1, scope 2 and scope 3 emissions. ○ Account for all scope 3 emissions (following the *Scope 3 Standard*), including emissions from the fifteen scope 3 categories, and disclose and justify any exclusions. ○ Account for emissions from all applicable accounting categories identified in this Guidance (including land use change, land management, and other categories listed in table 5.8). ○ Account for emissions of the following greenhouse gases: CO_2, CH_4, N_2O, HFCs, PFCs, SF_6, and NF_3.

[21] Throughout this Guidance, the term “company” is used as shorthand to refer to the entity (i.e., company or other organization) developing a GHG inventory.

[22] The Greenhouse Gas Protocol plans to update the *Corporate Standard*, *Scope 2 Guidance*, and *Scope 3 Standard* to ensure alignment with this publication where any differences exist.

	○ Disclose and justify any exclusions. • Reporting removals is optional. If companies account for and report removals in the GHG inventory, companies **shall**: ○ Meet all requirements for reporting removals in chapter 6 (refer to chapter 6 for more information). ○ Separately account for and report GHG emissions and removals. ○ Separately account for and report removals by scope (scope 1 vs scope 3) and by gas (if non-CO_2 removals are reported). ○ Account for and report all life cycle GHG emissions in the value chain of the removal pathway across scope 1, scope 2 and scope 3. • Companies **shall** separately account for and report biogenic and non-biogenic CO_2 emissions, and biogenic and non-biogenic CO_2 removals (if applicable).
6. Removal accounting	Reporting removals is optional. If companies account for removals in the GHG inventory, companies **shall**: • Separately account for and report removals based on their sink process (i.e., biogenic or technological sinks) and storage pool (i.e., land-based storage, product storage, or geologic storage). • Account for scope 1 removals and scope 3 removals (if applicable) based on annual net carbon stock changes occurring in the reporting year using stock-change accounting methods (*subject to open question #1, chapter 5, box 5.2)* Companies may account for and report scope 1 or scope 3 CO_2 removals only if the following requirements are met: • Ongoing storage monitoring: Companies **shall** account for and report removals only if there is ongoing storage monitoring of the relevant carbon pool(s), as specified through a monitoring plan, to demonstrate that the carbon remains stored or to detect losses of the stored carbon. • Traceability: Companies **shall** account for and report removals only if the reporting company has traceability throughout the full CO_2 removals pathway, including to the sink (where CO_2 is transferred from the atmosphere to non-atmospheric pools), to the carbon pools where the carbon is stored, and to any intermediate processes if relevant. • Primary data: Companies **shall** account for and report removals only if the net carbon stock changes are accounted for using empirical data specific to the sinks and pools where carbon is stored in the reporting company's operations or value chain. • Uncertainty: Companies **shall** account for and report removals only if the removals are statistically significant and companies provide quantitative uncertainty estimates for removals, including 1) the removal value, 2) the uncertainty range for the removal estimate based on a specified confidence level, and 3) justification of how the selected value does not overestimate removals. • Reversals accounting: ○ Companies **shall** account for and report net carbon stock losses of previously reported removals in the year the losses occur, as either: • Net CO_2 emissions, if the carbon pools are part of the GHG inventory boundary in the reporting year, or

	• Reversals, if the carbon pools are no longer in the GHG inventory boundary in the reporting year. o If companies lose the ability to monitor carbon stocks associated with previously reported removals, companies **shall** assume previously reported removals are emitted and report reversals.
7. Land use change and land tracking	Companies **shall:** • Account for land use change emissions from land carbon stock decreases across all carbon pools (biomass, soil organic carbon and dead organic matter). • Account for emissions of CO_2, methane (CH_4) and nitrous oxide (N_2O). • Account for and report direct land use change (dLUC) emissions or statistical land use change (sLUC) emissions in scope 1, scope 2, and scope 3. • When accounting for *Land use change emissions* using dLUC and/or sLUC, use an assessment period of 20 years or greater. • Use a linear discounting approach or an equal discounting approach to distribute emissions across the assessment period in the inventory. • Account for and report at least one land tracking metric (*Indirect land use change emissions*, *Carbon opportunity costs*, *Land occupation*), reported separately from emissions and removals. • Apply the chosen land tracking metric(s) consistently across the inventory.
8. Land management accounting	• Companies **shall** account for and report *Land management net CO_2 emissions* based on annual net land carbon stock changes. • Companies **shall** account for and report *Land management non-CO_2 emissions* • Companies **shall** account for anthropogenic land management net CO_2 emissions and removals (if applicable) using one of the following two approaches: o Classify all lands as managed lands o Develop and consistently apply an approach to classify lands as managed or unmanaged • Companies **shall** fully account for all land carbon stock changes for land designated as managed lands, including changes due to degradation and carbon stock losses from fires, storms, and other natural disturbances • Companies that own or control land **shall** account for land carbon stock changes from land management associated with all managed lands included in their organizational boundary • Companies with scope 3 land management impacts **shall** account for net land carbon stock changes on all attributable managed lands in their value chain or lands related to leased assets, franchises, and investments • Companies **shall** use a consistent scope 3 spatial boundary to account for land use change emissions and land management carbon stock changes, by product type, based on their level of traceability • If accounting for land management carbon stock changes at a sourcing region-level or jurisdiction-level, sourcing region or jurisdictional boundaries **shall** exclude the following types of land: o Lands designated as unmanaged lands by the reporting company, o Managed lands or land management units in land uses, forest types or crop types not relevant to the biogenic product or material, o Lands with legal or regulatory restrictions on harvests,

- Lands not capable of producing sufficient volumes of the product,
- Lands with other protective status.
- If accounting for *Land management net CO_2 removals*, companies **shall** include land carbon stock measurements representative of relevant lands and carbon pools in the company's GHG inventory base year or period and resample using consistent methods at least every 5 years to estimate carbon stock changes using measurement-based approaches or to calibrate model-based or remote sensing-based approaches.
- When estimating net land carbon stock change, companies **shall** account for the following carbon pools and land uses, at a minimum:
  - <u>Biomass carbon stock changes</u>, including aboveground and belowground biomass, on forest lands, or grasslands, croplands, wetlands and/or settlements with woody or permanent cover
  - <u>Dead organic matter carbon stock changes</u>, including dead wood and litter, on forest lands, grasslands and croplands, where management practices significantly impact woody residues.
  - <u>Soil carbon stock changes</u>, including soil organic carbon in mineral and organic soils, on grasslands and croplands, or forest lands, wetlands and settlements where management practices significantly disturb soils
- Companies may account for and report *Land management net CO_2 removals* only if the following requirements are met:
  - <u>Ongoing storage monitoring</u>: Companies **shall** account for and report *Land management net CO_2 removals* only if ongoing storage monitoring is documented in a land management plan or monitoring plan and implemented to ensure carbon remains stored on the landscape and they can detect losses of stored carbon in relevant land-based carbon pools.
  - <u>Traceability</u>: Companies **shall** account for and report scope 3 *Land management net CO_2 removals* only if they have physical traceability to the land management unit(s) where the carbon is stored [or to the first point of collection or processing facility]. This requirement is subject to open question #3 (chapter 8, box 8.3).
  - <u>Primary data</u>: Companies **shall** account for and report *Land management net CO_2 removals* only if the net carbon stock changes are accounted for using primary data specific to the land carbon pools where the carbon is stored in the reporting company's operations or value chain
  - <u>Uncertainty</u>: Companies **shall** account for and report *Land management net CO_2 removals* only if the net land carbon stock increase is statistically significant based on quantitative uncertainty estimates.
  - <u>Reversals</u>:
    - Companies **shall** account for and report net land carbon stock losses of previously reported *Land management net CO_2 removals* in the year the losses occur, as either:
      - *Land management net CO_2 emissions*, if the carbon pools are part of the GHG inventory boundary in the reporting year, or

	• *Reversals from land-based storage*, if the carbon pools are no longer in the GHG inventory boundary in the reporting year. ▪ If companies lose the ability to monitor land carbon stocks associated with previously reported removals, companies **shall** assume previously reported removals are emitted and report *Reversals from land-based storage*.
9. Accounting for product carbon pools	• Companies **shall** account for net carbon stock changes of biogenic and technological carbon dioxide removal (TCDR)-based products sold by the reporting company, using either of the following two approaches and report the approach used: **1.** Simplified approach: Assume there is no change in the total biogenic or TCDR-based carbon stock of products sold by the reporting company. • In this case, companies do not report net emissions or net removals from product carbon pools. **2.** Stock-change accounting approach: Account for annual net carbon stock changes of biogenic and TCDR-based products sold by the reporting company, using the stock-change approach. • If the total biogenic or TCDR-based product carbon stock increases in the reporting year, companies may report *Net removals with product storage* if the removals requirements in section 9.5 are met (*subject to open question #2, chapter 6, box 6.3)*. • If the total biogenic carbon stock in sold products decreases in the reporting year, report *Net CO_2 emissions from biogenic product storage*. If the total TCDR-based carbon stock in sold products decreases in the reporting year, report *Net CO_2 emissions from TCDR-based product storage*. • Companies **shall** account for all GHG emissions (including *Land management net CO_2 emissions* and *Land use change emissions*) that occur in the life cycle of products and report them as scope 1, scope 2, or scope 3 emissions (by scope 3 category), excluding gross CO_2 emissions from the biogenic or TCDR carbon content of products. • For gross CO_2 emissions from the biogenic or TCDR carbon content of products, companies **shall:** ○ Account for all direct and indirect gross CO_2 emissions across the life cycle (e.g., during processing, use, end-of-life treatment, and all other life cycle phases), and ○ Separately report these emissions under the *Gross emissions and gross removals* category, as *Gross biogenic product CO_2 emissions* or *Gross TCDR-based product CO_2 emissions* (if applicable), organized by the relevant scope 1, scope 2 or scope 3 categories to differentiate direct from indirect emissions. • Companies may account for and report *Net biogenic removals with product storage* only if the following requirements are met:

	◦ Companies **shall** account for the annual net land carbon stock changes on lands where the biogenic carbon contained in products is sourced from; and ◦ Companies **shall** demonstrate that there are increases or no change in land carbon stocks within attributable managed lands (or there are net carbon stock increases within attributable managed lands after factoring out carbon stock losses due to natural disturbances). • Companies may account for and report *Net removals with product storage* only if the following requirements are met: ◦ Ongoing storage monitoring: Companies **shall** account for and report removals with product storage only if there is ongoing storage monitoring of the product carbon pools, as specified through a monitoring plan, to demonstrate that the carbon remains stored or to detect losses of the stored carbon. ◦ Traceability: Companies **shall** account for and report removals with product storage only if the reporting company has traceability throughout the full CO_2 removal and product storage pathway, including to the sink (where CO_2 is transferred from the atmosphere to non-atmospheric pools), to the carbon pools where the carbon is stored, and to any intermediate processes if relevant. ◦ Primary data: Companies **shall** account for and report removals with product storage only if the net carbon stock changes are accounted for using primary data, i.e., empirical data specific to the sinks and product carbon pools where carbon is stored in the reporting company's operations or value chain. ◦ Uncertainty: Companies **shall** account for and report removals with product storage only if the removals are statistically significant and companies provide quantitative uncertainty estimates for removals with product storage, including 1) the removal value, 2) the uncertainty range for the removal estimate based on a specified confidence level, and 3) justification of how the selected value does not overestimate removals. ◦ Reversal accounting: ◦ Companies **shall** account for net product carbon stock losses of previously reported *Net removals with product storage* in the year the losses occur, as either: ▪ *Net CO_2 emissions from product storage*, if the carbon pools are part of the GHG inventory boundary in the reporting year, or ▪ *Reversals from product storage*, if the carbon pools are no longer in the GHG inventory boundary in the reporting year. ◦ If companies lose the ability to monitor product carbon stocks associated with previously reported removals, companies **shall** assume previously reported removals are emitted and report *Reversals from product storage*.
10. Accounting for geologic carbon pools	• For geologic storage pathways with enhanced oil and gas recovery, companies **shall** account for all downstream GHG emissions associated with the extraction, processing, transportation, distribution, storage and use (i.e., combustion) of oil, natural gas or other hydrocarbons produced from the

geologic reservoir and report such emissions in scope 1, scope 2, and/or scope 3.

- Companies **shall** account for all life cycle GHG emissions that occur throughout the geologic storage pathway (i.e., cradle to grave), including GHG emissions from the product life cycle(s) associated with the stored CO_2 or carbon, and report them in the corresponding reporting category in scope 1, scope 2 and/or scope 3.
- Companies may account for and report *Net biogenic removals with geologic storage* only if the following requirements are met:
    - Companies **shall** account for the annual net land carbon stock change on lands where the biogenic CO_2 or carbon stored in geologic reservoirs is sourced from; and
    - Companies **shall** demonstrate that there are increases or no change in land carbon stocks within attributable managed lands (or there are net carbon stock increases within attributable managed lands after factoring out carbon stock losses due to natural disturbances).
- To report scope 1 *Net removals with geologic storage* when no single entity owns or controls both the sink and the pool of the CO_2 removals:
    - The multiple entities involved in the geologic removal and storage pathway **shall** develop a contractual agreement which specifies:
        1. The ownership (rights) of the CO_2 sinks and pools and resulting removals, and the responsibility (obligations) of the GHG sources and resulting emissions (including any reversals) across the entire geologic removal and storage pathway; and
        2. Which single entity accounts for the removals as scope 1, and mechanisms to avoid double counting.
    - In such cases, a single ton of CO_2 removal with geologic storage **shall not** be reported by more than one entity under scope 1.
- Companies may account for and report *Net removals with geologic storage* (or not report emissions associated with captured GHG with geologic storage) only if the following requirements are met:
    - <u>Ongoing storage monitoring</u>: Companies **shall** account for and report *Net removals with geologic storage* (or no emissions associated with captured GHG with geologic storage) only if ongoing storage monitoring is in documented in a monitoring plan to ensure carbon remains stored in geologic reservoirs and they can detect losses of stored carbon from relevant geologic carbon pools.
    - <u>Traceability</u>: Companies **shall** account for and report *Net removals with geologic storage* (or no emissions associated with captured GHG with geologic storage) only if they have traceability to the entity(ies) providing CO_2 inputs to the injection site or geologic storage hub system and the entity(ies) operating the CO_2 injection site(s) and geologic storage reservoir(s).
    - <u>Primary data</u>: Companies **shall** account for and report *Net removals with geologic storage* (or no emissions associated with captured GHG with geologic storage) only if net CO_2 removals with geologic storage, captured CO_2 with geologic storage and life cycle emissions for the capture CO_2 or carbon stored in the geologic reservoir(s) are

	accounted for using primary data specific to the CO_2 injection site(s), geologic storage reservoir(s), and CO_2 or carbon inputs into the geologic storage reservoir(s). ○ <u>Uncertainty</u>: Companies **shall** account for and report *Net removals with geologic storage* (or no emissions associated with captured GHG with geologic storage) only if the net CO_2 removals with geologic storage or captured CO_2 with geologic storage is statistically significant based on quantitative uncertainty estimates. ○ <u>Reversals accounting</u>: ▪ Companies **shall** account for net geologic carbon stock losses of previously reported *Net removals with geologic storage* in the year the losses occur, as either: • *Net CO_2 emissions from geologic storage*, if the carbon pools are part of the GHG inventory boundary in the reporting year, or • *Reversals from geologic storage*, if the carbon pools are no longer in the GHG inventory boundary in the reporting year. ▪ If companies lose the ability to monitor geologic carbon stocks associated with previously reported removals, companies **shall** assume previously reported removals are emitted and report *Reversals from geologic storage*.
11. Evaluating the impact of actions	• If companies implement actions that could have a potentially significant negative impact (i.e., increase GHG emissions and/or decrease removals) outside the scope 1, 2 and 3 boundary, companies **shall** estimate the impacts on GHG emissions and removals resulting from the action using intervention accounting methods (including land tracking metric[s] in chapter 7) and report the impacts separately from the scopes.
12. Target setting and tracking progress	When companies set target(s) for GHG emissions, removals, land tracking metrics, and/or other metrics and track performance over time, companies **shall**: • Set separate targets for emissions, independent of any removals. Companies should set separate removal targets or net targets that include removals. • Choose a base year or base period and specify their reasons for choosing that particular year or period • For companies that set net targets: set separate land net targets (for land emissions and removals) vs. non-land net targets (for non-land emissions and removals) • For companies with removal targets or net targets: develop a reversals accounting policy and account for reversals of previously reported removals in their target accounting • If companies sell GHG credits from within their organizational boundary that are used as offsets or compensation, or if such credits are sold in the company's value chain: use emissions and removals values adjusted for sold credits when accounting for progress toward a GHG target to avoid double counting. (See chapter 13 for further requirements and guidance for preventing double counting of credits.)

	• Recalculate base year or base period emissions, removals, and land tracking metrics when significant changes in the company structure or inventory methodology occur • Develop a base year or base period recalculation policy, establish the significance threshold that triggers base year recalculations, apply the recalculation policy in a consistent manner, and clearly articulate the basis and context for any recalculations

13. Accounting for credited emission reductions and removals	• If applicable, companies **shall** avoid double counting between insets and the scope 3 inventory (e.g., by accounting for the impact of a value chain activity through scope 3 inventory accounting rather than through crediting)
	• Companies **shall** ensure that any credited GHG reductions or removals adhere to the following quality criteria: additionality, credible baselines, permanence, avoid leakage, unique issuance and claiming, regular monitoring, independent validation and verification, GHG program governance, and no net harm.
	• Companies **shall** not double count a ton of GHG reduction or removal that has been credited and sold if the credit is used (or could potentially be used) as an offset or for compensation.
	• To avoid double counting of credits used as offsets or compensation, companies **shall** deduct emission reductions or removals associated with the sale of credits used as offsets from the company's GHG target accounting. To do so, companies **shall** separately calculate:
	    • <u>Inventory emissions and removals</u>: scope 1, 2 and 3 emissions and scope 1 and 3 removals, independent of GHG credit purchases/sales, and
	    • <u>Emissions and removals adjusted for sold credits</u>: scope 1, 2 and 3 emission values that are adjusted for GHG credits issued or generated within the inventory boundary.
	• Companies **shall** use the emissions and removals values adjusted for sold credits when accounting for progress toward a target.

14. Reporting	See chapter 14 for list of reporting requirements
15. Assurance	*Guidance only*
Part 2: Calculation Guidance	
16. Data and quantification	*Guidance only*
17. Land use change and land tracking – Calculation Guidance	*Guidance only*
18. Land management carbon –	*Guidance only*

Calculation Guidance	
19. Land management non-CO_2 emissions – Calculation Guidance	*Guidance only*
20. Accounting for product carbon pools – Calculation Guidance	*Guidance only*
21. Accounting for geologic carbon pools – Calculation Guidance	*Guidance only*
Annexes - Sector-specific Guidance	
A. Technological removals	*Guidance only*
B. Biomethane	*Guidance only*
Glossary	*Guidance only*

1

4

Overview of Key Concepts

Chapter 4: Overview of Key Concepts

Guidance

This chapter provides an overview of key concepts related to accounting for GHG emissions, CO_2 removals and carbon storage in pools. It provides definitions for key terms and accounting approaches for biogenic and technological CO_2 removal carbon cycles. The chapter identifies GHG accounting categories and subcategories for companies in land sector and technological CO_2 removal value chains and references later chapters that contain applicable accounting requirements and guidance. It also provides background and definitions for land sector concepts, including land use and land use change.

Sections in this chapter

Section	Description
4.1	Corporate GHG inventory accounting
4.2	Fundamentals of carbon accounting
4.3	Stock-change and flow accounting
4.4	GHG accounting categories
4.5	Types of land uses

4.1 Corporate GHG inventory accounting

This section provides an overview of key concepts in corporate GHG inventory accounting. Companies can develop GHG inventories that reflect the direct GHG emissions from their operations (scope 1) and indirect GHG emissions associated with their value chain (scope 2 and scope 3), as well as CO_2 removals. GHG inventories enable companies to account for and track changes in GHG emissions and removals, so companies can manage and reduce GHG emissions over time.

4.1.1 Inventory vs. intervention accounting

Inventory accounting provides a complete assessment of the annual emissions from sources (and removals by sinks, if applicable) within the reporting entity's inventory boundary. This includes direct and indirect activities, where progress is tracked relative to a historic base year or period.

Intervention accounting, in contrast, is used to estimate GHG impacts of actions relative to counterfactual baseline scenarios or other performance standards.

An inventory accounting approach is applied in chapters 5-10 and Part 2 of this Guidance. An intervention accounting approach is applied in chapters 11 and 13. Companies should use both inventory and intervention accounting approaches to inform decision making, as described in chapter 11.

4.1.2 Relationship between corporate and national GHG inventory accounting

This Guidance uses national inventory methodologies, such as the Intergovernmental Panel on Climate Change (IPCC) *Guidelines for National Greenhouse Gas Inventories*,[23] as a starting point for estimating GHG emissions and CO_2 removals. Common methodologies help to promote consistency between corporate-level GHG inventories and national GHG inventories.

Both corporate and national GHG inventories use inventory accounting but apply different inventory boundaries, thus providing two parallel inventory accounting frameworks. There are some areas where corporate GHG inventories differ from national GHG inventories, particularly regarding the inventory boundary:

- National GHG inventory boundaries are based on a country's territorial boundary and are largely fixed in terms of what lands are included within the national GHG inventory boundary.
- Corporate GHG inventory boundaries are defined based on ownership or control of lands and other operations (explained further in chapter 5) and may change over time.

The United Nations Framework Convention on Climate Change (UNFCCC) processes aim to ensure countries will continue to account for changes in carbon stocks on their lands over time. However, a company's operational or value chain boundaries can change over time. This requires a different approach to the monitoring, accounting and reporting of carbon losses from reversals of previously reported removals that may occur outside the current inventory boundary, as described in chapter 6 section 6.2.5.

The majority of this Guidance seeks to align with national GHG inventory guidance. However, corporate-level accounting takes a different approach on topics, such as:

- The scopes framework, including direct and indirect emissions and removals (*Corporate Standard* and chapter 5)
- Life cycle accounting for indirect emissions in scope 3 (*Scope 3 Standard* and chapter 5)
- Requirements for reporting CO_2 removals, including reversals accounting (chapter 6)
- Land use change emissions accounting based on an assessment period rather than annual land use change occurring in the reporting year (chapter 7)
- Reporting categories and subcategories (*Corporate Standard* and chapter 14)

For some companies, it may be particularly important to align their corporate GHG inventories with national GHG inventories in countries or jurisdictions where they have operations or value chain activities. In this case, companies should seek to be consistent with the data and methods used in national GHG accounting, or apply methods to enable more accurate estimates where they have increased data resolution (e.g., a forest management company may have forest inventory data on carbon stock changes in forests they manage which would be preferable to data from countries that use international default values to estimate forest carbon stock changes in their national GHG inventory). This consistency enables corporate GHG inventory accounting to complement national GHG inventory accounting systems to provide additional resolution, improve data collection and contribute toward national GHG mitigation goals.

The double counting of emissions by sources or removals by sinks between the two inventory accounting frameworks is inherent, as a given source will appear in both a company's inventory and national inventory if the company operates in that country.

---

[23] The Refinement to the 2006 IPCC Guidelines for National GHG Inventories was published in 2019 and can, with earlier guidance and more recent supplementary material, be accessed at https://www.ipcc.ch/report/2019-refinement-to-the-2006-ipcc-guidelines-for-national-greenhouse-gas-inventories/

However, double counting can be a concern regarding GHG credits, that apply different accounting approaches (i.e., inventory accounting for corporate GHG inventories versus project/intervention accounting for GHG credits) and involve unique claims. Double counting of GHG mitigation by corporate GHG inventories and GHG credits is an issue where GHG credits are used toward compensation targets and must be avoided (as further described in chapter 13).

4.2 Fundamentals of carbon accounting

This section covers the fundamentals of carbon accounting including different types of GHG fluxes and carbon pools and the carbon cycle pathways associated with different carbon fluxes and pools.

4.2.1 Types of GHG fluxes

GHG inventories are designed to account for and report GHG emissions and removals. Emissions and removals are two types of GHG flux. A GHG flux is the transfer of a GHG between two pools, expressed as an amount over a given time (e.g., tonnes CO_2 per year). Fluxes can also be referred to as flows.

GHG emissions

The GHG Protocol *Corporate Standard* requires GHG inventories to include emissions of carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulphur hexafluoride (SF_6) and nitrogen trifluoride (NF_3). GHG emissions are reported in units of metric tonnes of each of individual GHG as well as metric tonnes of carbon dioxide equivalent (CO_2-eq).

To convert from units of each GHG to CO_2-eq, companies should use 100-year global warming potential (GWP) values from the most recent IPCC assessment report.

Carbon fluxes

A carbon flux is a type of GHG flux associated with the transfer of carbon between two pools as a solid (e.g., C in crops or harvested wood), liquid (e.g., C in fuels) or gas (e.g., C in CO_2 or CH_4). CO_2 emissions and removals are carbon fluxes that occur where carbon is exchanged with the atmosphere, as defined in table 4.1.

- CO_2 emissions occur where CO_2 is released to the atmosphere from a non-atmospheric carbon pool.
- CO_2 removals occur where CO_2 is transferred from the atmosphere to storage within a non-atmospheric carbon pool. A CO_2 removal can also be referred to as carbon sequestration or enhanced carbon storage where the carbon is derived from atmospheric CO_2.

Table 4.1 Key terms for carbon accounting

Term	Definition
GHG flux	The transfer of greenhouse gases or their constituent elements between pools, expressed as an amount over a given time.
Emission	The release of a greenhouse gas into the atmosphere.
Source	Any process, activity or mechanism that releases greenhouse gases into the atmosphere.
Removal	The transfer of a greenhouse gas from the atmosphere to storage within a non-atmospheric pool.
Sink	Any biogenic or technological process, activity or mechanism that removes greenhouse gases from the atmosphere.[24]
Pool	A physical reservoir or medium where a greenhouse gas or its constituent elements are stored.
Carbon storage	The process of maintaining CO_2 or carbon in a pool for a period of time.

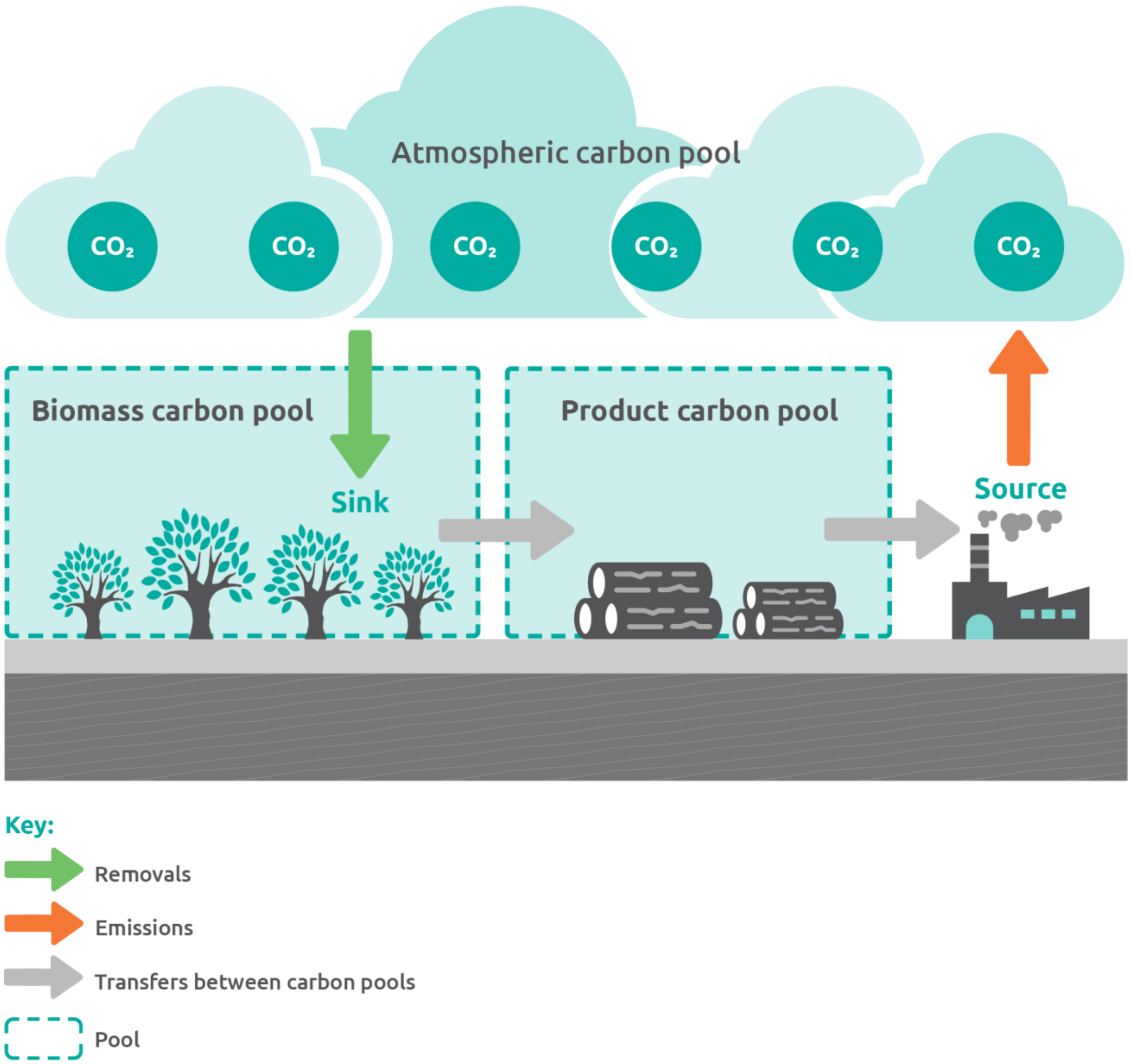
Emissions are produced from sources (e.g., combustion at a power plant). Removals result from sinks (e.g., photosynthesis occurring in trees or direct air capture equipment removing atmospheric CO_2). Figure 4.1 illustrates the relationship between carbon fluxes and pools and the sources and sinks that drive them.

Carbon fluxes can also refer to the transfer of carbon from one non-atmospheric carbon pool to another. For example, the transfer of carbon from biomass to product carbon pools that occurs during timber harvesting is a carbon flux, but these fluxes are neither emissions nor removals as there is no exchange with the atmosphere.

GHG capture is a type of GHG flux that alone is neither an emission nor a removal. GHG capture is the collection of a greenhouse gas from a source for storage within a pool. It is a flux between non-atmospheric pools – rather than an exchange with the atmosphere – in which GHGs are collected prior to release to the atmosphere and transferred to storage in non-atmospheric pools, preventing a GHG emission. This is distinct from direct air capture, where CO_2 is removed from the atmosphere. Chapters 9 and 10 provide further details on accounting for GHG capture and storage in products or geologic reservoirs.

[24] This definition of sink, based on the transfer of a GHG from the atmosphere, is consistent with UNFCCC and IPCC guidelines for national GHG inventories. The term sink is also sometimes used to describe the reservoir or pool where carbon is stored.

Figure 4.1 Illustration of carbon fluxes between carbon pools



4.2.2 Types of carbon pools

Carbon pools are classified into four general categories: land-based carbon pools, product carbon pools, geologic carbon pools, and ocean- or freshwater-based carbon pools, as defined in the sub-sections below.

CO_2 emissions and removals have different quantification methods, monitoring approaches and considerations regarding storage depending on the type of carbon pool. Carbon pools can differ in their ownership and control within a company's operations or value chain, the methods used to estimate and monitor changes over time, and their ability to store carbon over time. Chapters 8, 9 and 10 provide guidance on the different methods used to account for carbon storage in land-based, product and geologic carbon pools.

Land-based carbon pools

A land-based carbon pool is the carbon in terrestrial biomass, dead organic matter, and soil carbon pools. The biomass carbon pool is carbon in terrestrial living organisms 2 mm in size or greater and includes the aboveground and belowground carbon pools. The dead organic matter carbon pool is carbon in non-living organisms or other non-fossil organic compounds 2 mm in size or greater and includes the deadwood and litter carbon pool. The soil carbon pool is carbon in soil minerals and organic matter less than 2 mm in size and includes mineral soil organic carbon, organic soil organic carbon and soil inorganic carbon pools. See table 4.2 below for definitions and examples of the different types of land-based carbon pools.

Table 4.2 Land-based carbon pools

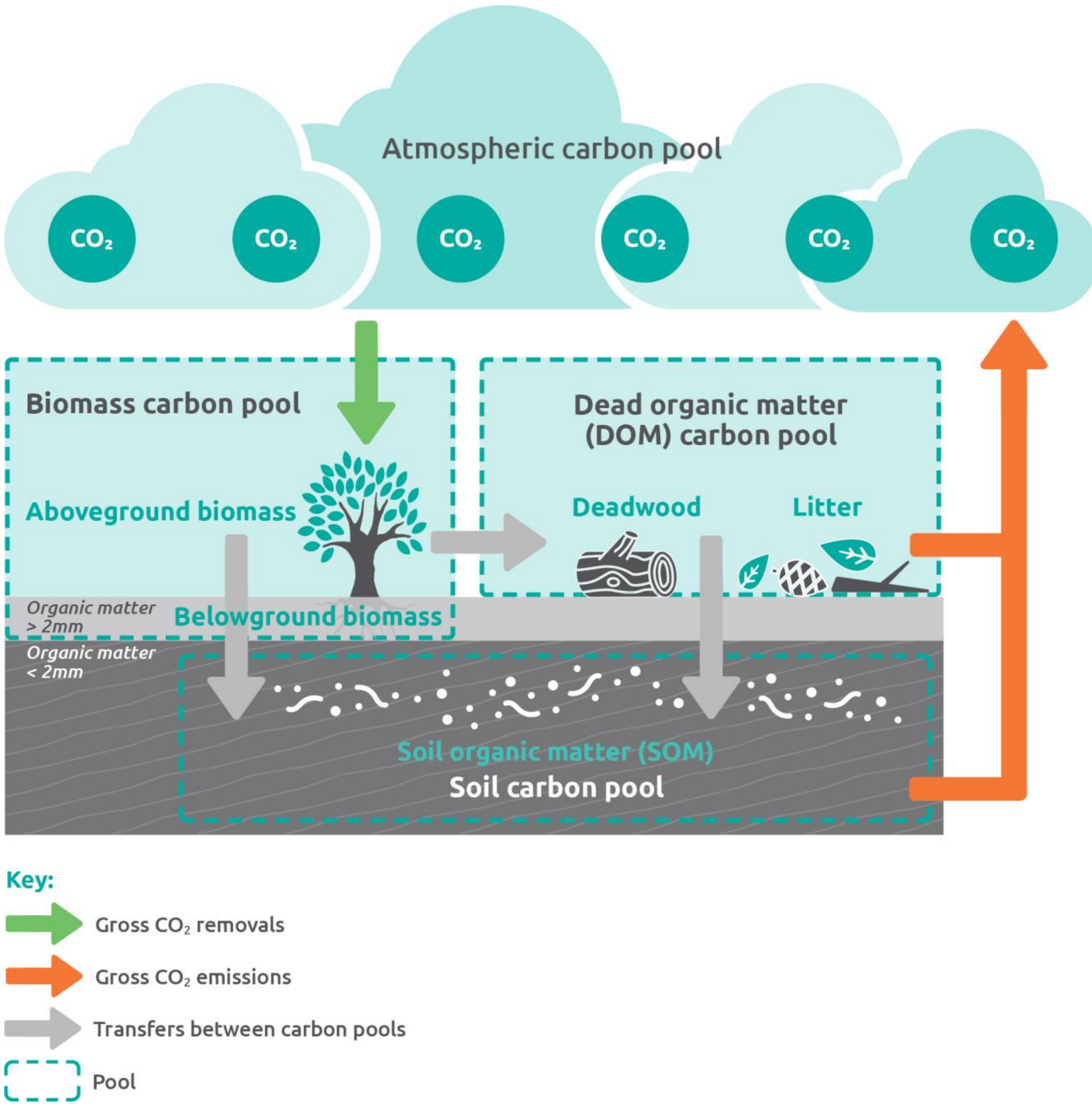
Land-based carbon pools		Definition[25]	Examples
Biomass carbon pool	Aboveground biomass carbon pool	Carbon in terrestrial living woody or herbaceous vegetation 2 mm in size or greater.	Carbon in trees, shrubs, plants.
	Belowground biomass carbon pool	Carbon in terrestrial live roots 2 mm in size or greater.	Carbon in roots.
Dead organic matter carbon pool	Deadwood carbon pool	Carbon in non-living woody biomass not contained in litter carbon pools that are 10 mm in size or greater.	Carbon in standing or lying deadwood, dead roots, stumps, forestry residues.
	Litter carbon pool	Carbon in non-living vegetation or other non-fossil organic compounds that are between 2-10 mm in size.	Carbon in leaf litter, crop residues, fine roots.
Soil carbon pool	Mineral soil organic carbon pool	Carbon in soil organic matter that is smaller than 2 mm in size in soil types that are not classified as organic soils.	Carbon in the topsoil of croplands from particulate matter or microbial biomass.
	Organic soil organic carbon pool	Carbon in soil organic matter that is smaller than 2 mm in size in organic soils that have an organic horizon greater than or equal to 10 cm in thickness and have greater that 12 to 20 percent organic carbon by weight depending on soil texture and subjectivity to water saturation[26].	Carbon in peat soils or wetland organic soils.
	Soil inorganic carbon pool	Carbon in soil carbonates and other mineral carbon forms.	Carbon in calcium carbonates in desert soils.

[25] Definitions are derived from *2006/2019 IPCC Guidelines for National Greenhouse Gas Inventories*

[26] See *2013 supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands* for additional details on classifying organic soils

Carbon enters land-based carbon pools through gross CO_2 removals associated with photosynthesis by plants or trees, that stores carbon in the biomass carbon pool. Carbon can be transferred between pools such as the transfer of live biomass to dead organic matter carbon, dead organic matter to soil carbon or belowground biomass to soil carbon. All land-based carbon pools can contribute to gross CO_2 emissions through respiration, decomposition or combustion of stored carbon. See figure 4.2 for an illustration of land-based carbon pools and their corresponding carbon fluxes.

Figure 4.2 Land-based carbon pools and fluxes



Product carbon pools

A product carbon pool is the carbon in products or materials not included within land-based or geologic carbon pools. Product carbon pools can be further classified based on the origin of the carbon such as biogenic or technological carbon dioxide removal (TCDR)-based product carbon pools as relevant to CO_2 removals accounting, as defined in table 4.3.

Table 4.3 Product carbon pools

Product carbon pool	Definition[27]	Examples
Biogenic product carbon pool	Carbon in products or materials derived from living organisms or biological processes, but not fossilized or from fossil sources.	Carbon contained in paper, sawn wood or bio-based plastics.
TCDR-based product carbon pool	Carbon in products or materials derived from technological CO_2 removal processes.	Carbon in synthetic fuels or plastics derived from direct air captured CO_2.

Geologic carbon pools

A geologic carbon pool is the carbon in geologic formations or inorganic minerals that are not used as products. Examples of geologic carbon pools can include fossil carbon in sedimentary formations containing oil and natural gas, carbon in carbonate rocks or carbon in CO_2 injected into deep saline aquifers or other geologic reservoirs for long-term carbon storage.

Ocean-based and freshwater-based carbon pools

Carbon can also be stored in ocean or freshwater resources. An ocean-based carbon pool is carbon in marine organic or inorganic carbon pools. Examples of ocean-based carbon pools include inorganic carbon in bicarbonate and carbonate ions in seawater, carbon in carbonate minerals in coral or shells, and organic carbon in seagrass beds, algae, kelp or sediments. A freshwater-based carbon pool is carbon in freshwater rivers, lakes, reservoirs, or other inland freshwater bodies in organic or inorganic carbon pools. Examples of freshwater carbon pools include dissolved inorganic carbon or organic carbon in algae or aquatic plants in freshwater bodies.

This Guidance does not provide guidance on accounting for CO_2 emissions and removals associated with ocean- or freshwater-based carbon pools.[28] These types of CO_2 fluxes should be separately accounted for and reported, and additional guidance may be provided in future revisions to the GHG Protocol.

[27] Definitions are derived from *2006/2019 IPCC Guidelines for National Greenhouse Gas Inventories*.

[28] The technical working group did not find sufficient data or methods to develop guidance on accounting for CO_2 removals with ocean- or freshwater-based storage at this time, given the current state of research on ocean-based CO_2 removal practices and technologies and freshwater carbon cycling.

4.2.3 Carbon cycle pathways

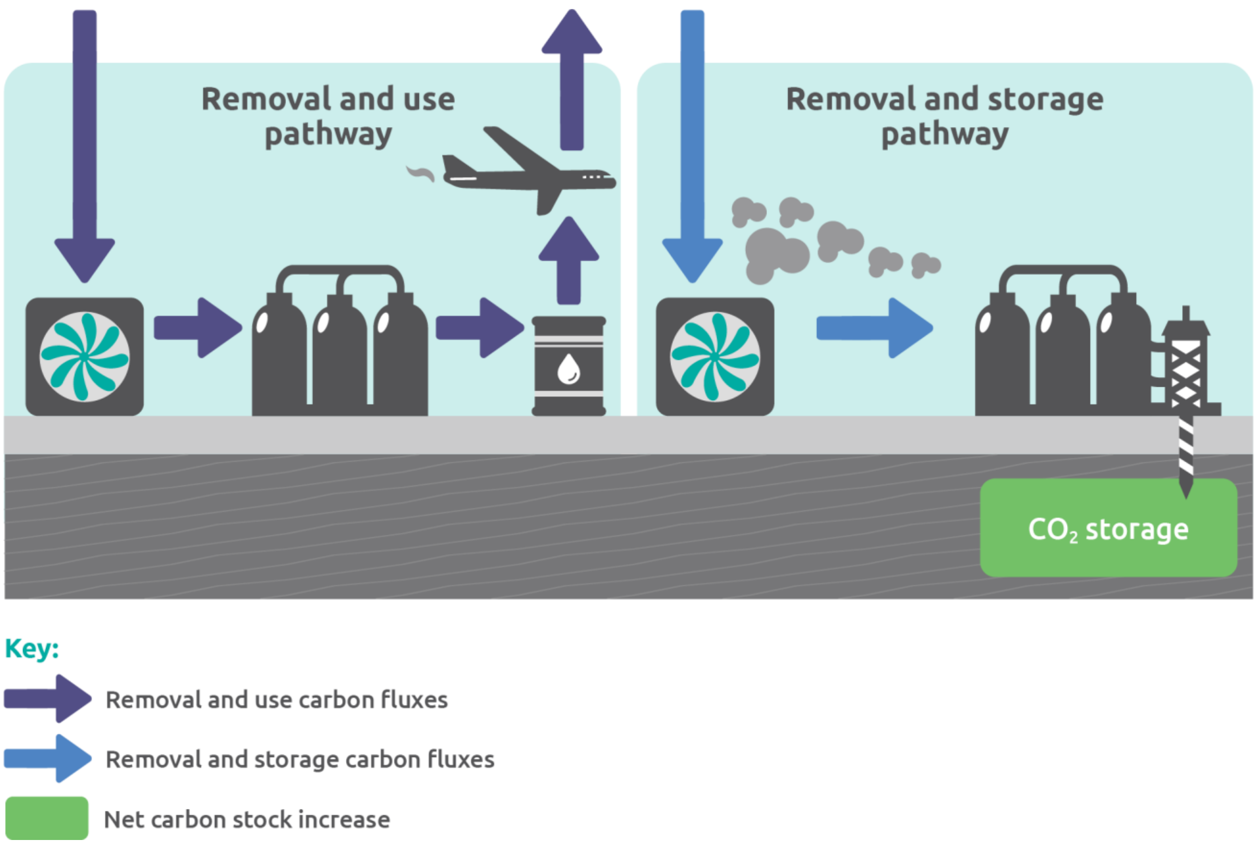
The overall flow of carbon from one carbon pool to another can be represented through a carbon cycle pathway. Where the GHG Protocol's *Corporate Standard*, *Scope 2 Guidance*, and *Scope 3 Standard* provide guidance on one directional flows to the atmosphere associated GHG emissions (e.g., transfer of fossil carbon in oil and gas reservoirs to the atmosphere through production of fossil fuels and CO_2 emissions from fossil fuel combustion), this Guidance includes CO_2 removal pathways that contain carbon fluxes to and from the atmosphere.

Carbon cycle pathways that include CO_2 removals can be broadly characterized as removal and use pathways or removal and storage pathways:

- **Removal and use pathway**: Carbon cycle pathway where CO_2 removed from the atmosphere is later returned to the atmosphere through CO_2 emissions. For example, CO_2 removed from the atmosphere via direct air capture technologies, converted to a CO_2-based fuel, then emitted back to the atmosphere during combustion.
- **Removal and storage pathway**: Carbon cycles pathway where CO_2 removed from the atmosphere contributes to increased storage in non-atmospheric carbon pools and carbon is not emitted back to the atmosphere. For example, CO_2 removed from the atmosphere via direct air capture technologies that is injected into geologic reservoirs for carbon storage.

Figure 4.3 shows two examples of carbon cycle pathways with direct air capture technologies to show the differences between the carbon flows in a removal and use pathway versus a removal and storage pathway.

Figure 4.3 Example of carbon fluxes in a removals and use versus removals and storage pathway



Carbon cycle pathways can also be characterized based on the sink processes that remove CO_2 from the atmosphere: the biogenic carbon cycle and the TCDR carbon cycle. The sections below detail the specific carbon fluxes and pools associated with biogenic and TCDR carbon cycles.

Biogenic carbon cycle

The land sector is unique from other sectors as land use change and land management impact the biogenic carbon cycle, both biogenic CO_2 removals and emissions. The land sector includes all companies in the value chain of agriculture, forestry and other land management activities. Land sector companies are required to account for GHG fluxes from the biogenic carbon cycle, as detailed in chapter 5.

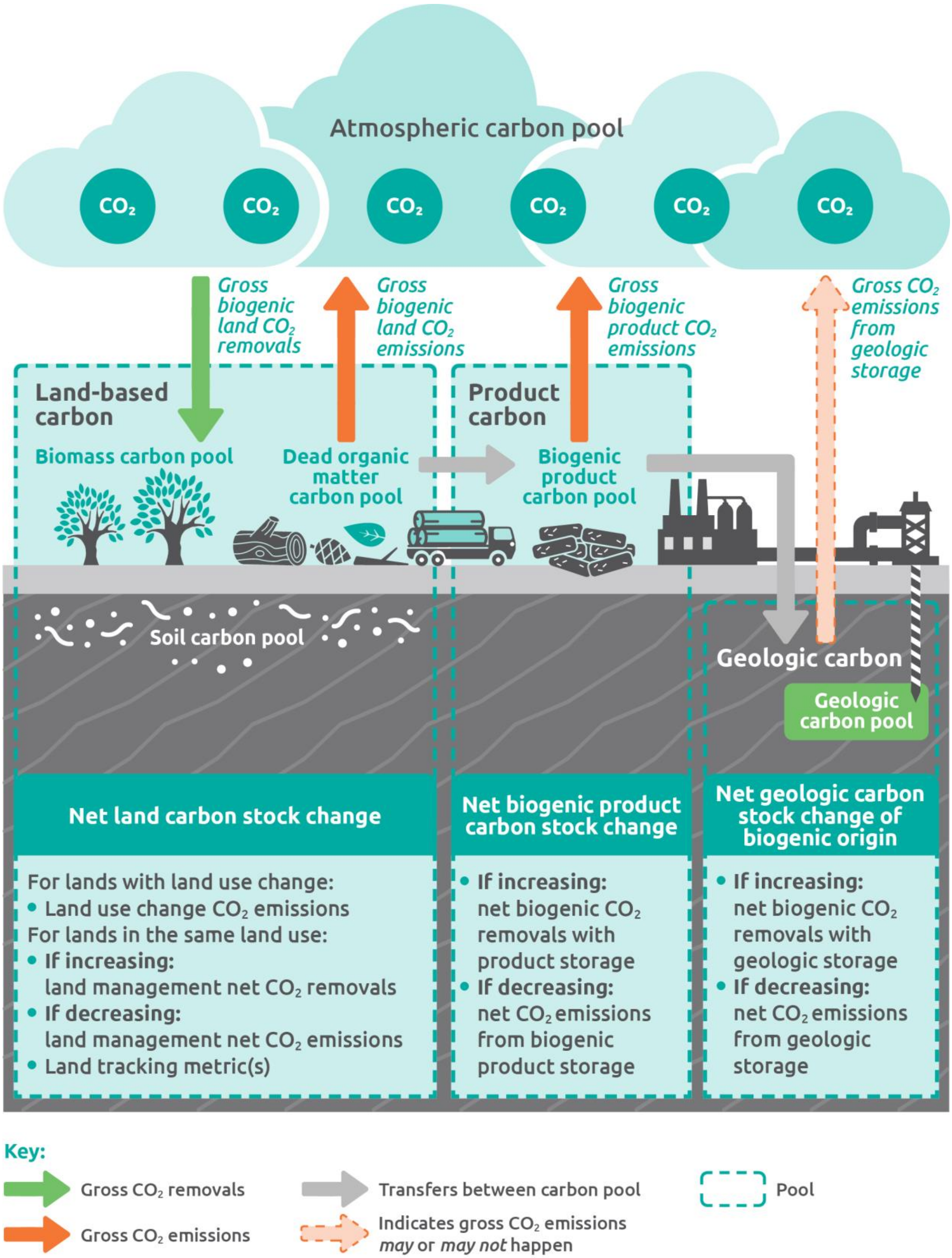
Table 4.4 Key terms for the biogenic carbon cycle

Term	Definition
Biogenic carbon	Carbon derived from living organisms or biological processes, but not fossilized materials or from fossil sources.
Biogenic carbon cycle	Carbon cycle pathway that includes biogenic CO_2 removals, transfers of biogenic carbon between carbon pools, and biogenic CO_2 emissions (see figure 4.4).
Biogenic sinks	Biological processes, primarily photosynthesis, that remove CO_2 from the atmosphere. Examples of biogenic sinks include afforestation and reforestation, forest management practices that increase forest carbon stocks and soil tillage and crop rotations that increase soil carbon stocks.
Biogenic CO_2 removals	CO_2 removals resulting from atmospheric CO_2 transferred via biological sinks to storage in biogenic carbon pools.
Biogenic CO_2 emissions	CO_2 emissions resulting from combustion, biodegradation or other losses from biogenic carbon pools to the atmosphere

The biogenic carbon cycle begins with gross biogenic CO_2 removals that remove CO_2 from the atmosphere via biogenic sinks and store biogenic carbon in biomass carbon pools. That biogenic carbon can then be transferred to dead organic matter, soil, biogenic product or geologic carbon pools. Biogenic carbon can be released back to the atmosphere through biogenic CO_2 emissions associated with combustion, decomposition or respiration of land-based carbon pool (i.e., gross biogenic land CO_2 emissions), combustion or decomposition of biogenic products (i.e., gross biogenic product CO_2 emissions), or fugitive losses of biogenic CO_2 stored in geologic reservoirs (i.e., gross CO_2 emissions from geologic storage).

See table 4.4 for definitions of key terms related to the biogenic carbon cycle. Figure 4.4 provides an illustration of the biogenic carbon cycle including relevant biogenic carbon flows and carbon stock changes.

1 **Figure 4.4 Representation of carbon stock change and flows within the biogenic carbon cycle.**



2 *Note:* Gross CO_2 fluxes using flow accounting are presented as arrows above the pools; stocks are presented as dotted boxes; net CO_2 fluxes using stock change accounting are presented below the pools; required reporting categories are in bold.

Technological Carbon Dioxide Removal (TCDR) carbon cycle

Another emerging carbon cycle pathway is associated with new technologies that remove CO_2 from the atmosphere such as direct air capture. The TCDR carbon cycle begins with technological CO_2 removals that store TCDR-based carbon in product or geologic carbon pools. TCDR-based carbon can then remain stored TCDR-based product or geologic carbon pools or emitted back to the atmosphere as gross TCDR-based product CO_2 emissions. See table 4.5 for definitions on key terms related to the TCDR carbon cycle.

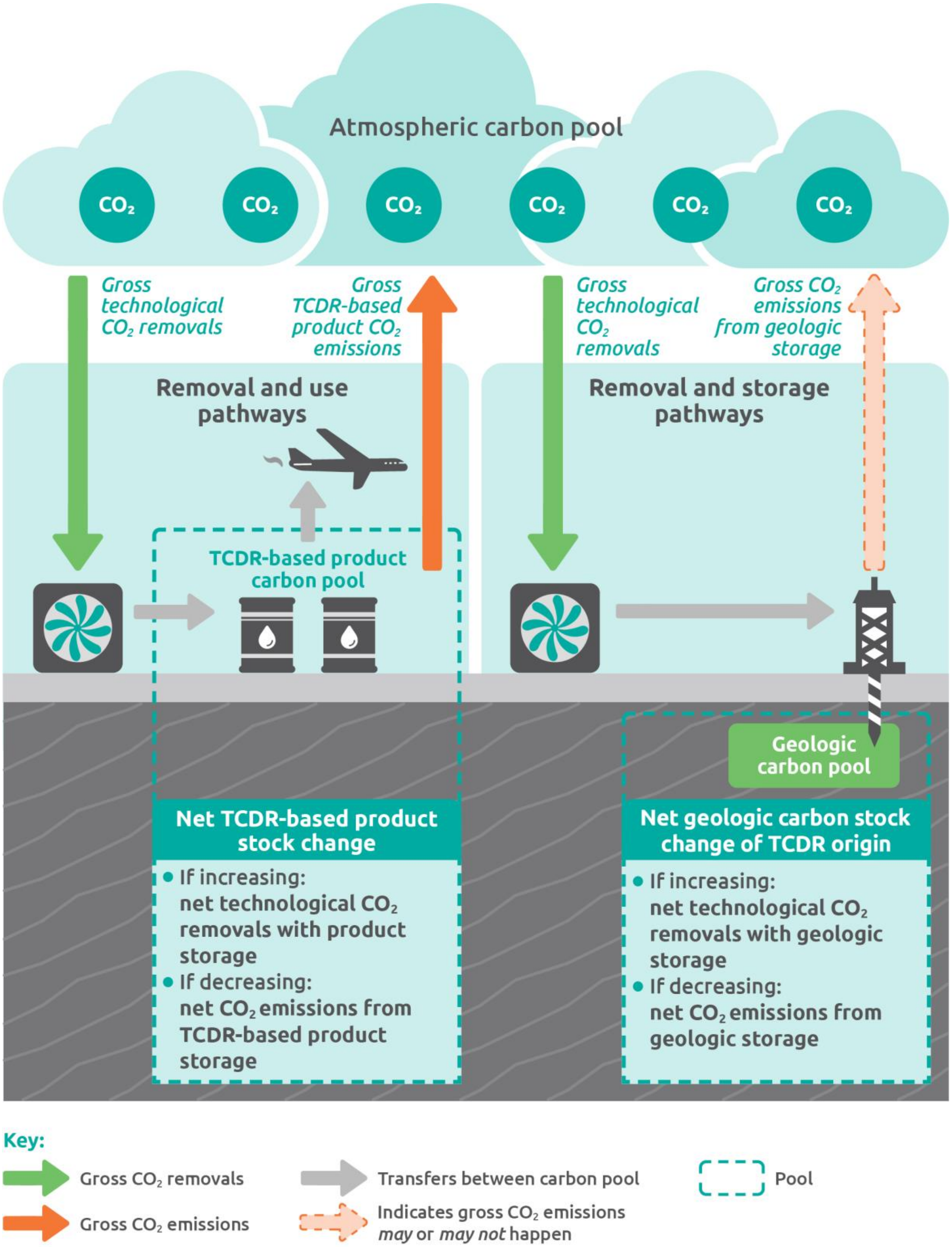
Table 4.5 Key terms for the TCDR carbon cycle

Term	Definition
TCDR-based carbon	Carbon derived from technological CO_2 removal processes.
TCDR carbon cycle	Carbon cycle pathway that includes technological CO_2 removals, transfers of TCDR-based carbon between carbon pools, and TCDR-based CO_2 emissions.
Technological sinks	Mechanical or chemical processes that remove CO_2 from the atmosphere and store CO_2 or TCDR-based carbon in non-atmospheric carbon pools. Examples of technological sinks include direct air capture facilities or enhanced weathering projects.
Technological CO_2 removals	CO_2 removals resulting from atmospheric CO_2 transferred via technological sinks to storage in TCDR-based products or geologic carbon pools.
CO_2 emissions of TCDR-based carbon	CO_2 emissions resulting from the combustion, degradation or other losses from TCDR-based carbon pools.

CO_2 removal technologies used to generate materials for products can lead to either short-term carbon cycling (i.e., removal and use pathways) through production of short-lived products such as direct air captured CO_2-based fuels (figure 4.5) or longer-term carbon cycling (i.e., removal and storage pathways) through the production of long-lived products such as direct air capture CO_2-cured cement.

Alternatively, CO_2 removal technologies can be applied for long-term carbon storage in geologic reservoirs (i.e., removal and storage pathways), such as direct air carbon capture and geologic storage (figure 4.5).

1 **Figure 4.5 Representation of CO_2 removals and CO_2 emissions within a technological carbon dioxide**
2 **removal (TCDR) CO_2 carbon cycle.**



Note: Gross CO_2 fluxes using flow accounting are presented as arrows above the pools; stocks are presented as dotted boxes; net
3 CO_2 fluxes using stock change accounting are presented below the pools; required reporting categories are in bold.

4.3 Stock-change and flow accounting

As described in table 4.6, there are two approaches to account for carbon cycle pathways: stock-change accounting and flow accounting. This Guidance is structured around the stock-change (net) accounting approach, with separate reporting of flow (gross) accounting categories.

Table 4.6 Comparison of stock-change and flow carbon accounting approaches

	Stock-change approach	Flow approach
Description	Accounts for carbon stock changes In other words, the net fluxes of carbon to and from the atmosphere based on the overall change in carbon stocks in a carbon cycle pathway	Accounts for emissions and removal flows In other words, the gross fluxes of carbon to and from the atmosphere based on the flows of carbon from the atmosphere to a carbon cycle pathway (i.e., gross removals) and flows of carbon out of the carbon cycle pathway to the atmosphere (i.e., gross emissions)
Accounting approach focuses on:	Carbon storage in pools	GHG flows by sink or source processes
Accounts for:	Net emissions and net removals from carbon pools	Gross emissions and gross removals from carbon pools

4.3.1 Flow accounting

Flow accounting tracks the gross CO_2 fluxes within a biogenic or TCDR carbon cycle pathway. Gross carbon fluxes are the one-directional transfer of carbon from one carbon pool to another over a defined time period. Gross CO_2 emissions are the fluxes from non-atmospheric carbon pools to the atmosphere and are typically reported with positive values, while gross CO_2 removals are fluxes from the atmosphere to storage in non-atmospheric carbon pools and are typically reported with negative values.

The net CO_2 flux in flow accounting can be quantified as the sum of all the individual gross CO_2 emission fluxes and gross CO_2 removal fluxes, so that for:

- Net CO_2 emissions - the total gross CO_2 emissions are greater than total gross CO_2 removals in a biogenic or TCDR carbon cycle pathway.
- Net CO_2 removals - the total gross CO_2 emissions are less than total gross CO_2 removals in a biogenic or TCDR carbon cycle pathway.

4.3.2 Stock-change accounting

A stock-change accounting framework provides a complementary approach based on changes in carbon stocks. A carbon stock is the mass of carbon contained in a carbon pool at a given time. A carbon stock change is the difference in carbon stocks between two points in time.

Carbon stock changes can be quantified as the difference between individual carbon gains and losses (i.e., the gain-loss method) or the difference between carbon stocks at two points in time (i.e., the stock-difference method).

Stock-change accounting of the carbon cycle tracks the net CO_2 flux within the system based on measurement of annual net carbon stock changes within all non-atmospheric carbon pools in that system. Net increases in carbon stocks result in net CO_2 removals (typically reported as negative CO_2 fluxes). Net decreases in carbon stocks result in net CO_2 emissions (typically reported as positive CO_2 fluxes).

Conversion from carbon to CO_2 is necessary for stock-change accounting as carbon stock changes are measured in units of carbon, while emissions and removals are measured in units of CO_2. To convert carbon stock changes to units of CO_2, units of carbon (C) are multiplied by the ratio of the molecular weight of CO_2 to C (i.e., 44/12), as shown in equation 4.1. An increase in carbon stocks is typically reported as a positive value, while a decrease in carbon stocks is typically reported as a negative value. To align with conventions for reporting CO_2 fluxes as emissions or removals, carbon stock changes are multiplied by -1 to convert net carbon stock changes into net CO_2 emissions or removals. For example, to convert a carbon stock decrease (negative value) into a net CO_2 emission (positive value) requires multiplying by -1, as shown in equation 4.1.

Equation 4.1 Conversion of carbon stock changes to net CO_2 flux

$$CO_2 = \Delta C \times 44/12 \times -1$$

CO_2	=	Net CO_2 flux (tonnes CO_2 yr^{-1})
ΔC	=	Net carbon stock change (tonnes C yr^{-1})
44/12	=	Molecular weight of CO_2 to C (tonnes CO_2 / tonnes C)

4.3.3 How stock change and flow accounting represent the carbon cycle

Stock-change accounting and flow accounting differ in their ability to represent short-term carbon cycles associated with CO_2 removal and use pathways and long-term carbon cycles associated with removals and storage.

- **Flow accounting** records all gross CO_2 emission and CO_2 removal fluxes that occur within a year, representing carbon cycles associated with short-term removal and use (e.g., bioenergy feedstock growth and biomass combustion, or short-lived direct air capture CO_2-based products) as well as long-term carbon cycles associated with CO_2 removal and storage pathways (e.g., ongoing carbon storage in forest biomass, cropland soils or CO_2 storage in geologic reservoirs).
- **Stock-change accounting** records the net CO_2 flux in a given year, to better represent long-term carbon cycles. It does not typically contain information on carbon cycles shorter than one year. For example, if corn is grown, harvested, converted to ethanol and combusted as a biofuel in a single year, flow accounting would report an equivalent amount of gross biogenic CO_2 removals from growth and gross biogenic CO_2 emissions from combustion, while stock-change accounting would not report any biogenic CO_2 fluxes, as the annual net carbon stock change for the bioenergy system was zero.

Box 4.1 provide additional examples for how stock-change and flow accounting represent removal and use and removal and storage pathways in the reporting.

Both methods lead to the same net CO_2 flux for a biogenic or TCDR carbon cycle pathway, but have differences in the way individual gross fluxes are reflected relative to a company's owned or controlled operations or value chain (see chapter 5, table 5.8 for further details).

Box 4.1 Examples illustrating the different between stock-change and flow accounting for CO_2 emissions and removals

The following examples are provided to better illustrate the conceptual differences between net CO_2 emissions and removals accounted for using stock-change accounting and gross CO_2 emissions and removals accounted for using flow accounting.

In many removals and use scenarios there are no net carbon stock changes, thus no net CO_2 emissions or removals to be accounted for and reported under stock-change accounting. However, flow accounting would account for and report on both the gross CO_2 removals and CO_2 gross emissions.

In most removals and storage scenarios both stock-change and flow accounting would account for and report net CO_2 removals. For stock-change accounting the net CO_2 removals are equal to the net carbon stock increases, whereas for flow accounting the net CO_2 removals would be equal to the difference between the individual gross CO_2 removals and gross CO_2 emissions in the system.

Scenario	Example of an activity with removals	Stock-change accounting and reporting	Flow accounting and reporting
Removals and use	Farm that grows corn, where biomass growth equals biomass harvests and soil carbon stocks do not change, and the corn is consumed as feed in the same year	○ The net land carbon stock does not change, resulting in zero *Land management net removals* ○ The net biogenic product carbon stock does not change, resulting in zero *Net biogenic removals with product storage*	○ *Gross biogenic land CO_2 removals* accounted for based on the CO_2 removed through photosynthesis during corn growth ○ *Gross biogenic land CO_2 emissions* accounted for based on the CO_2 emitted through burning of crop residues, crop respiration or decomposition in the field ○ *Gross biogenic product CO_2 emissions* accounted for based on the CO_2 emitted through consumption of the corn as animal feed
	Direct air capture facility producing CO_2-based fuels, where fuels are combusted in the same year	○ The net TCDR-based product carbon stock does not change, resulting in zero *Net technological removals with product storage*	○ *Gross technological CO_2 removals* accounted for based on the CO_2 removed from the atmosphere through direct air capture ○ *Gross technological CO_2 emissions* accounted for based on the CO_2 emitted from combustion of the CO_2-based fuels
Removals and storage	Forest management unit where tree harvests are less than annual growth, and the harvested wood leads to increased carbon storage in	○ The net land carbon stock increases, resulting in *Land management net removals* ○ The net biogenic product carbon	○ *Gross biogenic land CO_2 removals* accounted for based on the CO_2 removed through photosynthesis during tree growth ○ *Gross biogenic land CO_2 emissions* accounted for based on the CO_2 emitted through forest fires, tree respiration or decomposition in the forest

	wood furniture and building materials	stock increases, resulting in *Net biogenic removals with product storage*	○ *Gross biogenic product CO_2 emissions* accounted for based on the CO_2 emitted through processing at the sawmill, and combustion or decomposition of wood products during their use phase or end-of-life treatment
	Direct air capture facility producing CO_2-cured cement, which leads to increased carbon storage in cement	○ The net TCDR-based product carbon stock increases, resulting in *Net technological removals with product storage*	○ *Gross technological CO_2 removals* accounted for based on the CO_2 removed from the atmosphere through direct air capture ○ *Gross TCDR-based product CO_2 emissions* accounted for based on the CO_2 emitted from fugitive losses during processing or other CO_2 emissions during the cement's use phase or end-of-life treatment
	Farm that grows corn, where biomass growth equals biomass harvests and soil carbon stocks do not change; the corn is sent to an ethanol plant where it is converted to ethanol and combusted in the same year and any excess biogenic CO_2 is captured and stored in geologic reservoirs	○ The net land carbon stock does not change, resulting in zero *Land management net removals* ○ The net biogenic product carbon stock does not change, resulting in zero *Net removals with product storage* ○ The net geologic carbon stock from biogenic carbon increases, resulting in *Net biogenic removals with geologic storage*	○ *Gross biogenic land CO_2 removals* accounted for based on the CO_2 removed through photosynthesis during corn growth ○ *Gross biogenic land CO_2 emissions* accounted for based on the CO_2 emitted through burning of crop residues, crop respiration or decomposition in the field ○ *Gross biogenic product CO_2 emissions* accounted for based on the CO_2 emitted through combustion of the ethanol produced from the corn or fugitive CO_2 emissions not captured at the ethanol facility ○ *Gross CO_2 emissions from geologic storage* accounted for based on any fugitive CO_2 emissions at the geologic reservoir

4.3.4 Approach in this Guidance

This Guidance is structured around stock-change accounting methods to estimate the net biogenic CO_2 flux and net TCDR-based CO_2 flux. Annual decreases in biogenic or TCDR-based carbon stocks are accounted for as net CO_2 emissions. Annual increases in biogenic or TCDR-based carbon stocks are accounted for as net CO_2 removals (subject to the additional requirements for reporting removals in chapter 6). This approach is consistent with the accounting approach for the Agriculture, Forestry and Other Land Use (AFOLU) sector in the IPCC *Guidelines for National Greenhouse Gas Inventories.*[29] This approach is subject to open question #1 (in chapter 5, box 5.2).

Later chapters of this Guidance provide stock-change accounting guidance to account for land use change CO_2 emissions (chapter 7), annual net land carbon stock changes within land-based carbon pools (chapter 8), annual net biogenic or TCDR-based product carbon stock changes within product carbon pools (chapter 9) and annual net geologic carbon stock changes of biogenic or TCDR-based carbon origin within geologic carbon pools (chapter 10).

The GHG Protocol's *Corporate Standard*, *Scope 2 Guidance*, and *Scope 3 Standard* are structured around flow accounting for non-biogenic and non-TCDR-based GHG emissions to the atmosphere (e.g., from combustion of fossil fuels). To ensure transparency, the *Land Sector and Removals Guidance* also provides guidance on accounting for gross biogenic and TCDR-based CO_2 fluxes within the relevant chapters.

Note that stock-change accounting categories are denoted as "net" CO_2 emissions or removals, while flow accounting categories are denoted as "gross" CO_2 emissions or removals.

4.4 GHG accounting categories

GHG inventories distinguish between different types of GHG fluxes using GHG accounting categories. Accounting categories are based on the type of GHG flux (i.e., emission or removal), type of sources or sinks, type of carbon pools (i.e., land, product or geologic) and accounting approach (i.e., stock-change or flow), where each accounting category has distinct data, methods, and accounting guidance.

Table 4.7 outlines all accounting categories that should be considered to report a complete GHG inventory for companies with land sector activities and/or companies reporting CO_2 removals. Not all accounting categories are relevant to a single company's inventory depending on their sector and the types of activities in the operations or value chain. For example, only companies with technological CO_2 removal technologies (e.g., direct air capture) in their operations or value chain need to account for the technological CO_2 removal accounting categories.

Accounting categories can be further disaggregated into accounting subcategories based on the source of the emission (i.e., source category) or sink generating the removal and the pool the carbon is stored in (i.e., sink and storage category). The accounting subcategories in table 4.7 build on the four source categories identified in the *Corporate Standard* (i.e., stationary combustion, mobile combustion, process, and fugitive emissions). They are expanded in table 4.7 to include relevant source, sink and storage categories for the land sector and technological CO_2 removal sector.

[29] IPCC 2019a

1 **Table 4.7 Accounting categories and subcategories**

Accounting Category	Accounting Subcategories	Description	Examples	For guidance see…
Emissions (non-land)[1]	Stationary combustion emissions	GHG emissions from fuel combustion used to generate electricity, steam, heat or power in stationary equipment	Boilers, furnaces, burners, turbines, incinerators, engines, space and water heating, generators, driers, other non-mobile equipment	GHG Protocol *Corporate Standard, Scope 2 Guidance, Scope 3 Standard*
	Mobile combustion emissions	GHG emissions from fuel combustion by vehicles and transportation devices	Off-road equipment (tractors, harvesters, etc.), trucks, automobiles for transporting personnel, trains, airplanes, ships, etc.	
	Process emissions	Non-combustion GHG emissions generated from physical or chemical processes during manufacturing	Pulp & paper processes, food & beverage processes	
	Fugitive emissions	GHG emissions that are not physically controlled but result from intentional or unintentional release of GHGs	On-site biogas generation (e.g., through anaerobic digestion of wastes), refrigerants, wastewater treatment	
Emissions (land)	Land use change emissions[2] (biogenic)	Biogenic CO_2 emissions resulting from carbon stock losses and other GHG emissions due to land use change	Carbon stock losses from the conversion of forest to grassland or cropland (deforestation); the conversion from natural to planted forest, conversion of native grasslands to intensively managed pasturelands or croplands, conversion of peatlands to agriculture	Chapters 7 and 17
	Land management net CO_2 emissions[2] (biogenic)	Biogenic CO_2 emissions resulting from net carbon stock losses due to ongoing land management practices	Carbon stock losses on croplands and forestlands remaining in the same land use; emissions from forest degradation	Chapters 8 and 18
	Land management non-CO_2 emissions[1]	CH_4, N_2O and non-biogenic CO_2 emissions due to ongoing land management practices	Livestock CH_4 emissions, manure CH_4 and CH_4 emissions, fertilizer N_2O emissions, CH_4 emissions from rice and other flooded crops, wildfire and	Chapters 8 and 19

				prescribed burning CH_4 and N_2O emissions	
Emissions (from biogenic or TCDR carbon storage)[2]	Net CO_2 emissions from product storage	Net CO_2 emissions from biogenic product storage	CO_2 emissions resulting from net carbon stock decreases in biogenic product carbon pools	CO_2 emissions resulting from net carbon stock decreases in harvested wood products	Chapters 9 and 20
		Net CO_2 emissions from TCDR-based product storage	CO_2 emissions resulting from net carbon stock decreases in TCDR-based product carbon pools	CO_2 emissions resulting from net carbon stock decreases in direct air capture CO_2-derived products	Chapters 9 and 20
	Net CO_2 emissions from geologic storage		CO_2 emissions resulting from net carbon stock decreases in geologic carbon pools	CO_2 emissions resulting from net carbon stock decreases in geologic reservoirs in a bioenergy carbon capture and storage (BECCS) or direct air carbon capture and storage (DACCS) value chain	Chapters 10 and 21
Removals[2]	Land management net removals		Net increases to storage in land carbon pools due to ongoing land management practices	Increases in carbon stocks on croplands and forestlands remaining in the same land use; soil carbon sequestration	Chapters 8 and 18
	Net removals with product storage *(subject to open question #2, chapter 6, box 6.3)*	Net biogenic removals with product storage	Net increases to storage in product carbon pools from carbon derived from biogenic CO_2 sinks	CO_2 removed by photosynthesis and stored in harvested wood products or bioplastics	Chapters 9 and 20
		Net technological removals with product storage	Net increases to storage in product carbon pools from carbon derived from technological CO_2 sinks	CO_2 removed by direct air capture and stored in plastics or CO_2-cured cement	Chapters 9 and 20
	Net removals with geologic storage	Net biogenic removals with geologic storage	Net increases to storage in geologic carbon pools from carbon derived from biogenic CO_2 sinks	CO_2 removed through biomass growth, captured at a bioenergy facility and stored in a geologic reservoir (BECCS), or other biomass carbon capture and storage	Chapters 10 and 21
		Net technological removals with geologic storage	Net increases to storage in geologic carbon pools from carbon derived from technological CO_2 sinks	CO_2 removed by a direct air capture facility and stored in a geologic reservoir (DACCS)	Chapters 10 and 21
Land tracking	Indirect land use change emissions		Emissions due to land conversion on lands not	Recent carbon stock loss due to deforestation on lands not	Chapters 7 and 17

			owned or controlled by the company, or in its value chain, induced by change in demand for (or supply of) products produced or sourced by the company	in a company's supply chain, induced by change in demand for biofuels sourced by the company	
	Carbon opportunity costs		Emissions from total historical carbon losses from plants and soils on lands productively used	Total historical carbon losses on lands previously forested and now used for agriculture	
	Land occupation		The amount of land occupied for a certain time to produce a product	The amount of land needed to produce crops, livestock, or forestry products	
Gross emissions and gross removals[1]	Gross biogenic CO_2 emissions	Gross biogenic product CO_2 emissions (e.g., from combustion)	Gross CO_2 emissions from combustion, biodegradation or other losses from biogenic product carbon pools	CO_2 emissions from combustion of biomass, biofuels or biogas	Chapters 9, 20, and Annex B
		Gross biogenic land CO_2 emissions	Gross CO_2 emissions from combustion, biodegradation or other losses from land-based carbon pools	CO_2 emissions from land degradation or fire	Chapters 8 and 18
	Gross biogenic land CO_2 removals		Gross CO_2 removals from atmospheric CO_2 transferred via biogenic sinks to land-based carbon pools	CO_2 removals from photosynthesis in trees in a forest or plants on croplands	Chapters 8 and 18
	Gross technological CO_2 removals		Gross CO_2 removals from atmospheric CO_2 transferred via technological sinks to product or geologic carbon pools	CO_2 removed from the atmosphere by a direct air capture facility	Annex A
	Gross TCDR-based product CO_2 emissions		Gross CO_2 emissions resulting from the combustion, degradation or other losses from TCDR-based product carbon pools.	CO_2 emissions from combustion of a fuel containing CO_2 removed through direct air capture	Chapters 9 and 20
	Gross CO_2 emissions from geologic storage		Gross CO_2 emissions from the fugitive losses of CO_2 stored in geologic carbon pools	CO_2 emissions from a geologic reservoir in a BECCS or DACCS value chain	Chapters 10 and 21

Notes: [1] Using flow accounting for GHG emissions and gross CO_2 emissions and removals of biogenic and TCDR-based carbon

[2] Using stock-change accounting for net CO_2 emissions and removals of biogenic and TCDR-based carbon, where removals meet the removals requirements in chapter 6

TCDR = technological carbon dioxide removal

Non-CO_2 GHG removals

The *Land Sector and Removal Guidance* only provides guidance on accounting for CO_2 removals and carbon pools. However, there is potential for removal of other GHGs from the atmosphere. Box 4.2 describes the current potential for other non-CO_2 GHG removals, where additional guidance may be provided in the future.

Box 4.2 Non-CO_2 GHG removals

There is ongoing research into practices that enhance natural processes or new technologies that can remove other greenhouse gases from the atmosphere, in addition to CO_2 removals. Given much lower ambient concentrations of non-CO_2 GHGs (roughly 1,890 parts per billion (ppb) CH_4 and 330 ppb N_2O as opposed to 420,000 ppb CO_2) many of these technologies first require increased air flow or concentration of atmospheric gases through active direct air capture technologies similar to technological CO_2 removals. Direct air capture technologies include:

- **Active direct air capture:** use of mechanical devices such as fans to force air flow and recover GHG through increased contact with removal processes.
- **Passive direct air capture:** deployment of GHG removal processes at ambient atmospheric GHG concentrations or through natural air flow processes.
- **Solar chimney:** also known as solar updraft towers these technologies employ a large collection area to warm air using solar heating then directs that air into a chimney where removal processes can be employed in addition to generating electricity.[30]

A summary of the various non-CO_2 GHG removal technologies and practices under consideration is provided in the table. Many of these technologies are in the initial research phases and are not currently technologically or economically viable and so no additional guidance is provided to account for non-CO_2 GHG removals. Any non-CO_2 GHG removals should be separately accounted for and reported from scope 1 and scope 3 removals.

Removal process	Description	Relevant GHGs
Photocatalysis [31]	Conversion of GHG through chemical decomposition reactions using light and metal catalysts.	CH_4, N_2O, CFCs, HFCs
Microbial consumption	Conversion of GHG through microbial oxidation or reduction processes.	CH_4, N_2O

[30] Ming et al., 2016

[31] De Richter et al., 2017

Adsorption filters [32]	Trapping of GHG molecules on the surface of materials with high sorption capacities such as zeolites or porous polymer networks.	CO_2, CH_4, N_2O
Cryogenic separation	Cooling captured atmospheric GHGs to a low temperature where the gas can be liquified and separated.	CO_2, CH_4

4.5 Types of land uses

This Guidance contains requirements and guidance to accounting for emissions and removals based on land use. Land use is distinct from related classification systems by land cover as explained in box 4.3. This section provides an introduction and definitions on land use and land use change.

Box 4.3 Land cover and land use definitions

The IPCC distinguishes between land cover and land use: [33]

- **Land cover**: the observed physical and biological cover of the earth's land
- **Land use**: the total of arrangements, activities, and inputs that people undertake in a certain land parcel

Land cover classification systems broadly focus on identifiable land characteristics such as open water, bare ground, and deciduous forest. These cover characteristics are largely derived from field surveys and analysis of remotely sensed imagery. In contrast, land use classifications, such as grazing, conservation, timber extraction, often relate to socio-economic activity, can be context-specific, and occur across land cover types.

For example, consider a forest that was recently harvested and is experiencing a temporarily decreased tree canopy cover but is being replanted under a forest management plan. Under a land cover definition this might not meet the threshold for forest, however due to the arrangements on the land it would still be considered forest land under a land use definition.

Land cover and land use classifications can vary across data sources, making it important to understand the definitions of such classes, especially when considering changes in land designation over time.

4.5.1 Land use

The IPCC has created six land categories that are a mixture of land cover and land use classes to provide a system broad enough to classify all land areas in most countries. Following IPCC definitions, this Guidance defines land use change as transition between these six "land use" categories:

1. Forest Land
2. Grassland
3. Cropland
4. Wetlands
5. Settlements

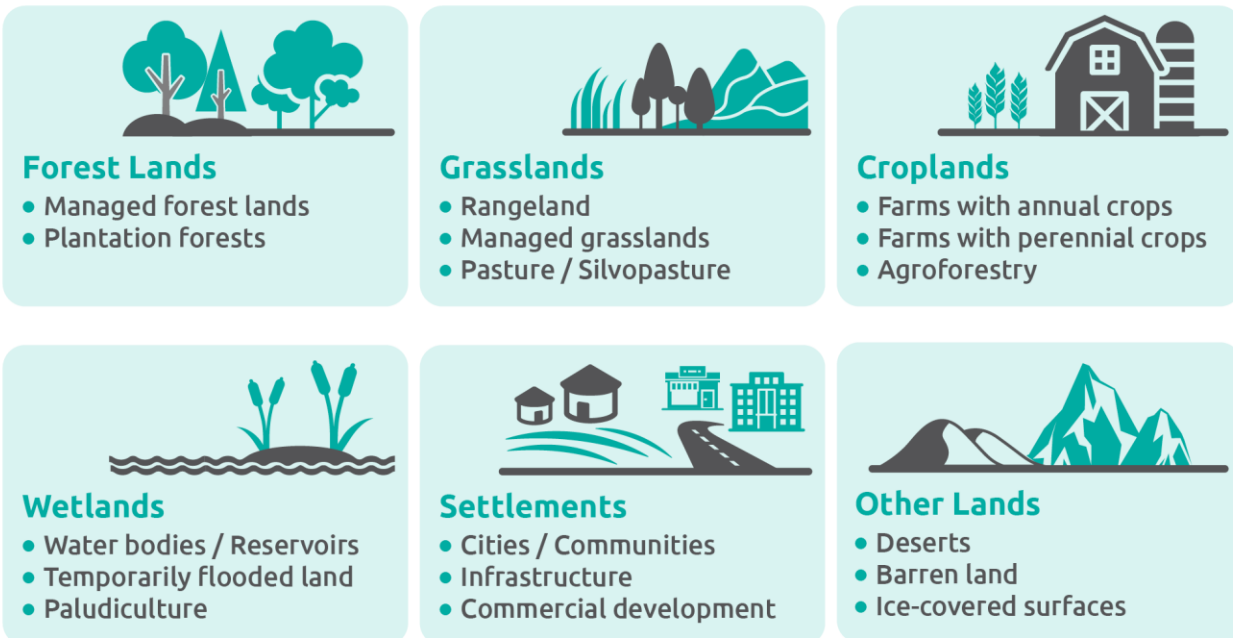
[32] Jackson et al., 2020

[33] IPCC, 2020

6. Other land

Most land-use categories can be further distinguished into managed and unmanaged lands, with relevance to corporate GHG inventory accounting (see chapter 8 for more detail). The following sections describe the IPCC's six land use categories in more detail. See figure 4.6 for examples.

Figure 4.6 Examples of land use categories



Forest Lands

Land area with woody vegetation, often further specified by ecosystem type (e.g., tropical rain forest, boreal coniferous forest, etc.). Forest land is frequently identified via some threshold value of tree cover and height, contingent on data resolution or scale of assessment. Broadly speaking, managed lands in this category include plantations and natural forests managed for various reasons including forest fire management and timber extraction. Natural forests are primary forests, and secondary forests following natural regrowth due to land abandonment or afforestation/reforestation.

Grasslands

Grasslands can span a wide range of climate conditions globally, generally defined by perennial grasses and vegetation structures below the forest land threshold. These systems are most commonly used for grazing and withstand regular perturbation from both grazing and fire. Managed land areas in this category includes rangeland, pastureland, and silvopastoral systems. Natural lands may include native grasslands and savannahs, as long as animal stocking rates and fire regimes are not intensively managed.

Croplands

Croplands includes arable and tillage land, rice fields, and agroforestry systems where vegetation structure consistently falls below established forest land thresholds. Annual croplands, including cereals, vegetables and root crops, as well as perennial croplands, such as orchards, vineyards, and plantations, are included. Agroforestry, subsistence agriculture, and shifting cultivation also fall within the cropland category. Mixed systems which are rotated between cropland and pastureland are also typically included as cropland, as the land's use for forage crops or grazing is temporary.

Wetlands

Land in this category is saturated by water for all or part of the year, and does not otherwise fall into forest land, cropland, grassland or settlements categories. Natural wetland areas can be found inland, along the coast, and often within conservation areas. Managed areas, including peat mining and paludiculture, are restricted to wetlands where the water table is artificially changed (e.g., by draining or through river diversion). Most managed wetland supports other land uses, such as cropland and grassland management, and can include manure management ponds, industrial effluent ponds, aquaculture ponds, and rewetting of previously drained wetlands.

Settlements

Settlement areas include developed lands of any size unless they are already included under other land categories. These areas include soils, herbaceous perennial vegetation such as turf grass and garden plants, urban trees falling below established forest land thresholds, green roofs and urban agriculture. Land within this category is administratively associated with particular cities or villages. A transition from previous land use classes to settlements can have significant impacts to carbon stocks and affect a significant portion of the landscape even in rural areas.

Other Lands

This category includes land areas that do not otherwise fall into the other land categories, including bare soil, rock, and ice. This land is often unmanaged, and related GHG impacts/changes are not accounted for within the inventory. A transition from forest land to other land can occur in the case of deforestation with subsequent severe degradation.

4.5.2 Land use change

Land uses can change over time due to both natural and anthropogenic causes. Such changes can be represented by land use change categories (e.g., forest land converted to cropland). Guidance on accounting for GHG emissions from land use change is provided in chapter 7.

Land uses can also remain within the same category over time (e.g., forest land remaining forest land or cropland remaining cropland) and generate GHG fluxes from land management practices. Guidance on accounting for biogenic CO_2 emissions and removals as well as other GHG emissions from land management is provided in chapter 8.

Where the land use category remains the same but land use subcategory changes, for example conversion from a primary forest (natural forest) to a plantation forest (planted forest), this should be accounted for as land use change in accordance with chapter 7.

5

Setting the Inventory Boundary

Chapter 5: Setting the Inventory Boundary

Requirements and Guidance

Setting the inventory boundary is a critical step when building a complete and consistent GHG inventory. This chapter provides requirements and guidance for setting the GHG inventory boundary, including setting the organizational boundary and setting operational boundaries. It also provides a list of accounting categories for land sector and removal activities.

Sections in this chapter

Section	Description
5.1	Introduction to boundary setting
5.2	Setting the organizational boundary
5.3	Setting the operational boundary
5.4	Guidance on operational boundaries

Checklist of accounting requirements in this chapter

Section	Accounting requirements
5.2	• Companies **shall** define their organizational boundaries (using equity share, financial control, or operational control) consistently across the GHG inventory, including all accounting categories. • If scope 1 removals are reported from an asset (or set of assets) owned or controlled by multiple companies, the multiple companies **shall** specify the exclusive right of one company to claim scope 1 removals from the asset or set of assets, or specify how the scope 1 removals will be apportioned between the companies, to avoid double counting scope 1 removals.

5.3	• Companies **shall**:
	  ○ Account for all scope 1, scope 2 and scope 3 emissions.
	  ○ Account for all scope 3 emissions (following the *Scope 3 Standard*), including emissions from the fifteen scope 3 categories, and disclose and justify any exclusions.
	  ○ Account for emissions from all applicable accounting categories identified in this Guidance (including land use change, land management, and other categories listed in table 5.8).
	  ○ Account for emissions of the following greenhouse gases: CO_2, CH_4, N_2O, HFCs, PFCs, SF_6, and NF_3.
	  ○ Disclose and justify any exclusions.
	• Reporting removals is optional. If companies account for and report removals in the GHG inventory, companies **shall**:

-
    - Meet all requirements for reporting removals in chapter 6 (refer to chapter 6 for more information).
    - Separately account for and report GHG emissions and removals.
    - Separately account for and report removals by scope (scope 1 vs scope 3) and by gas (if non-CO_2 removals are reported).
    - Account for and report all life cycle GHG emissions in the value chain of the removal pathway across scope 1, scope 2 and scope 3.
- Companies **shall** separately account for and report biogenic and non-biogenic CO_2 emissions, and biogenic and non-biogenic CO_2 removals (if applicable).

5.1 Introduction to boundary setting

Setting organizational and operational boundaries in the land sector follows the same general requirements of other sectors, based on the GHG Protocol *Corporate Accounting and Reporting Standard* and the GHG Protocol *Corporate Value Chain (Scope 3) Accounting and Reporting Standard*. The land sector has additional complexities, such as the inclusion of carbon sinks and pools across the value chain.

Land sector value chains can be extensive, spanning the inputs to land management activities, various land uses (chapter 4), and downstream distribution, processing, use, and end-of-life treatment of diverse biogenic products. Land use also results in wider impacts such as indirect land use change (iLUC).

Land impacts in a company's value chain depend on a reporting company's position within that value chain, such as whether the company:

- provides fertilizers, equipment, and other inputs to land sector activities that fall into scope 3 (downstream),
- is a land manager where land sector emissions and removals fall within its scope 1 boundary, and a range of upstream and downstream emissions are included in scope 3, or
- purchases biogenic products, where inputs to and activities on lands are accounted for in scope 3 (upstream).

The following sections provide requirements and guidance to companies to identify:

- land sector and removal activities that occur within their operations and value chain, and
- source, sink and storage pool categories that they are required to include within their inventory boundary.

This Guidance applies to any entity in land sector value chains or value chains with technological CO_2 removals.

5.2 Setting the organizational boundary

Setting the organizational boundary determines the businesses, lands, operations, and activities that constitute the company. This includes distinguishing the company from its value chain and determining how associated GHG emissions and removals are consolidated by the reporting company.

5.2.1 Choosing a consolidation approach to define the organizational boundary

There are three options for a company to define its organizational boundaries (table 5.1) as further detailed in the GHG Protocol *Corporate Standard*.

Table 5.1 Consolidation approaches

Consolidation approach	Description
Operational control	A company accounts for 100 percent of the GHG emissions, removals (if applicable), and other metrics from operations or lands over which it has operational control. A company has operational control over an operation or land if the company or one of its subsidiaries has the full authority to introduce and implement its operating policies at the operation or on such lands. It does not account for GHG emissions and removals from operations or lands in which it owns an interest but has no control.
Financial control	A company accounts for 100 percent of the GHG emissions, removals (if applicable), and other metrics from operations or lands over which it has financial control. A company has financial control over an operation or land if the company has the ability to direct the financial and operating policies of the operation or land with a view to gaining economic benefits from its activities. It does not account for GHG emissions and removals from operations or lands in which it owns an interest but does not have financial control.
Equity share	A company accounts for GHG emissions, removals (if applicable), and other metrics from operations or lands according to its share of equity in the operation or land. The equity share reflects economic interest, which is the extent of rights a company has to the risks and rewards flowing from an operation or land. Typically, the share of economic risks and rewards in an operation is aligned with the company's percentage ownership of that operation or land.

Each of these approaches can be suitable for land sector GHG inventories depending on the inventory objectives and type of business.

Accounting requirement
Companies **shall** define their organizational boundaries (using equity share, financial control, or operational control) consistently across the GHG inventory, including all accounting categories.

Table 5.2 provides a list of factors to consider when choosing an organizational boundary approach.

Table 5.2 Considerations for choosing an organizational boundary approach

Consideration	Preferred Boundary Approach	Explanation
Reflection of commercial reality	Equity share	Equity share is based on the share of economic interest in a business activity, which reflects commercial reality
Government reporting and emissions trading programs	Operational control	Programs usually require reporting based on operational control
Liability and risk management	Equity share or financial control	The ultimate financial liability for GHG emissions often rests with the group company that holds an equity share in the operation or has financial control over it
Alignment with financial accounting	Equity share or financial control	These approaches result in the closest alignment between GHG and financial accounting
Management information and performance tracking	Operational control or financial control	Managers can only be held accountable for activities under their control
Cost of administration and data access	Operational control or financial control	The equity share approach can result in higher costs because of resource requirements of collecting data from joint operations not under the control of the reporting company

Source: GHG Protocol *Agricultural Guidance*

5.2.2 Alignment of consolidation approach with multiple owners / operators

A given asset (e.g., operation, land or other carbon pool) can be owned or controlled by multiple companies. For instance, this can occur:

- Where an asset is owned by multiple joint venture partners or by a fund with multiple investors
- Where an asset is owned by one or multiple parties, but control of that asset is transferred to another party through lease or service agreements

All companies owning or controlling a given asset should use the same consolidation approach to define their organizational boundary.

Accounting requirement

If reporting scope 1 removals from an asset (or set of assets) owned or controlled by multiple companies, companies **shall**:

- specify the exclusive right of one company to claim scope 1 removals from the asset or set of assets, or
- specify how the scope 1 removals will be apportioned between the companies, to avoid double counting scope 1 removals.

To clarify ownership (rights) and responsibilities (obligations) issues, such companies should draw up contracts that specify how the ownership of emissions and removals or the responsibility for managing emissions and removals and associated risk is distributed between the parties. Within these arrangements, companies should provide a description of the contractual arrangement and include information on allocation of GHG-related risks and obligations. Agreements should specify which party accounts for the scope 1 emissions and removals. All scope 1 emissions need to be accounted for by at least one company (i.e., no scope 1 emissions are unaccounted for).

5.2.3 Leased assets

The first step in categorizing emissions and removals from leased assets is to understand the two different types of leases: finance or capital leases and operating leases.

- **Finance or capital lease:** This type of lease enables the lessee to operate an asset and also gives the lessee all the risks and rewards of owning the asset. Assets leased under a finance or capital lease are considered wholly owned assets in financial accounting and are recorded as such on the balance sheet.
- **Operating lease:** This type of lease enables the lessee to operate an asset, such as a building or vehicle, but does not give the lessee any of the risks or rewards of owning the asset. Any lease that is not a finance or capital lease is an operating lease.

A common type of lease for lands is the finance or capital lease. In many countries, land is leased using mid- to long-term contracts, where the lessee is farming the land for a fixed fee and takes all the risks and rewards related to the operations on the land.

Government concessions (e.g., for plantations) in many countries are also based on similar contract types. Instead of operating lease contracts, land owners and managers often use service contracts to commission another entity (e.g., another farmer, a service company) to execute certain work on the land they own or manage (e.g., harvesting), with a payment that is a function of the amount of worktime and/or type of machinery. However, it is possible that an operating lease contract could also be used.

Table 5.3 summarizes whether leased assets are included in the reporting company's organizational boundary based on the chosen consolidation approach. Leased assets that fall within the organizational boundary are reported in scope 1. Leased assets that do not fall within the organizational boundary are reported in scope 3 – either Upstream leased assets (scope 3, category 8) or Downstream leased assets (scope 3, category 13).

Table 5.3 Accounting for leased assets based on the chosen consolidation approach

Reporting company context[1]	Are the lands included within the reporting company's chosen organizational boundary approach?[2]		
	Operational Control	**Financial Control**	**Equity Share**
Land owner – manages the lands themselves	Yes	Yes	Yes
Land owner – the land is leased to a 3rd-party under an operating lease	No	Yes	Yes
Land owner – the land is leased to a 3rd-party under a finance or capital lease	No	No	No
Lessee – operating lease[3]	Yes	No	No
Lessee – finance or capital lease	Yes	Yes	Yes
Land manager – contracted by the land owner to manage the land	Yes	No	No
Service provider – contracted by the land owner / manager to perform specific tasks	No	No	No

Notes: [1] These reporting company contexts can apply regardless of whether the landowner is a private company, a non-governmental organization, or the government. Agreements can take many forms and be referred to in different ways (e.g., tenure, management agreement, license, permit, concession, contract), both between jurisdictions and within a given jurisdiction. In all cases, reporting companies should consult the specific text of applicable agreements and compare against the organizational boundary definitions in section 5.2.1 when deciding which organizational boundary approaches might apply to a given situation.

[2] Leased assets that fall within the organizational boundary are reported in scope 1. Leased assets that do not fall within the organizational boundary are reported in scope 3 – either Upstream leased assets (scope 3, category 8) or Downstream leased assets (scope 3, category 13).

[3] The accounting approach for this row may be subject to change to ensure alignment with the most recent international financial accounting rules (e.g., IFRS and other accounting standards).

5.2.4 Addressing unclear land rights

In some geographies land rights are often unclear. Land could be held in a collective manner under customary tenure arrangements and national laws might not recognize community land or customary tenure, particularly if they are not properly documented with the state or if they are contested. This could be a particular challenge with rural communities and smallholder landowners. Conflicts could arise on the rights and responsibilities related to emissions and removals on the land. These issues need to be addressed early on in a fair and transparent manner since there is potential for the contracts to impact (positively or negatively) the livelihoods of communities that depend on the land in question. These communities may be less able to assert their rights than the company preparing its GHG inventory. Specialized organizations[34] offer guidance on how to deal with unclear land rights and the applicability of different types of leases.

5.3 Setting the operational boundary

An operational boundary defines the scope of direct and indirect emissions, removals, and other accounting categories associated with operations that fall within a company's established organizational boundaries.

Summary of new accounting categories included in this Guidance

This Guidance builds on existing GHG Protocol standards but provides new accounting categories specific to land sector and removal activities, including:

- **Land emissions** (*Land use change emissions*, *Land management net CO_2 emissions*, and *Land management non-CO_2 emissions*), which are required to be reported as part of scope 1, scope 2, and scope 3 emissions.
- **Removals**, which may be reported as scope 1 or scope 3 removals (on a net basis through stock-change accounting methods, explained in chapter 4), if requirements for reporting removals (see chapter 6) are met.
- **Net emissions of biogenic and technologically removed CO_2 stored in product or geologic carbon pools**, which are required to be reported as part of scope 1 and scope 3 emissions if companies report removals from product or geologic carbon pools (on a net basis through stock-change accounting methods).
- **Land tracking metrics**, one or more of which is required to be reported as scope 1, scope 2, and scope 3 land tracking (explained in chapter 7).

Each of the above categories is reported separately from other categories in a GHG inventory. Land emissions are reported separately from non-land emissions; removals are reported separately from emissions; and land tracking metrics are reported separately from emissions and removals. The accounting categories are not to be summed, aggregated, or netted together when reporting a corporate inventory. Chapter 12 provides requirements and guidance on the inclusion of different categories in targets.

Table 5.4 provides a summary of these new elements and requirements in the *Land Sector and Removals Guidance* and how they compare to the requirements in the *Corporate Standard* and *Scope 3 Standard*. As described in chapter 1, companies applying the Greenhouse Gas Protocol are required to follow the *Land Sector and Removals Guidance* if the company has land sector activities and/or removals in its operations or value chain.

[34] This includes the Voluntary Guidelines on the Responsible Governance of Tenure provided by the Food and Agriculture Organization of the United Nations (FAO), available at: https://www.fao.org/tenure/voluntary-guidelines/en/.

Table 5.4 Operational boundary requirements across GHG Protocol standards

Greenhouse Gas Protocol standards and guidance	Accounting categories					
	Non-land emissions	**Land emissions (biogenic and non-biogenic)**	**Emissions from biogenic carbon in products**	**Emissions from technologically removed CO_2 and geologic storage**	**Removals**	**Land tracking**
Corporate Standard	Required for scope 1 and scope 2 at minimum	Not fully addressed	Required; direct CO_2 emissions from combustion of biomass reported separately from scopes	Not addressed	Optional; reported separately from scopes	Not addressed
Scope 3 Standard (Requires conformance with *Corporate Standard*)	Required for scope 1, scope 2 and scope 3	Not fully addressed	Required; direct and indirect (value chain) CO_2 emissions from combustion of biomass reported separately from scopes	Not addressed	Optional; reported separately from scopes	Not addressed
Land Sector and Removals Guidance (Requires conformance with *Corporate Standard* and *Scope 3 Standard*)	Required for scope 1, scope 2 and scope 3	Required; reported as scope 1, scope 2 and scope 3 emissions[1]	Required; net emissions[1] reported as scope 1, 2 and 3 emissions (if companies report removals); gross biogenic product CO_2 emissions[2] reported separately *(subject to open question #1, box 5.2)*	Required (if applicable); net emissions[1] reported as scope 1, 2 and 3 emissions (if companies report removals); gross emissions[2] reported separately *(subject to open question #1, box 5.2)*	Optional; reported as scope 1 or scope 3 removals[1] if requirements are met (see chapter 6)	Required; one or more land tracking metrics reported as scope 1, scope 2 and/or scope 3 land tracking (see chapter 7)

Notes: [1] Using stock-change accounting for emissions and removals of biogenic and technologically removed CO_2 stored in land carbon pools, product carbon pools, and geologic carbon pools (described in chapter 4), and where removals meet the removals requirements in chapter 6.

[2] Using flow accounting for emissions and removals of biogenic and technologically removed CO_2 (described in chapter 4).

5.3.1 Emissions by scope

Following the *Corporate Standard* and the *Scope 3 Standard*, emissions are categorized as direct or indirect based on which entity owns or controls an emission source.

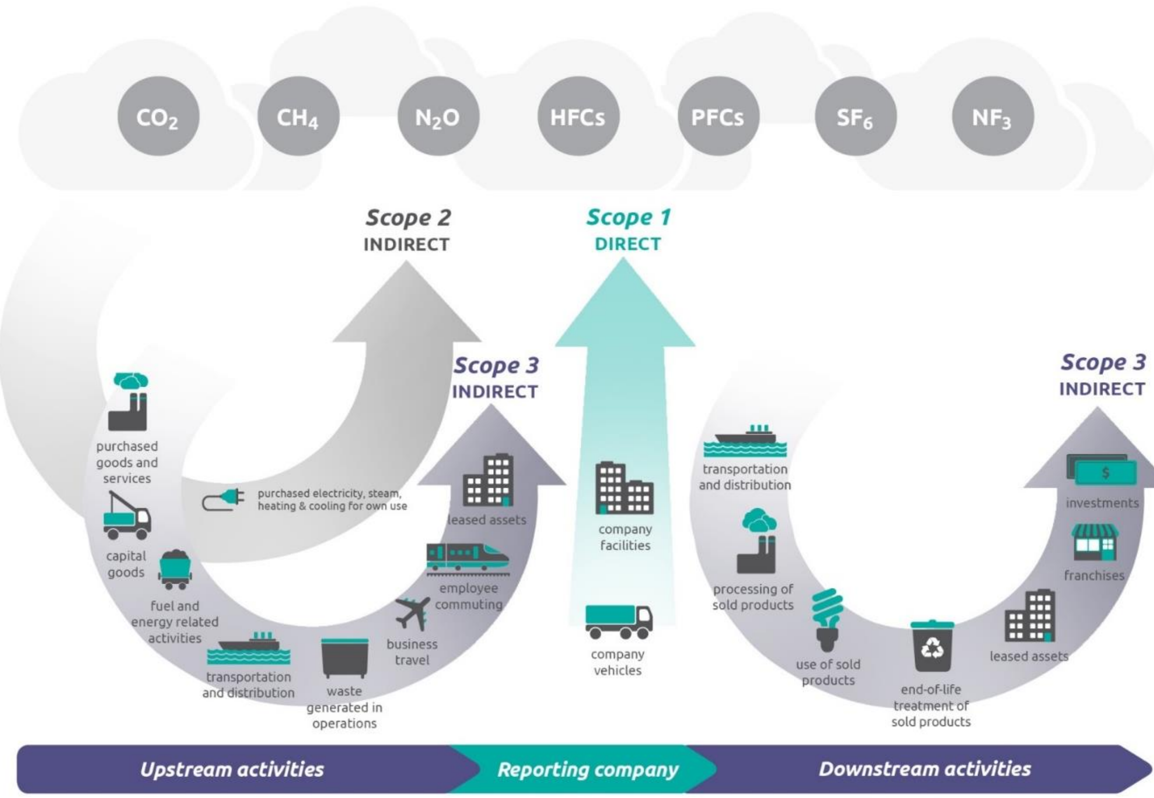
Direct emissions result from sources or lands that are owned or controlled by the reporting company. Indirect emissions are a consequence of the activities of the reporting company but result from sources or lands outside of the reporting company's organizational boundary.

Emissions are further divided into three scopes. Direct emissions are included in scope 1, and indirect emissions are included in scope 2 and scope 3 (see table 5.5 and figure 5.1).

Table 5.5 Emissions by scope

Emissions type	Scope	Definition	Example
Direct	Scope 1	Emissions from operations or lands owned or controlled by the reporting company.	Emissions from livestock on pastureland owned or controlled by the reporting company.
Indirect	Scope 2	Emissions from the generation of purchased or acquired electricity, steam, heating, or cooling consumed by the reporting company.	Emissions from a power plant generating electricity purchased by the reporting company.
	Scope 3	All emissions (not included in scope 2) that are a consequence of the activities of the reporting company but occur from operations or lands owned or controlled by another company.	Emissions on land used to grow feed purchased by the reporting company.

Figure 5.1 Emissions and scopes across the value chain



Source: GHG Protocol *Scope 3 Standard*

Most emissions typically occur in a company's value chain. While a company has control over its direct emissions, the company has influence over its indirect emissions. Consequently, it is important for companies to comprehensively account for all scope 1, scope 2, and scope 3 emissions.

Accounting requirement

Companies **shall:**

- account for all scope 1, scope 2, and scope 3 emissions.
- account for all scope 3 emissions (following the *Scope 3 Standard*, including boundary requirements in chapters 5 and 6), including emissions from the fifteen scope 3 categories, and disclose and justify any exclusions.
- account for emissions from all applicable accounting categories identified in this Guidance (including land use change, land management, and other categories listed in table 5.8).
- account for emissions of the following greenhouse gases: CO_2, CH_4, N_2O, HFCs, PFCs, SF_6, NF_3.
- disclose and justify any exclusions.

5.3.2 Removals by scope

Accounting requirement

Reporting removals is optional. If companies account for and report removals in the GHG inventory, companies **shall**:

- meet all requirements for reporting removals in chapter 6 (refer to chapter 6 for more information).
- separately account for and report GHG emissions and removals.
- separately account for and report removals by scope (scope 1 vs scope 3) and by gas (if non-CO_2 removals are reported).
- account for and report all life cycle GHG emissions in the value chain of the removal pathway across scope 1, scope 2, and scope 3.

Life cycle emissions include all cradle-to-grave emissions, including both land and non-land emissions that occur from activities associated with land management or throughout the product or geologic storage pathway.

A removal is defined as a process that includes two distinct elements:

1. **transfer** of greenhouse gases from the atmosphere via **sinks** (the process, activity or mechanism that removes greenhouse gases from the atmosphere),[35] and
2. **storage** of the carbon or CO_2 within **pools** (the physical reservoir or medium where the removed carbon or CO_2 is stored).[36]

This approach to removals accounting is based on the stock-change accounting approach explained in chapter 4, which focuses on the storage of carbon (removed from the atmosphere) in pools. Under this approach, removals are synonymous with enhanced carbon storage in carbon pools (where the carbon is derived from atmospheric CO_2).

Sinks and associated storage pools can be owned or controlled by the same entity or different entities. Removals are categorized as direct or indirect for the reporting company based on whether the reporting company owns or controls a sink and/or the associated pools where the carbon or CO_2 is stored.

Direct (scope 1) removals result where the reporting company owns or controls both the sink that transferred CO_2 from the atmosphere and the pool where the carbon is stored. Indirect (scope 3) removals result where the reporting company does not own or control both the sink and the associated storage pools. To be reported as either scope 1 or scope 3, removals must meet the requirements for reporting removals in chapter 6.

Classifying removals as scope 1 or scope 3 depends on two processes (transfer and storage), whereas for emissions, the categorization depends only on which entity owns or controls an emission source.

Figure 5.2 shows how removals are accounted for by scope depending on which entity removes the CO_2 from the atmosphere and which entity owns or controls the pools.

Table 5.6 provides definitions of scope 1 and scope 3 removals. Table 5.7 provides further guidance by pool.

[35] Such as photosynthesis or direct air capture (or other technological removal) processes.

[36] Including geologic carbon pools, land-based carbon pools, product carbon pools and ocean-based carbon pools.

Figure 5.2 Accounting for removals by scope

<table>
<tr><th></th><th colspan="3">Which entity owns or controls the pool where carbon is stored?</th></tr>
<tr><th>Which entity owns or controls the sink that removes CO_2 from the atmosphere?</th><th>Reporting company</th><th>Other company in the value chain</th><th>No ongoing storage (or if other requirements for reporting CO_2 removals in chapter 6 are not met)</th></tr>
<tr><td>Reporting company</td><td>Scope 1 removal</td><td rowspan="2">Scope 3 removal</td><td rowspan="3">Not accounted for as a removal</td></tr>
<tr><td>Other company in the value chain</td><td></td></tr>
<tr><td>Not removed from the atmosphere (e.g., CCS of industrial flue gas)</td><td colspan="2"></td></tr>
</table>

Table 5.6 Removal definitions by scope

Removal type	Scope	Definition
Direct	Scope 1	Removals for which the reporting company owns or controls **both** the sink (that transfers CO_2 from the atmosphere) **and** the pool (that stores the CO_2 or carbon)
Indirect	Scope 3	Removals that are a consequence of the activities of the reporting company, but where the reporting company does not own or control **both** the sink (that transfers CO_2 from the atmosphere) **and** the pool (that stores the CO_2 or carbon).

Notes:

Chapter 6 provides requirements for reporting CO_2 removals which must be met for removals to be reported in scopes.

There are no scope 2 removals, since removals do not occur in the generation of electricity, steam, heating, or cooling. Any removals occurring in the value chain of the energy generation process (e.g., in the case of BECCS) are accounted for in scope 3, category 3 (subject to requirements and criteria for reporting removals in chapter 6).

Table 5.7 Removals by scope: Guidance by pool

Pool Type	Guidance
Land carbon pools	Removals with land-based storage are accounted for as scope 1 removals by the company that owns or controls land (which is both the sink and pool). With land carbon pools, the sink and storage pools are owned/controlled by the same entity.
Product carbon pools	Removals with product storage are not accounted as scope 1 removals by any entity. With product carbon pools, no entity controls both sink and storage across the value chain, since products are intended to be transferred to other entities (including end users) across the value chain. (Note: reporting of removals with product storage is subject to open question #2 in chapter 6, box 6.3).

Geologic carbon pools	A removal is accounted for as a scope 1 removal with geologic storage if the reporting company owns or controls both the sink (that transfers CO_2 from the atmosphere, such as land growing biomass or a technological removal process) and the pool (that stores the CO_2 or carbon, such as a geologic reservoir). For scope 1 removals with geologic storage, ownership or control can be defined either as direct ownership or control or through contractual ownership or control (for example, through CO_2 storage as a service). Geologic removal and storage pathways may present circumstances where no single entity owns or controls all the relevant processes. See chapter 10 for more information on accounting for scope 1 removals in this situation.

5.3.3 Accounting categories by scope

Table 5.8 provides a list and definitions of accounting categories by scope. This table includes both required and optional categories.

Accounting requirement

As indicated in table 5.8, companies **shall** account for and report:

- Non-land emissions
- Land emissions (i.e., *Land use change emissions*, *Land management net CO_2 emissions*, *Land management non-CO_2 emissions*)
- Net emissions of biogenic or TCDR CO_2 stored in product or geologic carbon pools, if removals from product or geologic carbon pools are reported
- One or more land tracking metrics
- The following gross categories, separately reported from and not aggregated with net categories
  - *Gross biogenic product CO_2 emissions* (e.g., from combustion)
  - *Gross TCDR-based product CO_2 emissions*, if applicable
  - *Gross CO_2 emissions from geologic storage*, if applicable

Companies shall report:

- Removals
- The following gross categories, separately reported from net categories
  - Gross biogenic land CO_2 emissions
  - Gross biogenic land CO_2 removals
  - Gross technological CO_2 removals

Accounting requirement

Companies **shall** separately account for and report biogenic and non-biogenic CO_2 emissions, and biogenic and non-biogenic CO_2 removals if applicable.

Companies should account for each accounting category in the appropriate scope, as relevant to the reporting company (as described in table 5.8).

The approach to net and gross biogenic and TCDR CO_2 emissions is subject to open question #1 (chapter 5, box 5.2).

Table 5.8 Accounting categories and subcategories by scope

Accounting Category	Accounting Subcategories	Scope 1	Scope 2	Scope 3
Non-land emissions *Required*	Stationary combustion emissions	Non-land emissions from sources owned or controlled by the reporting company	Non-land and non-biogenic emissions from the generation of purchased or acquired electricity, steam, heating, or cooling consumed by the reporting company	Non-land and non-biogenic emissions that are a consequence of the activities of the reporting company but occur from sources owned or controlled by another company
	Mobile combustion emissions			
	Process emissions			
	Fugitive emissions			
Land emissions[1] *Required*	Land use change emissions (biogenic)	Biogenic CO_2 emissions from carbon stock losses and other GHG emissions due to land use change on land owned or controlled by the reporting company	Biogenic CO_2 emissions from carbon stock losses and other GHG emissions due to land use change on land used to generate purchased or acquired electricity, steam, heating, or cooling consumed by the reporting company	Biogenic CO_2 emissions from carbon stock losses and other GHG emissions due to land use change that are a consequence of the activities of the reporting company but occur on lands owned or controlled by another company
	Land management net CO_2 emissions (biogenic)	Biogenic CO_2 emissions from net carbon stock losses on land carbon pools owned or controlled by the reporting company	N/A	Biogenic CO_2 emissions from net carbon stock losses that are a consequence of the activities of the reporting company but occur on land carbon pools owned or controlled by another company
	Land management non-CO_2 emissions	CH_4, N_2O and non-biogenic CO_2 emissions from management of land owned or controlled by the reporting company	CH_4, N_2O and non-biogenic CO_2 emissions from management of land used to generate purchased or acquired electricity, steam, heating, or cooling consumed by the reporting company	CH_4, N_2O and non-biogenic CO_2 emissions from management of land that are a consequence of the activities of the reporting company but occur from lands owned or controlled by another company

Net emissions of biogenic or TCDR CO_2 stored in product or geologic carbon pools[1] *Required if removals from product or geologic carbon pools are reported*	Net CO_2 emissions from biogenic product storage	N/A	N/A	CO_2 emissions from net carbon stock decreases in biogenic or TCDR-based product carbon pools that are a consequence of the activities of the reporting company but where the pools are owned or controlled by another company
	Net CO_2 emissions from TCDR-based product storage			
	Net CO_2 emissions from geologic storage	CO_2 emissions from net carbon stock decreases in geologic carbon pools owned or controlled by the reporting company	N/A	CO_2 emissions from net carbon stock decreases in geologic carbon pools that are a consequence of the activities of the reporting company but where the pools are owned or controlled by another company
Removals[1] *Optional*	Land management net removals	Net increases to storage in land carbon pools where the land is owned or controlled by the reporting company	N/A	Net increases to storage in land carbon pools that are a consequence of the activities of the reporting company but where the land is owned or controlled by another entity
	Net removals with product storage *(subject to open question #2, chapter 6, box 6.3)*	N/A	N/A	Net increases to storage in product carbon pools sold by the reporting company that are a consequence of the activities of the reporting company
	Net removals with geologic storage	Net increases to storage in geologic carbon pools where the sink and the geologic carbon pool are owned or controlled by the reporting company[4]	N/A	Net increases to storage in geologic carbon pools that are a consequence of the activities of the reporting company but where the sink and/or geologic carbon pool are owned or controlled by another company
Land tracking *Required to report one or more metrics*	Indirect land use change emissions	Emissions (from carbon stock losses) due to land conversion on lands not owned or controlled by the reporting company, or in its value chain,	N/A	Emissions (from carbon stock losses) due to land conversion on lands not owned or controlled by the reporting company, or in its value chain, induced by change in demand for (or supply of) products

		induced by change in demand for (or supply of) products produced by the reporting company.		sourced by the reporting company.
	Carbon opportunity costs	Emissions from total historical carbon losses from plants and soils on lands productively used that are owned or controlled by the reporting company	Emissions from total historical carbon losses from plants and soils on lands productively used to generate purchased or acquired electricity, steam, heating, or cooling consumed by the reporting company	Emissions from total historical carbon losses from plants and soils on lands productively used in the value chain of the reporting company (lands owned or controlled by another company)
	Land occupation	The amount of land owned or controlled by the reporting company that is occupied to produce land-based products	The amount of land occupied to generate purchased or acquired electricity, steam, heating, or cooling consumed by the reporting company	The amount of land owned or controlled by another company that is occupied to produce land-based products in the value chain of the reporting company
Separate reporting of gross emissions and gross removals (Separately reported from and not aggregated with net emissions or net removals above)				
Gross emissions and gross removals[2] *See individual categories for which are required or optional*	Gross biogenic product CO_2 emissions (e.g., from combustion) *Required*	Gross CO_2 emissions from biogenic product carbon pools owned or controlled by the reporting company	Gross CO_2 emissions from biogenic product carbon pools used to generate purchased or acquired electricity, steam, heating, or cooling consumed by the reporting company	Gross CO_2 emissions from biogenic product carbon pools that are a consequence of the activities of the reporting company but where the pools are owned or controlled by another company
	Gross biogenic land CO_2 emissions *Optional*	Gross CO_2 emissions from land-based carbon pools owned or controlled by the reporting company	N/A	Gross CO_2 emissions from land-based carbon pools that are a consequence of the activities of the reporting company but where the pools are owned or controlled by another company
	Gross biogenic land CO_2 removals *Optional*	Gross CO_2 removals to land-based carbon pools owned or controlled by the reporting company	N/A	Gross CO_2 removals to land-based carbon pools that are a consequence of the activities of the reporting company but where the pools are owned

				or controlled by another company
	Gross technological CO_2 removals *Optional*	Gross CO_2 removals via technological sinks owned or controlled by the reporting company	N/A	Gross CO_2 removals via technological sinks that are a consequence of the activities of the reporting company but where the sinks are owned or controlled by the reporting company
	Gross TCDR-based product CO_2 emissions *Required if applicable*	Gross CO_2 emissions from TCDR-based product carbon pools owned or controlled by the reporting company	Gross CO_2 emissions from TCDR-based product carbon pools used to generate purchased or acquired electricity, steam, heating, or cooling consumed by the reporting company	Gross CO_2 emissions from TCDR-based product carbon pools that are a consequence of the activities of the reporting company but where the pools are owned or controlled by another company
	Gross CO_2 emissions from geologic storage *Required if applicable*	Gross CO_2 emissions from geologic carbon pools owned or controlled by the reporting company	N/A	Gross CO_2 emissions from geologic carbon pools that are a consequence of the activities of the reporting company but where the pools are owned or controlled by another company

Notes: [1] Using stock-change accounting for emissions and removals of biogenic and technologically removed CO_2 stored in land carbon pools, product carbon pools, and geologic carbon pools (described in chapter 4), and where removals meet the removals requirements in chapter 6.

[2] Using flow accounting for emissions and removals of biogenic and technologically removed CO_2 (described in chapter 4).

[3] All accounting categories are annual, such that the reporting company reports emissions, removals, net carbon stock changes, etc. that occur in the reporting year.

[4] Subject to additional guidance for geologic carbon pools in section 5.3.2.

TCDR = technological carbon dioxide removal

5.3.4 Time boundary of accounting categories

Table 5.9 provides the time boundary for each accounting category. Scope 1 and scope 2 emissions are annual and reflect emissions occurring in the reporting year. Scope 3 emissions account for emissions related to the reporting company's activities in the reporting year. For some scope 3 categories, emissions occur in the reporting year, while for other scope 3 categories, emissions can occur in other years (past or future years) related to the reporting company's activities in the reporting year. For more information on the time boundary of scope 3 emissions, refer to the GHG Protocol *Scope 3 Standard* (chapter 5).[37]

The time boundary of removals is annual and reflects carbon stock increases occurring in the reporting year. The categories for net emissions from carbon stock decreases are also annual and reflect carbon stock decreases occurring in the reporting year.

For the categories representing net emissions or net removals based on a stock-change accounting approach, companies account for net emissions or net removals from the annual carbon stock change in land carbon pools, geologic carbon pools, and product carbon pools (as applicable) occurring in the reporting year.

Table 5.9 Time boundary of accounting categories

Accounting category	Accounting subcategories	Scope 1	Scope 2	Scope 3
Non-land emissions	Non-land emissions	Annual	Annual	Depends on scope 3 category[1]
Land emissions[1]	Land use change emissions (biogenic)	Annualized over the assessment period (20 years or greater)	Annualized over the assessment period (20 years or greater)	Annualized over the assessment period (20 years or greater)
	Land management net CO_2 emissions (biogenic)	Annual	N/A	Annual
	Land management non-CO_2 emissions	Annual	Annual	Depends on scope 3 category[1]
Net emissions of biogenic or TCDR CO_2 stored in product or geologic carbon pools[1]	Net CO_2 emissions from biogenic product storage	N/A	N/A	Annual
	Net CO_2 emissions from TCDR-based product storage	N/A	N/A	Annual
	Net CO_2 emissions from geologic storage	Annual	N/A	Annual
Removals[1]	Land management net removals	Annual	N/A	Annual
	Net removals with product storage *(subject to open*	N/A	N/A	Annual

[37] Available at https://ghgprotocol.org/standards/scope-3-standard

	question #2, chapter 6, box 6.3)			
	Net removals with geologic storage	Annual	N/A	Annual
Land tracking	Indirect land use change emissions	Annualized over the assessment period (20 years or greater)	N/A	Annualized over the assessment period (20 years or greater)
	Carbon opportunity costs	Annualized over COC assessment period	Annualized over COC assessment period	Annualized over COC assessment period
	Land occupation	Annual	Annual	Annual
Separate reporting of gross emissions and gross removals (Separately reported from and not aggregated with net emissions or net removals above)				
Gross emissions and gross removals[2]	Gross biogenic product CO_2 emissions (e.g., from combustion)	Annual	Annual	Annual or depends on scope 3 category[1] *(TBD; subject to open question #1, box 5.2)*
	Gross biogenic land CO_2 emissions		N/A	
	Gross biogenic land CO_2 removals		N/A	
	Gross technological CO_2 removals		N/A	
	Gross TCDR-based product CO_2 emissions		Annual	
	Gross CO_2 emissions from geologic storage		N/A	

Note: [1] Cradle-to-gate for emissions from upstream product-related scope 3 categories (categories 1, 2, 3, 4); gate-to-grave for emissions from waste, downstream product-related scope 3 categories, and investments (categories 5, 9, 10, 11, 12, 15); annual for emissions from other scope 3 categories (categories 6, 7, 8, 13, 14); annual for CO_2 emissions from net carbon stock decreases from ongoing storage monitoring of land, product and geologic carbon pools (for all scope 3 categories)

Box 5.2 Open question #1: Biogenic CO_2 and technologically removed CO_2 accounting and reporting

The draft Guidance is based on a stock-change accounting approach for biogenic carbon and technologically removed CO_2, where net CO_2 emissions and net CO_2 removals (based on stock-change accounting) are included in the scopes, while gross CO_2 emissions and gross CO_2 removals (based on flow accounting) are separately reported (and required to be reported where noted).

For biogenic products, the stock-change accounting approach for biogenic value chains used in this Guidance accounts for gross CO_2 emissions from the carbon in biogenic products as:

- scope 1 land management net CO_2 emissions or removals by land management companies, through a reduction in the land carbon stock due to harvest (when carbon is transferred from land carbon pools into product carbon pools), and
- scope 3 (upstream) land management net CO_2 emissions or removals by consumers of biogenic products, through a reduction in the land carbon stock on sourcing lands due to harvest.

As an alternative approach, flow-based accounting would report biogenic carbon flows (emissions and removals) at the point when they are transferred to or from the atmosphere, as is the approach used in non-land sectors. A flow-based approach puts an emphasis on the entities that own or control the sources and sinks that transfer CO_2 to and from the atmosphere.

During pilot testing and review, we would like to gain practical experience with data and methods and understand the implications of the options to determine whether the current approach should be maintained, or alternative approaches should be pursued in the final Guidance.

We invite pilot testers to pilot test different approaches in order to learn about the feasibility and implications of each approach to inform the final decision. In particular, we invite pilot testing companies to account for and report on all net (stock-change) accounting categories and all gross (flow) accounting categories, including the categories currently identified as optional, to inform the decision in the final Guidance.

How should biogenic CO_2 emissions and removals be reported? Options:

1. Current approach (stock-change accounting in scopes, flow-based accounting outside scopes): Companies **shall** account for net biogenic emissions and removals in the scopes through stock-change accounting of annual net land carbon stock changes (including all attributable managed lands within the value chain), with separate reporting of gross biogenic CO_2 emissions and removals (at the source and sink where they occur) using flow-based accounting.
   - Note: The current approach requires accounting for annual net land carbon stock changes in scope 1 or scope 3 for all biogenic products.
2. Scope 1 if not scope 3: Under this approach, companies have two options: companies **shall** either follow the current approach (stated above), or, if companies do not have data available to account for annual net land carbon stock changes within scope 3 associated with biogenic products they purchase or consume, then companies **shall** report direct gross biogenic product CO_2 emissions as scope 1 emissions and indirect gross biogenic product CO_2 emissions as scope 2 or scope 3 emissions.
   - Note: If the company has data to report all net carbon stock changes on lands in scope 3 (including land use change and land management), then this alternative approach does not apply.
3. Dual reporting: Companies **shall** separately account for and report both of the following types of information in the scopes:
   - Net land management emissions and removals based on annual net land carbon stock changes (using stock-change accounting) in scope 1, scope 2 or scope 3 as relevant, and

- All gross emissions and removals including gross biogenic land CO_2 removals, gross biogenic land CO_2 emissions, and gross biogenic product CO_2 emissions (using flow-based accounting) in scope 1, scope 2, or scope 3 as relevant.

4. Other option?

Following the same approach for biogenic carbon, how should technologically-removed CO_2 emissions and removals be reported? Options:

1. Current approach (stock-change accounting in scopes, flow-based accounting outside scopes): Companies **shall** account for net technologically removed CO_2 in the scopes through stock-change accounting, with separate reporting of gross technologically removed CO_2 emissions and removals (at the source and sink where they occur) using flow-based accounting.
2. Scope 1 if not scope 3: Under this approach, if companies do not have data on the origin of the carbon in materials (i.e., whether it is technologically removed CO_2), then they **shall** report direct gross technologically removed CO_2 emissions as scope 1 emissions (and indirect gross technologically removed CO_2 emissions as scope 2 or scope 3 emissions).
    - Note: If the company has this data, then this does not apply.
3. Dual reporting: Companies **shall** report both net carbon stock changes (using stock-change accounting) and gross technologically removed CO_2 emissions and removal (using flow-based accounting) in the scopes, separately from each other, rather than only stock-change accounting being included within the scopes.
4. Other option?

5.4 Guidance on operational boundaries

This section provides additional guidance on accounting for biogenic products, scope 2, and scope 3 activities in the GHG inventory boundary.

5.4.1 Emissions from combustion or decomposition of biogenic products

Companies that purchase and consume biogenic products account for and report:

- **Gross biogenic product CO_2 emissions** from combustion, decomposition or other processes (quantified using emission factors that reflect the CO_2 emissions released to the atmosphere at combustion, decomposition or other process, by type of biofuel/biomaterial), separately reported from scope 1, scope 2, and scope 3 emissions (as gross emissions, not aggregated with net emissions) and organized by scope category to differentiate direct and indirect gross emissions (see table 5.8).
- **Scope 1, scope 2, or scope 3 methane (CH_4) and nitrous oxide (N_2O) emissions** from combustion, decomposition or other processes (using CH_4 and N_2O emission factors by type of biofuel/biomaterial).
- **Scope 3, category 1 upstream emissions from purchased biomaterials and scope 3, category 3 upstream emissions from purchased bioenergy** (extraction, production, and transportation of biomaterials and bioenergy consumed by the reporting company). This includes cradle-to-gate emissions of purchased biomaterials/bioenergy from raw material extraction up to the point of (but excluding) combustion or decomposition, including *Land use change emissions* (see chapter 7 and 17), *Land management net CO_2 emissions* (chapter 8 and 18), *Land management non-CO_2 emissions* (chapter 8 and 19), and emissions from processing, transportation, and all other upstream impacts.
- **Any other scope 1, scope 2, or scope 3 emissions**, if applicable.
- **Optionally, and if applicable, removals stored in land, product, or geologic carbon pools**, using stock-change accounting methods (further described in chapter 6).
- **One or more land tracking metrics** (*Indirect land use change emissions*, *Carbon opportunity costs*, *Land occupation*), reported separately from emissions and removals.

5.4.2 Scope 2 emissions

Scope 2 emissions are indirect emissions associated with the generation of purchased electricity, steam, heating, and cooling purchased and consumed by the reporting company.

Fossil fuels, biomass or biofuels may be combusted as part of the generation of purchased electricity, steam, heating, and cooling consumed by the reporting company. Companies should account for scope 2 emissions based on the mix of fuels used to generate purchased energy.

Scope 2 emissions include all non-biogenic CO_2 emissions as well as all CH_4 and N_2O emissions released from the generation process, with biogenic CO_2 emissions from combustion required to be separately reported.

Companies should separately account for fossil and biogenic emissions by determining the grid-average emission factors for fossil CO_2 emissions vs biogenic CO_2 emissions of purchased electricity, steam, heating, and cooling sourced from an electric grid or other distribution system. Companies should report each portion separately (fossil and biogenic), following the accounting and reporting requirements.

Companies should report all emissions upstream of the energy generation process in scope 3, category 3 (fuel- and energy-related activities not included in scope 1 or scope 2). This category includes extraction, production, and transportation of fuels consumed in the generation of electricity, steam, heating, and cooling consumed by the reporting company. Examples include emissions from coal mining; extraction, refining and distribution of petroleum products and natural gas; and land use change, land management, processing, and distribution of biomass/biofuels.

Removals are not reported in scope 2, since removals do not occur in the generation of electricity, steam, heating, or cooling. Any removals occurring in the value chain of the energy generation process (e.g., in the case of BECCS) are accounted for in scope 3, category 3 (subject to requirements for reporting removals in chapter 6).

5.4.3 Identifying relevant scope 3 emissions and removals

Scope 3 comprises the emissions and removals occurring in the value chain of a company, both upstream and downstream. A complete scope 1, scope 2, and scope 3 inventory enables a complete view of GHG impacts across the full value chain or life cycle to understand where impacts and mitigation opportunities are largest, to focus mitigation efforts on where they make the biggest improvement. Box 5.1 provides further information on the importance of scope 3 emissions accounting and reporting.

Companies following this Guidance are required to account for all scope 3 emissions, including emissions from the 15 scope 3 categories, following the GHG Protocol *Scope 3 Standard*. Companies must disclose and justify any exclusions. Refer to the *Scope 3 Standard* (chapter 6) for more information.

Box 5.1 Importance of scope 3 accounting and reporting for the land sector and for removals

- Scope 3 accounting enables land management GHG impacts to be accounted for by companies in land-based value chains that do not own or control land, to provide a means of incentivizing improved land management practices to reduce emissions and increase removals. For many companies, land impacts are located in scope 3.
- Scope 3 accounting is needed for companies that consume biogenic products, since the stock-change accounting approach used in this Guidance accounts for CO_2 emissions from the carbon in biogenic products as:
    - scope 1 *Land management net CO_2 emissions* by land management companies, through a reduction in the land carbon stock due to harvest (when carbon is transferred from land into products), and
    - scope 3 (upstream) *Land management net CO_2 emissions* by consumers of biogenic products, through a reduction in the land carbon stock on sourcing lands due to harvest.

- This Guidance introduces removals accounting within GHG inventory. If a company reports removals within the scopes, the company needs to report all life cycle emissions related to those activities, in line with the principles of completeness and conservativeness. For example, if a company in a direct air capture and utilization value chain reports removals, the company needs to report all life cycle emissions (e.g., energy required to remove CO_2 from the atmosphere) to determine the total GHG impact looking across all processes. If a company in a biomass value chain reports removals, the company needs to report all life cycle emissions (e.g., land use change emissions, land management emissions, land tracking category) to determine the total GHG impact looking across all processes in the value chain. These impacts are most often located in scope 3.

For landowners and managers as well as biogenic product processors and consumers, scope 3 impacts are diverse across the various upstream and downstream scope 3 categories. Table 5.10 provides a description and examples for each scope 3 category.

For product-related scope 3 categories, the scope 3 boundary for purchased and sold products includes all attributable processes in the life cycle of the product, following the scope 3 category boundaries defined in chapter 5 of the *Scope 3 Standard*.

Table 5.10 Examples of scope 3 categories for different land sector reporting entities

Scope 3 Category		Description	Examples
1	**Purchased goods and services**	All upstream (cradle-to-gate) emissions that occur in the life cycle of purchased goods and services purchased or acquired by the reporting company in the reporting year, up to the point of receipt by the reporting company (not otherwise included in Categories 2–8). Cradle-to-gate emissions may include: extraction of raw materials, agricultural activities, manufacturing, production, and processing, generation of electricity consumed by upstream activities, disposal/treatment of waste generated by upstream activities, land management and land-use change, transportation of materials and products between suppliers, and any other activities prior to acquisition by the reporting company.	Cradle-to-gate emissions of producing purchased food, feed, fertilizer, agrichemicals, forest products, bioenergy (biogas, biofuels, biomass), etc. Cradle-to-gate emissions from biogenic materials includes: • Land-use change emissions, including: biogenic CO_2 emissions due to carbon stock decreases occurring as a result of land conversion within or between land use categories; biogenic and non-biogenic CO_2, N_2O, and CH_4 emissions resulting from the preparation of converted land, such as biomass burning or liming • Land management emissions from attributable processes associated with agricultural and forestry practices such as growth, fertilizer application, cultivation, and harvesting. For example, rice cultivation produces CH_4 emissions that would be included in the inventory of a rice product. • All other cradle-to-gate emissions Land management net removals from attributable processes associated with producing agricultural and forestry products purchased by the reporting company.
2	**Capital goods**	All upstream (cradle-to-gate) emissions of purchased capital goods from the extraction, production, and transportation of capital goods	Cradle-to-gate emissions associated with producing farm machinery and equipment

		purchased or acquired by the reporting company in the reporting year.	
3	**Fuel- and energy-related activities**	Extraction, production, and transportation of fuels and energy purchased or acquired by the reporting company in the reporting year, not already accounted for in scope 1 or scope 2.	Upstream emissions of purchased biofuels/biogas (i.e., cradle-to-gate emissions of purchased fuels, from raw material extraction up to the point of, but excluding combustion), including land use change and land management emissions Upstream emissions of purchased electricity generated from biomass (i.e., cradle-to-gate emissions of purchased fuels, from raw material extraction up to the point of, but excluding combustion), including land use change and land management emissions Net biogenic removals with geologic storage where the reporting company purchases electricity, steam, heating or cooling from a bioenergy facility that captures biogenic CO_2 and stores the CO_2 in geologic reservoirs (i.e., BECCS)
4	**Upstream transportation and distribution**	Transportation and distribution of products purchased by the reporting company in the reporting year between a company's tier 1 suppliers and its own operations; transportation and distribution services purchased by the reporting company, including inbound logistics, outbound logistics (e.g., of sold products), and transportation and distribution between a company's own facilities	Landowner contracts for the transportation of harvested wood to local saw mills Farm machinery manufacturer pays for the transportation of raw materials and components to their facility
5	**Waste generated in operations**	Disposal and treatment of waste generated in the reporting company's operations in the reporting year (in facilities not owned or controlled by the reporting company)	Food processing company sends waste agricultural inputs to a waste management site operated by a third party for disposal Pulp and paper facility sends wastewater residual to third party landfill
6	**Business travel**	Transportation of employees for business-related activities during the reporting year (in vehicles not owned or operated by the reporting company)	Employee air travel
7	**Employee commuting**	Transportation of employees between their homes and their worksites during the reporting year (in vehicles not owned or operated by the reporting company)	Employee commuting or telework
8	**Upstream leased assets**	Operation of assets leased by the reporting company (lessee) in the reporting year and not included in scope 1 and scope 2 (reported by lessee)	Tenant farmer has an operational lease for lands that they are farming but uses an equity share organizational boundary approach
9	**Downstream transportation**	Transportation and distribution of products sold by the reporting company in the reporting year between the reporting company's operations and the	Direct air capture company sells captured CO_2 to a third party that transports that CO_2 to a final storage site

	and distribution	end consumer (if not paid for by the reporting company), including retail and storage (in vehicles and facilities not owned or controlled by the reporting company)	
10	**Processing of sold products**	Processing of intermediate products sold in the reporting year by downstream companies (e.g., manufacturers)	Emissions at downstream facilities where biogenic or technologically removed carbon products are processed (e.g., sawmill, pulp and paper facility, processed food manufacturer, textile company)
11	**Use of sold products**	End use of goods and services sold by the reporting company in the reporting year	N_2O emissions from use of fertilizer sold by a fertilizer producer Combustion of sold products by end users Net removals with product storage in biogenic or TCDR-based products sold by the reporting company *(subject to open question #2, chapter 6, box 6.3).*
12	**End-of-life treatment of sold products**	Waste disposal and treatment of products sold by the reporting company (in the reporting year) at the end of their life	Methane emissions from disposal of biogenic products at the end-of-life
13	**Downstream leased assets**	Operation of assets owned by the reporting company (lessor) and leased to other entities in the reporting year, not included in scope 1 and scope 2 (reported by lessor)	Land management emissions on farmland leased by the landowner to a tenant Land management net removals on farmland leased by the landowner to a tenant
14	**Franchises**	Operation of franchises in the reporting year, not included in scope 1 and scope 2 (reported by franchisor)	A restaurant chain franchisor reports on emissions associated with a franchisee's operations.
15	**Investments**	Operation of investments (including equity and debt investments and project finance) in the reporting year, not included in scope 1 or scope 2	A financial institution invests in agricultural and farmland that is not included within its scope 1 or scope 2 boundary. Net removals with geologic storage where the reporting company invests in technological CO_2 removal and geologic storage facilities (but does not operate the facilities, and uses the operational control consolidation approach)

Source: Adapted from *Scope 3 Standard*

5.4.4 Scopes and double counting

Scope 1, scope 2, and scope 3 are mutually exclusive for the reporting company, so that there is no double counting of emissions or removals between the scopes within one company's inventory. For example, a company's scope 3 inventory does not include any emissions or removals already accounted for as scope 1 by the same company.

Scope 1 and scope 2 are defined to ensure that two or more companies do not account for the same emissions within scope 1 or scope 2. However, counting the same emission or removal in two company's scope 1 inventories can occur if land is owned by one entity but operated by another and the two entities use different consolidation approaches. Companies should strive to avoid this form of double counting, especially for removals, by following the guidance in section 5.2.2.

By definition, scope 3 emissions or removals occur from sources or sinks and pools owned or controlled by other entities in the value chain (e.g., raw material suppliers, waste management companies, lessees and lessors, distributors, retailers, customers, etc.). As a result, it is expected that across different reporting entities a given emission or removal will be counted more than once across the scopes (i.e., as one entity's scope 1 emissions or removals and another entity's scope 3 emissions or removals).

Counting the same emission or removal between scopes is an inherent part of requiring that companies consider not only direct but also indirect impacts in their GHG inventory. For example, a farmer reports emissions from farm operations as scope 1, while the consumer of agricultural products reports those same emissions under scope 3, category 1. Accounting for direct and indirect impacts helps enable a broader range of companies to take accountability for and look for opportunities to reduce emissions and increase removals across the value chain.

As a result, scope 3 emissions or removals should not be aggregated across companies to determine the total emissions or removals in a given region. Note that while a single emission or removal may be accounted for by more than one company as scope 3, in certain cases the emission or removal is accounted for by each company in a different scope 3 category. Companies should follow the definitions of scope 3 categories from the Scope 3 Standard to avoid overlap between scope 3 categories.

To ensure transparency and avoid misinterpretation of data, companies should acknowledge any potential double counting of emission reductions or removals when making claims about scope 3 reductions or removals. For example, a company may state that it is working with partners to reduce emissions or increase removals, rather than taking exclusive credit for scope 3 reductions or removals.

Unlike the above cases, double counting must be avoided if GHG reductions or removals take on a monetary value or receive credit in a GHG reduction program. Double counting must be avoided for offset credits or other market instruments that convey unique claims to GHG reductions or removals if they are used for offsetting or compensation. To avoid double crediting, companies should specify the exclusive ownership of reductions through contractual agreements. See chapters 12 and 13 for more information on avoiding double counting of credits, including adjusting emissions and removals for sold credits when accounting for progress toward targets.

6

Removal Accounting

Chapter 6: Removal Accounting

Requirements and Guidance

This chapter includes guidance and requirements companies must follow to account for and report CO_2 removals in a GHG inventory. This chapter includes requirements to meet the permanence principle and to balance tradeoffs between accuracy and conservativeness principles, described in chapter 3. Removals are optional to be reported in a GHG inventory.

Companies should refer to chapter 4 for an overview of removals and carbon pools, chapter 5 for scopes definitions for removals, and chapters 8, 9, and 10 for additional requirements and guidance for removals by carbon pool.

Sections in this chapter

Section	Description
6.1	Introduction to removal accounting
6.2	CO_2 removal requirements

Checklist of accounting requirements in this chapter

Section	Accounting requirements
6.1	Reporting removals is optional. If companies account for removals in their GHG inventory, companies **shall**: • Separately account for and report removals based on their sink process (i.e., biogenic or technological sinks) and storage pool (i.e., land-based storage, product storage, or geologic storage). • Account for scope 1 removals and scope 3 removals (if applicable) based on annual net carbon stock changes occurring in the reporting year using stock-change accounting methods *(subject to open question #1 chapter 5, box 5.2)*
6.2	Companies may account for and report scope 1 or scope 3 CO_2 removals only if the following requirements are met: • Ongoing storage monitoring: Companies **shall** account for and report removals only if there is ongoing storage monitoring of the relevant carbon pool(s), as specified through a monitoring plan, to demonstrate that the carbon remains stored or to detect losses of the stored carbon. • Traceability: Companies **shall** account for and report removals only if the reporting company has traceability throughout the full CO_2 removals pathway, including to the sink (where CO_2 is transferred from the atmosphere to non-atmospheric pools), to the carbon pools where the carbon is stored, and to any intermediate processes if relevant. • Primary data: Companies **shall** account for and report removals only if the net carbon stock changes are accounted for using empirical data specific to the sinks and pools where carbon is stored in the reporting company's operations or value chain.

- Uncertainty: Companies **shall** account for and report removals only if the removals are statistically significant and companies provide quantitative uncertainty estimates for removals, including 1) the removal value, 2) the uncertainty range for the removal estimate based on a specified confidence level, and 3) justification of how the selected value does not overestimate removals.
- Reversals accounting:
  - Companies **shall** account for and report net carbon stock losses of previously reported removals in the year the losses occur, as either
    - Net CO_2 emissions, if the carbon pools are part of the GHG inventory boundary in the reporting year, or
    - Reversals, if the carbon pools are no longer in the GHG inventory boundary in the reporting year.
  - If companies lose the ability to monitor carbon stocks associated with previously reported removals, companies **shall** assume previously reported removals are emitted and report reversals.

6.1 Introduction to removal accounting

6.1.1 Types of CO_2 removals

As described in chapter 4, CO_2 removals are classified according to both the sink (which transfers CO_2 from the atmosphere to non-atmospheric pools) and the carbon pool where the removal is stored (which keeps CO_2 or carbon out of the atmosphere).

Accounting requirement
If companies account for removals in their GHG inventory, companies **shall** separately account for and report removals based on their sink process (i.e., biogenic or technological sinks) and storage pool (i.e., land-based, product, or geologic storage).

There are two general types of sinks that remove CO_2 from the atmosphere: biogenic and technological.

- **Biogenic CO_2 removals** are CO_2 removals resulting from atmospheric CO_2 transferred via biological sinks, primarily photosynthesis, to storage in biogenic carbon pools.
- **Technological CO_2 removals** are CO_2 removals resulting from atmospheric CO_2 transferred via technological sinks to storage in TCDR-based product or geologic carbon pools.

There are three general types of storage processes: land-based, product and geologic storage.[38] Storage processes are specific to the carbon pool(s) in which CO_2 removed from the atmosphere is stored. Table 6.1 provides a summary of the removal accounting subcategories by sink and storage types.

- **Land management net removals** are net CO_2 removals resulting from annual net increases to carbon stored in land-based carbon pools (including biomass, dead organic matter and soil carbon pools) due to land management. All land management net removals are from biogenic sinks.

[38] This excludes ocean-based and freshwater-based carbon storage which is not addressed in this Guidance.

- **Net removals with product storage** are net CO_2 removals resulting from annual net increases to carbon stored in product carbon pools from carbon derived from biogenic or technological CO_2 sinks.
- **Net removals with geologic storage** are net CO_2 removals resulting from annual net increases to carbon stored in geologic carbon pools from carbon derived from biogenic or technological CO_2 sinks.

Only the CO_2 removed from the atmosphere that is ultimately transferred to storage in a carbon pool is accounted for as a removal.[39] Similarly, only carbon stored in carbon pools that originated from atmospheric CO_2 in the reporting year (i.e., biogenic carbon or technologically removed carbon) is accounted for as a removal. (See section 6.1.3 for more information on time considerations).

Table 6.1 Removal accounting subcategories

Sink	Storage	Accounting subcategory	Examples
Biogenic	Land-based carbon pools	Land management net removals	Biomass carbon stock increases on forest lands; soil carbon stock increases on croplands
	Product carbon pools	Net biogenic removals with product storage *(subject to open question #2, box 6.3)*	Increases to the total carbon stock stored in wood products sold by a reporting company in the use phase or end-of-life phase.
	Geologic carbon pools	Net biogenic removals with geologic storage	Bioenergy carbon capture and geologic storage (BECCS)
Technological	Product carbon pools	Net technological removals with product storage *(subject to open question #2, box 6.3)*	Increases to the total carbon stock stored in direct air capture-based cement or plastics sold by a reporting company in the use phase or end-of-life phase
	Geologic carbon pools	Net technological removals with geologic storage	Direct air carbon capture and geologic storage (DACCS)

6.1.2 Accounting for net and gross CO_2 removals

Biogenic and TCDR carbon cycle pathways include both removals and emissions (chapter 4). These carbon cycle pathways can be accounted for using stock-change accounting (based on net CO_2 fluxes) or flow accounting (based on gross CO_2 fluxes). See table 6.2 for a comparison of gross removals and net removals.

As explained in chapter 5, companies are required to account for and report all scope 1, scope 2 and scope 3 emissions. Companies may account for and report scope 1 and scope 3 removals, if relevant to their operations or value chain.

[39] Losses that occur in the process of capturing and storing CO_2 within the reporting company's operations are not accounted for as removals, since they are not transferred to storage within a carbon pool (e.g., fugitive CO_2 emissions at direct air capture facilities).

Table 6.2 Net removals vs gross removals

Term	Involves transfer of CO_2 from atmosphere	Involves storage in carbon pools	Reported as scope 1 removals or scope 3 removals	Examples
Gross removal	Yes	No	No	• Plant growth • Direct air capture
Net removal	Yes	Yes	Yes (subject to removals requirements)	• Plant growth with land-based carbon storage • Direct air capture with geologic storage

Stock-change accounting for net CO_2 removals

This Guidance adopts a stock-change accounting approach for removals, which quantifies net CO_2 removals based on annual net carbon stock increases within land-based, product and/or geologic carbon pools. This is synonymous with enhanced carbon storage in carbon pools (where the carbon is derived from atmospheric CO_2). The net carbon stock change can be estimated using either the stock-difference method or the gain-loss method, as further described by land-based, product or geologic carbon pools (see chapters 8, 9 and 10).

Scope 1 removals and scope 3 removals are accounted for as net CO_2 removals using stock-change accounting, subject to open question #1 (chapter 5, box 5.2).

Accounting requirement
If companies account for removals in their GHG inventory, companies **shall** account for scope 1 removals and scope 3 removals (if applicable) based on annual net carbon stock changes occurring in the reporting year using stock-change accounting methods.

Throughout this Guidance, any requirements or guidance for "removals" accounting and reporting refers to net removals based on stock-change accounting. Any reference to flow accounting of removals will specifically refer to "gross removals" or "gross CO_2 removals". If the term "removal" is used without qualification (net vs. gross), the term "removal" refers to "net CO_2 removal" based on stock-change accounting.

Flow accounting for gross CO_2 removals

Flow accounting quantifies annual gross CO_2 removals based on the one-directional gross CO_2 flux from the atmosphere to land-based, product or geologic carbon pools. Accounting for and reporting gross CO_2 fluxes can help to ensure complete accounting of net carbon stock changes and provide transparency as to the individual gross CO_2 fluxes that contribute to the net carbon stock change. Box 6.1 provides guidance on accounting for gross biogenic CO_2 removals and gross technological CO_2 removals.

Reporting gross CO_2 fluxes is optional and includes accounting for both gross CO_2 removals and gross CO_2 emissions within the company's value chain. Gross CO_2 removals (based on flow accounting) may not be reported as scope 1 removals or scope 3 removals. Companies may separately report gross CO_2 removals under the gross CO_2 removal reporting category for transparency. However, gross CO_2 removals may not be combined or aggregated with GHG emissions or net CO_2 removals.

Box 6.1 Flow accounting for gross biogenic CO_2 removals and gross technological CO_2 removals

Gross biogenic CO_2 removals

Gross biogenic CO_2 removals are accounted for using flow accounting to estimate the gross transfer of CO_2 from the atmosphere to biogenic carbon pools. Chapter 8 contains guidance on land management carbon accounting, with calculation guidance on the various methods to estimate gross biogenic CO_2 removals provided in chapter 18. Chapters 9 and 10 contain guidance on accounting for biogenic carbon stored in product and geologic carbon pools.

Gross technological CO_2 removals

Gross technological CO_2 removals are accounted for using flow accounting to estimate the gross transfer of CO_2 from the atmosphere to TCDR-based product carbon pools or geologic carbon pools. Chapters 9 and 10 contain guidance on accounting for technologically removed CO_2 stored in product and geologic carbon pools. Annex A provides methods to estimate gross technological CO_2 removals and emissions associated with technological removal processes.

6.1.3 Applying the permanence principle

This Guidance uses a storage monitoring framework to account for the non-permanence risk associated with CO_2 removals. This section provides background on the climate impacts of CO_2 removals and why a storage monitoring framework is needed to implement the permanence principle. It also explains the time boundary of CO_2 removals accounted for in annual inventories.

Climate impacts of CO_2 removals

The ability to stay within the global carbon budget and limit overall warming is determined by cumulative emissions to the atmosphere (see box 6.2 for more information).

When CO_2 is removed from the atmosphere and continues to be stored in a carbon pool, it contributes to reducing cumulative net CO_2 emissions. When CO_2 removed from the atmosphere is only temporarily stored in a carbon pool, it does not reduce cumulative net CO_2 emissions since it is re-emitted in the future, unless the overall carbon stock of that pool remains constant or increases over time.[40]

This Guidance uses a storage monitoring framework to implement the permanence principle (see chapter 3, section 3.2). A storage monitoring framework ensures mechanisms are in place to:

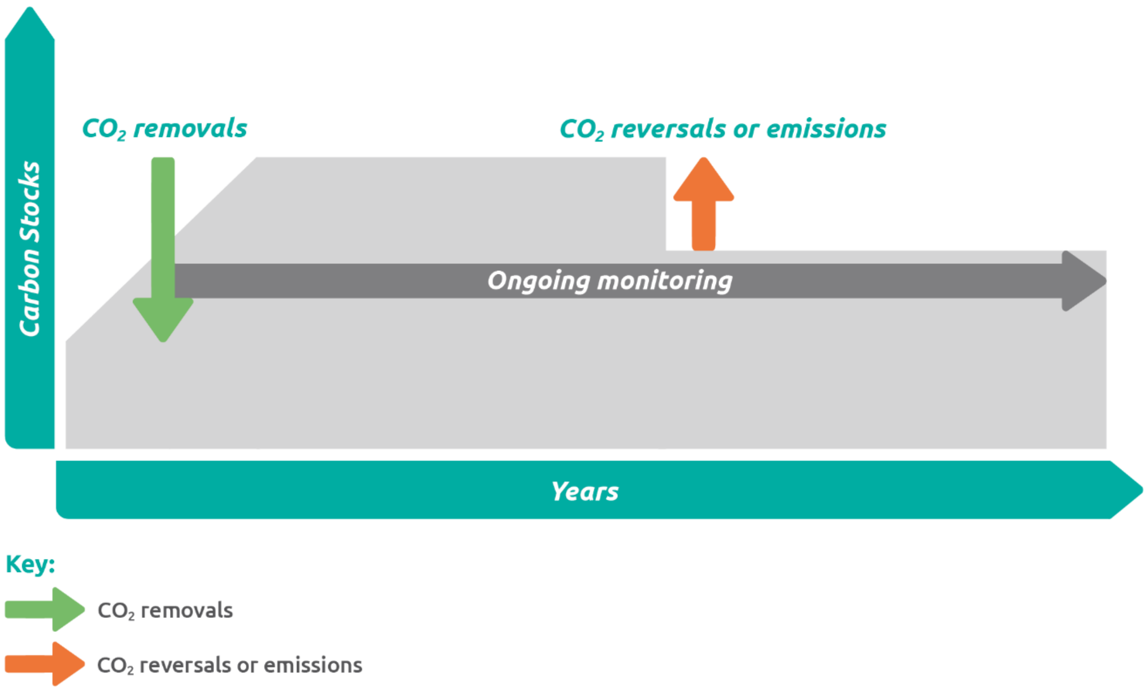
- demonstrate that carbon remains stored in carbon pools associated with CO_2 removals, and
- account for net carbon stock losses in such carbon pools if they occur and report such losses as emissions or reversals in future inventory years.

[40] When accounted for as an aggregate carbon pool with ongoing storage monitoring, temporary storage can contribute to reducing cumulative net CO_2 emissions if the net carbon change increases across all individual pools. For example, if the annual carbon stock gains to the product carbon pool associated with biogenic product sold by a company are greater than the carbon stock losses from combustion, decomposition or other emissions from their products, there is a reduction in atmospheric CO_2 equivalent to the net biogenic product carbon stock increase in that year.

Figure 6.1 illustrates the storage monitoring framework for a carbon pool. In the initial years, a company accounts for annual increases in the carbon stock as removals. Through ongoing storage monitoring, the company accounts for the carbon stored in the carbon pool over time. In later years, the carbon stock declines. The annual carbon stock decrease is accounted for either as CO_2 emissions or reversals, depending on whether the activity is still in the inventory boundary of the reporting company when the carbon stock losses occur (further described in section 6.2.5).

This Guidance implements the storage monitoring framework through a set of requirements for reporting removals (provided in section 6.2).

Figure 6.1 Representation of a storage monitoring framework



An alternative to the storage monitoring framework is a storage discounting framework that uses dynamic carbon accounting methods to account for temporary carbon storage. Dynamic carbon accounting methods can be used to evaluate the impact on atmospheric radiative forcing of temporarily storing carbon in land-based, product or geologic carbon pools. Such estimates are then used to discount the total quantity of carbon stored to reflect the climate impact of temporary carbon storage relative to a selected time horizon (see box 6.2 for details). Companies may separately account for temporary storage using dynamic methods and report such impacts outside the scopes, subject to open question #2 on the preferred methods to account for *Net removals with product storage* (see box 6.3).

Box 6.2 Climate impacts of removing and storing carbon

Overview and need for storage monitoring framework

The human-induced increase in global average temperature is caused by cumulative greenhouse gas emissions in the atmosphere. Once CO_2 is emitted to the atmosphere, a proportion of the emission leaves the atmosphere through natural processes such as plant growth or absorption by the oceans. However, a proportion stays in the atmosphere for millennia. The resulting accumulation of greenhouse gases causes long-term warming.

Cumulative CO_2 emissions, and therefore long-term temperature change, is largely independent of when emissions occur. Whether an emission happens now or in 500 years' time, it will contribute the same amount to cumulative emissions and long-term warming. This fact underpins the idea of a global 'carbon budget', that there is a fixed amount of carbon or 'budget' that can be emitted before a given temperature change limit is exceeded (such as the 1.5°C and well below 2°C targets of the Paris Agreement).

The fact that CO_2 can persist in the atmosphere for thousands of years, and that long-term temperature change is caused by cumulative CO_2 emissions, has important implications for understanding the relevant timescales for the storage of CO_2 removed from the atmosphere.

If the removed carbon is stored in non-atmospheric carbon pools for less than millennial timescales (e.g., 100 years) and there are no additional CO_2 removals to maintain the net carbon stocks in that pool, it will not contribute to lowering cumulative CO_2 emissions. 1 t CO_2 removal + 1 t CO_2 release of stored carbon = 0 t CO_2 contribution to lowering cumulative emissions.

A storage monitoring framework, which ensures ongoing monitoring of stored carbon and reporting of emissions or reversals where carbon losses occur, can accurately reflect the impact of CO_2 removals on cumulative CO_2 emissions and thus long-term temperature change.

Dynamic carbon accounting methods and temporary carbon storage

Dynamic carbon accounting methods aim to measure the climate impact of removing CO_2 from the atmosphere and temporarily storing carbon, or delaying the emission of CO_2, by estimating the impacts to atmospheric radiative forcing within a selected time horizon.

A 100-year time horizon is generally used to calculate global warming potential (GWP) values that compare non-CO_2 GHG emissions to CO_2 emissions in terms of CO_2 equivalent. This same time horizon is sometimes applied to dynamic carbon accounting methods to justify that after 100 years, emissions of stored carbon associated with removals no longer need to be accounted for. However, if a GHG inventory is to accurately represent an entity's contribution to cumulative CO_2 emissions and long-term temperature change, then all CO_2 emissions and removals must be counted equally, regardless of when they occur. For example, if a removal is reported in 2025 but the subsequent emissions are discounted or omitted because they occur in 2125, the accounts will understate the reporting entity's contribution to cumulative CO_2 emissions. When calculating GWP values, the use of a selected time horizon is necessary to compare the radiative forcing effects of non-CO_2 gases to CO_2. However, to quantify the effect of CO_2 emissions and removals on cumulative CO_2 emissions, it would be inaccurate to apply a limited time horizon or discount CO_2 emissions or removals based on when they occur.

Temporarily storing removed CO_2 still has important benefits as it delays the accumulation of emissions in the atmosphere. It can also reduce the rate of warming that occurs, and cumulative radiative forcing, which is important for limiting impacts such as sea level rise.[41] This 'buys time' for the development and deployment of other climate change mitigation options, including options for permanent storage. It also gives more time for society and natural ecosystems to adapt to climate change, because both the absolute temperature increase and the speed of change matter. It is therefore important that GHG inventories provide information on the timing of removals and subsequent emissions, which can be achieved through a storage monitoring framework of annual net carbon stock changes through an annual GHG inventory.

1

[41] Brandao et al., 2013

Box 6.3 Open question #2 Removals with product storage

The draft Guidance is based on a stock-change accounting approach, applied through a storage monitoring framework to implement the permanence principle for all carbon pools (land carbon pools, geologic carbon pools, and biogenic and TCDR-based product carbon pools). Under this approach, net emissions and net removals (based on stock-change accounting and subject to meeting the requirements for reporting removals) are included in the scopes.

Alternatively, companies may use storage discounting frameworks (e.g., dynamic methods such as tonne-year methods) which quantify the radiative forcing impact of delaying CO_2 emissions until the end of storage period and report them under a separate reporting category “temporary product carbon storage” outside the scopes.

During the pilot testing and review phase, we would like to gain practical experience with data/methods and understand the implications of the options to determine whether the current approach should be maintained or alternative approaches should be pursued in the final guidance.

We invite pilot testers to pilot test different approaches in order to learn about the feasibility and implications of each approach to inform the final decision.

Questions:

1. Should net product carbon stock changes, accounted for using a storage monitoring framework, be reported in scope 3 or outside the scopes in a separate reporting category?
    - In this case, net increases in product carbon stocks are reported as removals with biogenic or TCDR-based product storage, and net decreases in product carbon stocks are reported as net CO_2 emissions from biogenic or TCDR-based product storage.
2. Should removals with product storage, accounted for using a storage discounting framework, be reported outside the scopes in a separate reporting category (as temporary product carbon storage)? Or should other metrics be used to report on product storage and longevity?

Time boundary of removals

All removals are accounted for based on annual net carbon stock changes occurring in the reporting year (outlined in chapter 5, table 5.9).

Scope 1 removals (i.e., removals where both the sink process and storage pool are owned/controlled by the reporting company) are reported for the reporting year when the net carbon stock increase occurs. Companies are required to report any annual net carbon stock losses associated with previously reported scope 1 removals with ongoing monitoring of carbon stocks. Losses are reported either as scope 1 emissions or reversals in the reporting year when they occur (detailed in section 6.2.5).

Scope 3 removals are reported in the reporting year when the net carbon stock increase occurs in carbon pools relevant to a company’s value chain. Through ongoing monitoring of carbon stocks, companies are required to report any annual net carbon stock losses associated with previously reported scope 3 removals. Losses are reported as either scope 3 emissions or reversals in the reporting year when they occur (detailed in section 6.2.5).

For example, a paper company could account for Scope 3 *Land management net removals* associated with the wood they purchased in 2020 based on the net land carbon stock changes in the relevant forest lands in 2020 to estimate CO_2 removals. If ongoing monitoring later reveals net forest carbon stock decreases for the company in 2021, they would account for and report such losses as Scope 3 *Land management net CO_2 emissions* in 2021.

6.2 CO_2 removal requirements

This Guidance includes a set of requirements to account for and report CO_2 removals in a GHG inventory. The requirements are based on the principles underlying corporate GHG inventory accounting (see box 6.4). These requirements are needed to implement the permanence principle (using a storage monitoring framework) and to balance the accuracy and conservativeness principles.

Companies **shall** meet the five requirements provided in table 6.3 to account for and report scope 1 or scope 3 CO_2 removals. The requirements must be met in the reporting year as well as in future years. Guidance on each requirement is provided in the sections below.

Companies should have their GHG inventories third-party assured to verify that the requirements and criteria are met (detailed in chapter 15).

Table 6.3 CO_2 removal requirements

Criteria	Requirement
Ongoing storage monitoring	Companies **shall** account for and report removals only if there is ongoing storage monitoring of the relevant carbon pool(s), as specified through a monitoring plan, to demonstrate that the carbon remains stored or to detect losses of the stored carbon.
Traceability	Companies **shall** account for and report removals only if the reporting company has traceability throughout the full CO_2 removals pathway, including to the sink (where CO_2 is transferred from the atmosphere to non-atmospheric pools, e.g., forest where trees are growing or direct air capture facility removing atmospheric CO_2), to the carbon pools where carbon is stored (e.g., farms where increased soil carbon storage occurs, markets where long-lived products are used and their end-of-life treatment occurs, or geologic reservoirs), and to any intermediate processes, if relevant.
Primary data	Companies **shall** account for and report removals only if the net carbon stock changes are accounted for using empirical data specific to the sinks and pools where carbon is stored in the reporting company's operations or value chain.
Uncertainty	Companies **shall** only account for and report statistically significant removals and provide quantitative uncertainty estimates for removals including: 1) the removal value, 2) the uncertainty range for the removal estimate based on a specified confidence level, and 3) justification for how the selected value does not overestimate removals.
Reversals accounting	Companies **shall** account for and report net carbon stock losses of previously reported removals in the year they occur, as either • Net CO_2 emissions, if carbon pools are part of the GHG inventory boundary in the reporting year, or • Reversals, if carbon pools are no longer in the GHG inventory boundary in the reporting year.

	If companies lose the ability to monitor carbon stocks associated with previously reported removals, companies **shall** assume previously reported removals are emitted and report reversals.

Box 6.4 Relationship of CO_2 removals requirements to GHG accounting and reporting principles

The GHG Protocol *Corporate Standard* and *Scope 3 Standard* are based on five principles that underpin corporate-level GHG emissions accounting: relevance, completeness, consistency, accuracy, and transparency. This Guidance introduces two additional principles (see chapter 3) that underpin corporate-level GHG removals accounting: permanence and conservativeness.

The storage monitoring framework in this chapter operationalizes the permanence principle through the following CO_2 removals requirements:

- Traceability (to ensure companies have visibility to the specific pools where carbon is stored)
- Ongoing storage monitoring (to detect any future net carbon stock losses, if they occur, from the carbon pools storing the removed CO_2)
- Reversals accounting (to ensure that that the climate impact of carbon losses from previously removed CO_2 is accounted for, reported as an emission or reversal in future inventories and used to track progress towards targets)

The principles of accuracy and conservativeness are interrelated: companies should strive to achieve accurate results but use conservative assumptions when improving accuracy is not possible. Removals must also meet the conservativeness principle to be accounted for in a GHG inventory. This chapter operationalizes the accuracy and conservativeness principle through the following CO_2 removals requirements:

- Primary data (to ensure accuracy and representativeness of quantified carbon stock changes based on primary data specific to the relevant carbon pools so as not to overestimate removals)
- Uncertainty (to meet minimum uncertainty levels and to use conservative assumptions where uncertainty is high)

6.2.1 Ongoing storage monitoring

Accounting requirement
Companies **shall** account for and report removals only if there is ongoing storage monitoring of the relevant carbon pool(s), as specified through a monitoring plan, to demonstrate that the carbon remains stored or to detect losses of the stored carbon.

Ongoing storage monitoring ensures a complete and closed accounting system where continued storage can be accounted for and any reversals from previously reported removals are identified, accounted for and reported as emissions or reversals in the year they occur.

Companies can use a variety of data sources to support ongoing monitoring of carbon stock changes including the following:

- Carbon stock change data from value chain partners (e.g., farmers, forest managers, geologic storage operators, etc.)
- Sampling-based approach or ground-based inventories within relevant spatial boundaries
- Remote sensing of land management practices within relevant spatial boundaries
- Statistical data through surveys of relevant land management practices or product end users relevant to carbon pools storing carbon
- Carbon stock change data or data on management practices from certification programs relevant to carbon pools storing carbon

Companies should use annual data on carbon stock change or can annualize data from longer monitoring frequencies up to every five years. If using model-based or remote sensing-based approach to support ongoing storage monitoring, the model should be verified with primary data at minimum once every five years.

For scope 3 removals accounting, ongoing storage monitoring can be managed by a single entity (e.g., the land manager, geologic storage operator or downstream company) or multiple entities (e.g., a supply chain coalition consisting of farmers, distributors, food processers, retailers or other relevant third parties supporting GHG accounting) to facilitate the exchange of monitoring information, standardize data, and increase efficiencies between all relevant companies and partners in the value chain (see chapters 8, 9 and 10 for ongoing storage monitoring guidance by storage type).

6.2.2 Traceability

Companies accounting for and reporting CO_2 removals need to identify the specific carbon pools relevant to their operations or value chain. The specific pools need to be identified to account for the initial net carbon stock increases and demonstrate continued storage through ongoing storage monitoring to detect net carbon stock losses in such carbon pools. A company's traceability to these carbon pools enables the company to accurately reflect carbon stock changes relevant its operations or value chain. Traceability refers to the ability of a company to identify, track, and collect information on activities in its value chain, across its upstream and downstream processes and products.

For scope 1 removals, the reporting company is the entity that owns or controls both the sink and the pools that store carbon. Therefore, the reporting company will have traceability to both the specific sink and pools where carbon is stored.

Accounting requirement

For scope 3 removals, companies **shall** account for and report removals only if the reporting company has traceability throughout the full CO_2 removals pathway, including to the sink (e.g., forest where trees are growing or direct air capture facility removing atmospheric CO_2), to the carbon pools where carbon is stored (e.g., farms where increased soil carbon storage occurs, markets where long-lived products are used and their end-of-life treatment occurs, or geologic reservoirs), and to any intermediate processes, if relevant.

Companies may use third party assurance providers or other programs to ensure traceability where they may not have direct access to all the relevant information (e.g., through third party certification programs).

See chapters 8, 9 and 10 for ongoing storage monitoring guidance by storage type. Chapter 16 provides guidance on improving traceability within scope 3 accounting.

6.2.3 Primary data

Primary data refers to data from specific activities within a company's operations or value chain in which the CO_2 removals occur. This data is essential to provide accurate estimates of CO_2 removals and the associated uncertainty.

Accounting requirement

Companies **shall** account for and report removals only if the net carbon stock changes are accounted for using empirical data specific to the sinks and pools where carbon is stored in the reporting company's operations or value chain.

Primary data on net carbon stock changes should consist of direct measurements, through sampling-based approaches or inventories, of the carbon stocks within the company's operations or value chain, or model-based or remote sensing-based approaches calibrated using direct measurements (see chapter 16 for calibration guidance).

Some secondary data may be used to support the calculations of carbon stock change estimates. For example, forest carbon stock changes may be estimates using primary data on amount of wood harvested, area experience disturbance events, and growth rates specific to the forest management unit, and secondary data on the wood densities, root to shoot ratios and carbon content of biomass.

Any secondary data used to support calculations should be technologically, temporally, and geographically representative. Secondary data should also be based on peer-reviewed scientific literature, government statistics, or reports published by international institutions confirming the estimated value and associated uncertainty over multiple studies (see chapters 8, 9 and 10 for additional guidance on primary data considerations by storage type).

Chapter 16 provides further guidance on data types and data collection.

6.2.4 Uncertainty

There is an inherent uncertainty associated with measuring annual net carbon stock changes. Therefore, when accounting for removals, quantitative estimates of uncertainty are needed to balance tradeoffs between the GHG accounting principles of accuracy and conservativeness.

Accounting requirement

Companies **shall** account for and report removals only if the removals are statistically significant and companies provide quantitative uncertainty estimates for removals, including:

1) the removal value,
2) the uncertainty range for the removal estimate based on a specified confidence level, and
3) justification for how the selected value does not overestimate removals.

Uncertainty can be comprised of the following general sources:

- **Conceptualization uncertainty**: Lack of knowledge of the true value due to assumptions about the system (e.g., use of managed land proxy to assume all carbon stock changes on managed land are anthropogenic or the selected spatial boundary based on traceability to estimate net land carbon stock change relevant to company's scope 3 activities), lack of completeness (e.g., exclusion of certain carbon pools) or bias from the use of proxy data or other data not fully representative of the system to help fill data gaps.

- **Methodological uncertainty**: Lack of knowledge of the true value due to bias and random error in the methods or model used to estimate the value, random error in the methods used to extrapolate or interpolate missing data, and random errors in the statistical methods used to propagate input data uncertainty.
- **Input data uncertainty:** Lack of knowledge of the true value due to the inherent variability of the system being quantified, random errors based on sampling or inventory design, random errors from measurement technique or calibration, and random errors or bias in uncertainty estimates obtained from expert judgment.

Quantitative uncertainty analysis can be used to evaluate random errors based on the variability inherent to a system, sample size of data collection, random errors from measurement techniques or calibration, and random components of uncertainty obtained from expert judgment.

Other components of uncertainty can be much more difficult to quantify, such as systematic errors that may arise because of imperfections in conceptualization, models, measurement techniques, or other human-induced error associated with the systems for collecting, recording and analyzing the data.[42]

Companies should, to the extent possible, document all causes of uncertainties that are likely to be addressed through a quantitative uncertainty analysis. This includes documenting if some causes of uncertainties have not been included and the steps taken to reduce the uncertainty.

Companies can conduct a quantitative uncertainty analysis to determine an uncertainty range, test for statistical significance and select a conservative removal value by applying the steps in table 6.4.

Table 6.4 Steps to determine uncertainty range, statistical significance, and conservative removal values

Step	Description
1. Propagate uncertainty from input data	Quantitative uncertainty estimates for input data used to estimate the annual net carbon stock changes should follow IPCC national inventory guidance on data collection and uncertainty quantification[43], national guidance for uncertainty reporting[44], or peer-reviewed statistical methods for estimating uncertainty. Where there are no uncertainty estimates for the input data underlying CO_2 removal estimates, companies should report on assumed uncertainty in the underlying data based on best available data or expert judgment. Uncertainty estimates from input data should be combined using error propagation, Monte Carlo simulations or other peer-reviewed statistical methods for estimating uncertainty. Uncertainty in the estimate of the annual net carbon stock change can be represented by a probability density function, which supports reporting on the uncertainty range and statistical testing as described in steps 2 and 3. A probability density function represents the range and relative likelihood of possible values for the estimated value

[42] IPCC, 2006 (Volume 1, Chapter 3)

[43] IPCC, 2019b (Volume 1, Chapters 2 and 3)

[44] USDA, 2014

	(e.g., net carbon stock change) based on error propagation of uncertainties in the input data.
2. Determine the confidence level and uncertainty range	An uncertainty range is the range of possible values for a specified confidence level that contains the true value for the estimate. To determine an uncertainty range associated with the CO_2 removals estimate, companies must first specify a confidence level (e.g., a removal estimate of 100 t CO_2e may have an uncertainty range of 92 to 108 t CO_2e based on a 95% confidence interval). Companies should use a 95% confidence interval or greater to represent uncertainty, but may justify other confidence levels based on the underlying data, methods, carbon pools or other relevant factors. The estimated net carbon stock change values at the upper and lower bounds of the uncertainty range can then be determined from the probability density function by using the confidence level to determine the relevant percentiles. For example, using a 95% confidence interval the uncertainty range includes values from the 2.5^{th} to 97.5^{th} percentiles of the probability density function representing the likelihood of different values for the net carbon stock change.
3. Test for statistical significance	Companies are required to only report removals that are statistically significant. The significance level, or alpha, can be determined as 'one minus the confidence level'. Statistically significant removals are annual net carbon stock change estimates where all values in probability density function are greater than zero for probabilities greater than or equal to the significance level (i.e., the null hypothesis of no carbon stock change or that net carbon stocks decrease is rejected using a 1-tailed statistical test). For example, if a 95% confidence interval is used, removals would be significant where the estimate of the annual net carbon stock change at the 5^{th} percentile (i.e., significance level = 1 – 0.95) of the probability density function is greater than zero. Where the estimate for the net carbon stock changes at the significance level's probability in the probability density function is zero or a negative value, it cannot be assumed that carbon stocks are increasing and net CO_2 removals occurred (i.e., the null hypothesis of no carbon stock change or that net carbon stock decreases occurred cannot be rejected). Therefore, in such cases, the removals estimates are not statistically significant and cannot be reported.
4. Select a conservative value	The uncertainty range for the CO_2 removal estimate may be quite large due to data collection constraints, natural variability in the system or other factors. Companies must apply the principle of conservativeness to ensure the value for CO_2 removals selected from the uncertainty range does not overestimate CO_2 removals. To select conservative values, companies should determine the mean and the median estimate of annual net carbon stock changes within the probability density function and select the lesser value of the two, or a value representing a percentile of the probability density function lower than both the mean and the median. Companies should provide justification for the value selected, and how the estimated value uses conservative assumptions given the uncertainty range, methods and underlying data.

Some examples of practices to improve accuracy or ensure conservativeness when estimating CO_2 removals and their uncertainty ranges include:

- Collecting data to estimate uncertainty where currently available datasets do not provide quantitative estimates of uncertainty,

- Increasing sample size or improving sampling design of data collection protocols
- Undertaking a sensitivity analysis to understand which parameters have the largest influence on modeled results and improving data collection for such parameters,
- Choosing values at the lower end of an uncertainty range where a given variable or parameter has a positive correlation with CO_2 removal estimates,
- Choosing values at the higher end of an uncertainty range where a given variable or parameter has a negative correlation with CO_2 removal estimates.

6.2.5 Reversal accounting

To ensure a complete GHG accounting system that captures the full climate impact of CO_2 removals, companies must account for reversals. A reversal is an emission from a carbon pool that stores carbon associated with a removal previously reported by the reporting company.

Accounting requirement

Companies **shall** account for and report net carbon stock losses of previously reported removals in the year the losses occur, as either:

- Net CO_2 emissions, if the carbon pools are part of the GHG inventory boundary in the reporting year, or
- Reversals, if the carbon pools are no longer in the GHG inventory boundary in the reporting year.

If companies lose the ability to monitor carbon stocks associated with previously reported removals, companies **shall** assume previously reported removals are emitted and report reversals.

In cases where a company changes suppliers or sourcing regions, sells lands or otherwise loses formal business relationships with entities that own or control carbon pools associated with previously reported CO_2 removals, companies may work with supply chain partners or other relevant stakeholders to ensure ongoing monitoring can occur.

If companies detect losses of stored carbon associated with previously reported removals, the losses are accounted for and reported as one of the following:

- **Net CO_2 emissions by storage type in scope 1, scope 2, or scope 3:** where the carbon pools associated with the carbon stock decrease are still within the reporting company's inventory boundary in the reporting year
- **Reversals by storage type organized by scope 1, scope 2, or scope 3 categories:** where carbon pools associated with the carbon stock decrease are no longer within the reporting company's inventory boundary in the reporting year.

All net carbon stock decreases associated with carbon pools in the inventory boundary must be reported as emissions. Where net carbon stock decreases are detected through ongoing storage monitoring in carbon pools associated with previously reported removals that are outside the inventory boundary, only the carbon stock loss associated with previously reported removals must be accounted for as a reversal. If reversals occur that are equivalent or greater than previously reported removals, and they are accounted for and reported, no additional ongoing storage monitoring of the associated carbon pools is necessary.

For example, if a forest product manufacturer reports 50 t CO_2 scope 3 removals from a forest management company they source from, then changes suppliers but continues to monitor the relevant forest land and later detects a net carbon stock loss of 75 t CO_2 emissions from forest lands associated with their previously reported removals, they only need to report 50 t CO_2 emissions as scope 3 reversals, since that is equivalent to their previously reported removal.

Where reversals are accounted for because the company can no longer monitor stored carbon, they are required to account for emissions equal to all CO_2 removals previously reported (excluding associated emissions and reversals already accounted for and reported), and ongoing monitoring is no longer required.

In the previous example, if the forest product manufacturer stopped monitoring the forest lands associated with their previously reported scope 3 removals, they would need to report 50 t CO_2 emissions as scope 3 reversals to account for their previously reported removals, but they are then no longer responsible for monitoring the carbon stock changes.

Where companies have previously accounted for scope 1 removals, they must account for emissions or reversals within the relevant scope under the following scenarios:

- When annual net carbon stock decreases occur in land-based or geologic carbon pools associated with previously reported scope 1 removals, as detected by ongoing storage monitoring; or
- When companies are no longer able to monitor annual net carbon stock changes in carbon pools where previously reported scope 1 removals are stored.

Where companies have previously accounted for scope 3 removals, they must account for the emissions or reversals within the relevant scope under the following scenarios:

- When annual net carbon stock decreases occur in land-based, product or geologic carbon pools associated with previously reported scope 3 removals, as detected by ongoing storage monitoring; or
- When companies are no longer able to monitor annual net carbon stock changes in relevant carbon pools in their value chain where previously reported scope 3 removals are stored.

Refer to chapter 12 for requirements and guidance on accounting for reversals in the context of on target setting and tracking progress.

7

Land Use Change and Land Tracking

Chapter 7: Land Use Change and Land Tracking

Requirements and Guidance

This chapter provides requirements and guidance on accounting for and reporting GHG emissions from land use change in a company's GHG inventory. Land use change accounting considers deforestation along with any other type of land use conversion or transition (e.g., conversion of native grasslands to intensively managed pasturelands or croplands, conversion of peatlands to agriculture).

Land use change, including deforestation and losses of other land classes such as wetlands and grasslands, accounted for roughly 5 Gt CO_2 annually between 2007–16 on a net basis, equal to around 10 percent *of total global emissions. Pathways for stabilizing the climate at acceptable levels require halting deforestation and conversion of other natural ecosystems and facilitating afforestation, reforestation, and/or restoration.*[45]

This chapter includes both land use change metrics (direct land use change emissions and statistical land use change emissions) as well as land tracking metrics (indirect land use change emissions, carbon opportunity costs, and land occupation).

Sections in this chapter

Section	Description
7.1	Introduction to land use change accounting and land tracking
7.2	Direct and statistical land use change emissions (scopes 1, 2 and 3)
7.3	Land tracking metrics (indirect land use change emissions, carbon opportunity costs, and land occupation)
7.4	Comparison and selection of land use change metrics

Checklist of accounting requirements in this chapter

Section	Accounting requirements
7.1	Companies **shall**: • Account for land use change emissions from land carbon stock decreases across all carbon pools (biomass, soil organic carbon and dead organic matter). • Account for emissions of CO_2, methane (CH_4) and nitrous oxide (N_2O).

[45] IPCC, 2019

7.2	Companies **shall**: • Account for and report direct land use change (dLUC) emissions or statistical land use change (sLUC) emissions in scope 1, scope 2, and scope 3. • When accounting for *Land use change emissions* using dLUC and/or sLUC, use an assessment period of 20 years or greater. • Use a linear discounting approach or an equal discounting approach to distribute emissions across the assessment period in the inventory.
7.3	Companies **shall**: • Account for and report at least one land tracking metric (*Indirect land use change emissions*, *Carbon opportunity costs*, *Land occupation*), reported separately from emissions and removals. • Apply the chosen land tracking metric(s) consistently across the inventory.

7.1 Introduction to land use change accounting and land tracking

The purpose of land use change (LUC) accounting is to account for GHG emissions from land use change occurring on lands a company owns or controls (scope 1), on lands generating purchased or acquired electricity, steam, heating or cooling consumed by the reporting company (scope 2), or on other lands in a company's value chain (scope 3). Specifically, land use change accounting captures carbon stock losses occurring in the conversion or transition from one land use category to another, such as from forest to grassland or cropland.[46]

Land use change also captures carbon stock losses occurring in the conversion or transition from one land use subcategory to another (e.g., natural to planted forest, grassland to intensively managed pasture). Figure 7.1 presents various land use categories. The sections below and in chapter 8 contain guidance for accounting for land use change in each type of conversion scenario.

[46] IPCC, 2003; IPCC, 2019b

Figure 7.1 Land Use Categories and Subcategories, and Relationship to Accounting Approaches

Pre-Conversion Land Use Category \ Post-Conversion Land Use Category	Forest Land	Grassland	Cropland	Wetland	Settlement	Other Land
Forest Land	F > F	F > G	F > C	F > W	F > S	F > O
Grassland	G > F	G > G	G > C	G > W	G > S	G > O
Cropland	C > F	C > G	C > C	C > W	C > S	C > O
Wetland	W > F	W > G	W > C	W > W	W > S	W > O
Settlement	S > F	S > G	S > C	S > W	S > S	S > O
Other Land	O > F	O > G	O > C	O > W	O > S	O > O

Forest Subcategories	Natural Forest	Planted Forest
Natural Forest	NF > NF	NF > PF
Planted Forest	PF > NF	PF > PF

Grassland & Wetland Subcategories	Natural Ecosystem	Intensively Managed Land
Natural Ecosystem	NE > NE	NE > IML
Intensively Managed Land	IML > NE	IML > IML

Key:

- Land use change with carbon stock losses (Chapter 7)
- Land management and/or land use change with carbon stock gain (Chapter 8)
- Forest Subcategories
- Grassland & Wetland Subcategories

Notes: "Planted forest" is synonymous with "tree plantation" as defined by the Accountability Framework initiative: https://accountability-framework.org/the-framework/contents/definitions/
List of land uses is not exhaustive; "other land" includes bare soil, rock, ice, and all unmanaged land areas that do not fall into any of the other five categories (IPCC 2003). Cell shading is illustrative; instances of land-use change with carbon losses should use the guidance in this chapter, and accounting approaches for land-use changes that lead to carbon removals due to carbon stock gains are described in Chapter 8.

Source: IPCC (2003); IPCC (2019), Table 1.1.

7.1.1 Relationship between land use change and land management accounting

Chapter 7 covers land use change accounting, in which there are CO_2 emissions due to land use change. Land use change accounting is distinct from land management carbon accounting (covered in chapter 8). Land management accounting considers annual carbon stock changes in the reporting year *within* a given land use category (e.g., where carbon stock changes occur due to agriculture or forestry management practices, but the land use classification does not change).

Chapter 8 also covers situations in which there are net CO_2 removals due to carbon stock gains. CO_2 removals due to land use change (e.g., reforestation, afforestation) are accounted for as *Land management net CO_2 removals* in chapter 8. This is for multiple reasons:

- Carbon stock gains are accounted for as annual net land carbon stock increases occurring in the reporting year, rather than over a historic assessment period of 20 years or greater (as is used for *Land use change emissions*);
- Annual carbon stock gains following conversion (e.g., reforestation, afforestation) occur in the same land use category (e.g., forest land); and
- *Land management net CO_2 removals* must meet the requirements for reporting removals described in chapter 8.

7.1.2 Types of land use change metrics

There are multiple approaches to accounting for a company's land use change impacts. This Guidance provides five different metrics that can be used to account for carbon stock changes from land use change with definitions of these metrics in table 7.1. Technical methods and data which can be used to generate such estimates are provided in the calculation guidance in chapter 17.

Table 7.1 Overview of metrics related to land use change

Metric	Definition	Unit of Measure	Scope(s) and relevant section
Direct land use change (dLUC) emissions	Emissions (primarily from carbon stock losses) due to recent (previous 20 years or more) land conversion directly on the area of land that a company owns/controls or on specific lands in the company's value chain	CO_2e	Scope 1, scope 2, and scope 3 emissions; see section 7.2
Statistical land use change (sLUC) emissions	Emissions (primarily from carbon stock losses) due to recent (previous 20 years or more) land conversion within a landscape or jurisdiction. sLUC can serve as a proxy for dLUC where specific sourcing lands are unknown or when there is no information on the previous states of the sourcing lands	CO_2e	
Indirect land use change (iLUC) emissions	Emissions (primarily from carbon stock losses) due to land conversion on lands not owned or controlled by the company, or in its value chain, induced by change in demand for (or supply of) products produced or sourced by the company	CO_2e	Scope 1, scope 2, and scope 3 land tracking; see section 7.3
Carbon opportunity costs (COC)	Emissions from total historical carbon losses from plants and soils on lands productively used (this quantity also represents the amount of carbon that could be stored if land in production were allowed to return to native vegetation)	CO_2e	
Land occupation	The amount of land occupied for a certain time to produce a product	hectares	

Both dLUC and sLUC have advantages in capturing different types of climate impacts related to land use change and enable companies to pursue different types of mitigation options. If a company uses dLUC to account for *Land use change emissions* in the scopes, they should also account for statistical land use change emissions, but separately from the scopes. Quantifying and reporting sLUC can help capture the wider land use change impacts in the jurisdictions of production or from where the company sources land-based products. See section 7.2 for guidance on how to account for dLUC and sLUC.

In some situations, actions to reduce dLUC/sLUC emissions and/or other emissions in scopes 1, 2 and 3 can lead to increased land use change on land outside of a company's inventory boundary (or the spatial boundary chosen for sLUC emissions calculation). These impacts are illustrated in the following examples:

- Crop-based biofuel production could increase overall global demand for crops, which could lead to additional land clearing;
- A large-scale shift to lower-input agriculture could reduce fertilizer emissions, but could also reduce yields and lead to additional land clearing;
- A large-scale shift to alternative grazing practices could increase soil carbon sequestration, but could also reduce beef output per hectare and lead to additional land clearing;
- An increase in fertilizer use could increase fertilizer emissions, but could also increase yields and avoid land clearing that would have otherwise occurred;
- A shift to sourcing from suppliers in areas not recently deforested could reduce dLUC and/or sLUC emissions (if measured at a national or regional level), but could increase or decrease global agricultural land demand depending on relative effects on yields and so affect pressures on natural ecosystems elsewhere.

To track these systemic effects – which are typically overlooked by dLUC and sLUC measures – this Guidance includes a category of land tracking metrics to account for and report land use change impacts on lands outside of the company's inventory boundary. By managing these metrics, companies can help ensure that corporate land-use and sourcing decisions not only improve the scope 1, 2 and 3 emissions inventory, but also lead to meaningful system-wide GHG reductions. These land tracking metrics, which are detailed in section 7.3, include:

- *Indirect land use change emissions* (iLUC) (section 7.3.1),
- *Carbon opportunity costs* (COC) (section 7.3.2), and
- *Land occupation* (section 7.3.3).

Section 7.4 provides guidance on choosing which land use change metric(s) to track and report.

7.1.3 Carbon pools to include

Accounting requirement
Companies **shall** account for land use change emissions from land carbon stock decreases across all carbon pools (biomass, soil organic carbon and dead organic matter).

Three types of carbon pools are relevant when assessing changes to carbon stocks due to land use change: biomass (including aboveground biomass and belowground biomass), soil organic carbon (including soil organic carbon in mineral and organic soils) and dead organic matter (including dead wood and litter). The relative importance of each carbon pool depends on the ecosystem under consideration.

7.1.4 Greenhouse gases to include

Accounting requirement
Companies **shall** account for emissions of CO_2, methane (CH_4) and nitrous oxide (N_2O).

Carbon dioxide (CO_2) typically dominates LUC emissions,[47] but methane (CH_4) and nitrous oxide (N_2O) can also result from LUC. For example, the following situations can cause land use change emissions of the three gases:

- **Burning vegetation** impacts biomass by releasing additional GHG emissions (CO_2, CH_4, and N_2O).
- **Losses of soil carbon (CO_2)** are coupled to the mineralization of nitrogen in soil, which in turn generates N_2O emissions.
- **Peatland drainage** impacts soil carbon stocks (CO_2), nitrous oxide (N_2O) and methane (CH_4) emissions.

7.1.5 Types of activities to include

Companies should consider LUC for any materials sourced from or produced on the land—whether a product or its original material(s)—or other activities impacting lands within a company's organizational boundary or value chain. Table 7.4 presents a non-exhaustive list of the types of activities to consider when accounting for land use change.

Table 7.4 Types of activities to include

Activity type	Description
Production of land-based products	• Commodities (e.g., beef, cocoa, palm oil, soy, timber, cereals) • Other livestock products and associated inputs (e.g., poultry, pork, terrestrial aquaculture, animal feeds) • Other crops • Other fibers (e.g., cotton, wood fiber, wool, leather, paper) • Biofuels and bioenergy feedstocks (e.g., ethanol, vegetable oils, wood pellets) • Chemicals with natural precursors (e.g., glucose, cellulose acetate, xylitol)
Other land-intensive activities	• Mining • Infrastructure or facility development • Urban expansion
Activities in other scope 3 categories	• Leased assets • Franchises • Investments • Any other relevant lands that fall outside a company's organizational boundary but still within their value chain

[47] IPCC, 2014

7.1.6 Data frequency and resolution

Land use change estimates should be updated annually, or at least every 2 to 3 years as data availability allows, to enable companies to consistently measure progress.

Companies should track metrics at the finest-possible geographical or spatial resolution given their supply chain traceability and analytical capabilities (further described in chapter 16).

7.1.7 Implications for target setting and GHG management

Companies should use the scope 1, 2 and 3 inventory (including dLUC and/or sLUC) and the chosen land tracking metric(s) in combination when informing decision making and mitigation strategies. Companies should set targets to reduce scope 1, 2, and 3 emissions (including dLUC or sLUC), and improve performance in the chosen land tracking metric(s), and track progress over time. See chapter 12 for more information.

7.2 Direct and statistical land use change emissions (scopes 1, 2 and 3)

This section provides guidance on how to account for direct and statistical land use change emissions, which quantify recent (e.g., the past 20 years) land use changes on land that is owned/controlled by the reporting company or in the company's value chain.

Accounting requirement
Companies **shall** account for and report direct land use change (dLUC) emissions or statistical land use change (sLUC) emissions within scope 1, scope 2, and scope 3.

Table 7.2 provides definitions on what constitutes scope 1, scope 2, and scope 3 emissions from direct land use change (dLUC) or statistical land use change (sLUC).

Table 7.2 Scope 1, scope 2, and scope 3 emissions from direct land use change (dLUC) or statistical land use change (sLUC)

Scope	Definition
Scope 1 land use change emissions	Land use change emissions on lands owned or controlled by the reporting company.
Scope 2 land use change emissions	Land use change emissions on lands generating purchased or acquired electricity, steam, heating, or cooling consumed by the reporting company (Note: land use change emissions upstream of energy generation are accounted for in scope 3, category 3).
Scope 3 land use change emissions	Land use change emissions that are a consequence of the activities of the reporting company but occur on lands owned or controlled by another company (not included in scope 2).

7.2.1 Types of land use change metrics

There are two available metrics for a company to choose from when reporting emissions from recent land use change: direct land use change and statistical land use change. Table 7.5 has a detailed comparison of the two metrics, including what each metric quantifies and the benefits and challenges in quantifying these metrics.

For scope 1 accounting, companies should use dLUC unless data only allows for sLUC calculation. For scope 2 and scope 3 accounting, companies should use the more relevant of dLUC or sLUC.

Companies **shall** disclose and justify which metric(s) were used (i.e., direct land use change and/or statistical land use change emissions).

Table 7.5 Comparison of direct land use change emissions (dLUC) and statistical land use change emissions (sLUC)

Recent LUC metric	Description	Causation	What it measures	Benefits	Challenges	Time horizon
Direct land use change emissions (dLUC)	Calculated at the farm or land management unit level, where entities owning and managing the land make decisions regarding its use	Direct (attributional) causation; the impacts happened on the land where the product was produced	GHG emissions from recent LUC on the land where the product was produced	More spatially precise information for company than sLUC; easy to communicate	More data-intensive than sLUC	Most recent 20 years or greater (annualized)
Statistical land use change emissions (sLUC)	Calculated at a landscape or jurisdictional level; cannot distinguish direct and indirect LUC (see section 7.3); may be used as proxy for dLUC due to limited primary data or traceability to the farm or land management unit where a product was produced	May be used as a proxy of direct (attributional) causation; the impacts happened in the geographical area (sLUC boundary) where the product was produced	GHG emissions from recent LUC inside the sLUC boundary; may be used as a proxy for GHG emissions from recent LUC on the land where the product was produced	Relatively easy to calculate; data readily available from secondary data sources; captures some indirect LUC effects of other actors within sLUC boundary	Because it captures actions of multiple actors over a landscape, it is a less precise indicator than dLUC of the direct impacts of company's actions or performance over time	

Direct land use change emissions are relevant when the agricultural or forestry commodity in question has – in the past 20 years – expanded onto natural land or planted land that previously had greater carbon storage.

Direct land use change emissions reflect a causal relationship between activities on the land and the decrease in the land's carbon stock. As such, dLUC relates to lands owned or controlled by a company and lands that a company knows to be in its supply chain.

Companies should choose the most relevant metric based on their circumstances. As table 7.2 shows, both dLUC and sLUC have benefits in capturing different types of impacts related to land use change and enabling companies to pursue mitigation options. For this reason, if a company uses dLUC to account for *Land use change emissions* in the scopes, they should also account for sLUC, but separately from the scopes.

Generally, dLUC or sLUC emissions can be estimated from literature-based LUC calculation tools, directly from field-based estimates, derived from satellite imagery, or using a combination of field data, imagery, and modeling. Further details on methods and data sources are provided in the calculation guidance in chapter 17.

Companies **shall** report the data sources, methods, and assumptions used. Companies should generally use the same assumptions each year, even if approaches vary between land-based products in their inventory due to unevenness in data quality.

As data quality improves, companies should use more refined data. Note that updates to data and methodology may trigger base year recalculations to enable consistent tracking over time. This is especially true if a company switches their primary metric tracked from sLUC to dLUC. For more information on base year recalculation, see chapter 12.

7.2.2 Distributing land use change emissions across time

When accounting for scope 1, 2, and 3 emissions from recent land use change (dLUC and sLUC), companies should follow the requirements and guidance below to distribute land use change emissions across time.

Companies **shall** disclose and justify the assessment period and discounting approach to distribute emissions across time.

Determining the assessment period for recent land use change

Accounting requirement
When accounting for *Land use change emissions* using dLUC and/or sLUC, companies **shall** use an assessment period of 20 years or greater.

The assessment period reflects the time period used to evaluate whether or not land use change occurred. There is a default assessment period of 20 years or more. For example, if products are sourced from lands that have an annual crop cycle or rotation period less than or equal to 20 years, companies should use the default 20-year assessment period. For lands or products sourced from lands that have a crop cycle or rotation period of more than 20 years, that assessment period (i.e., more than 20 years) should be used.

The 20-year default assessment period for LUC is from IPCC's 2003 Good Practice Guidance for Land Use, Land-Use Change and Forestry.[48] Its basis is that when land use changes occur, it takes some time for the stored

[48] See https://www.ipcc-nggip.iges.or.jp/public/gpglulucf/gpglulucf_files/GPG_LULUCF_FULL.pdf for the full IPCC (2003) guidance document.

carbon to reach a new equilibrium. Therefore, allocating all emissions from a land use change event in the year it occurs would be physically inaccurate.

Distributing emissions across time

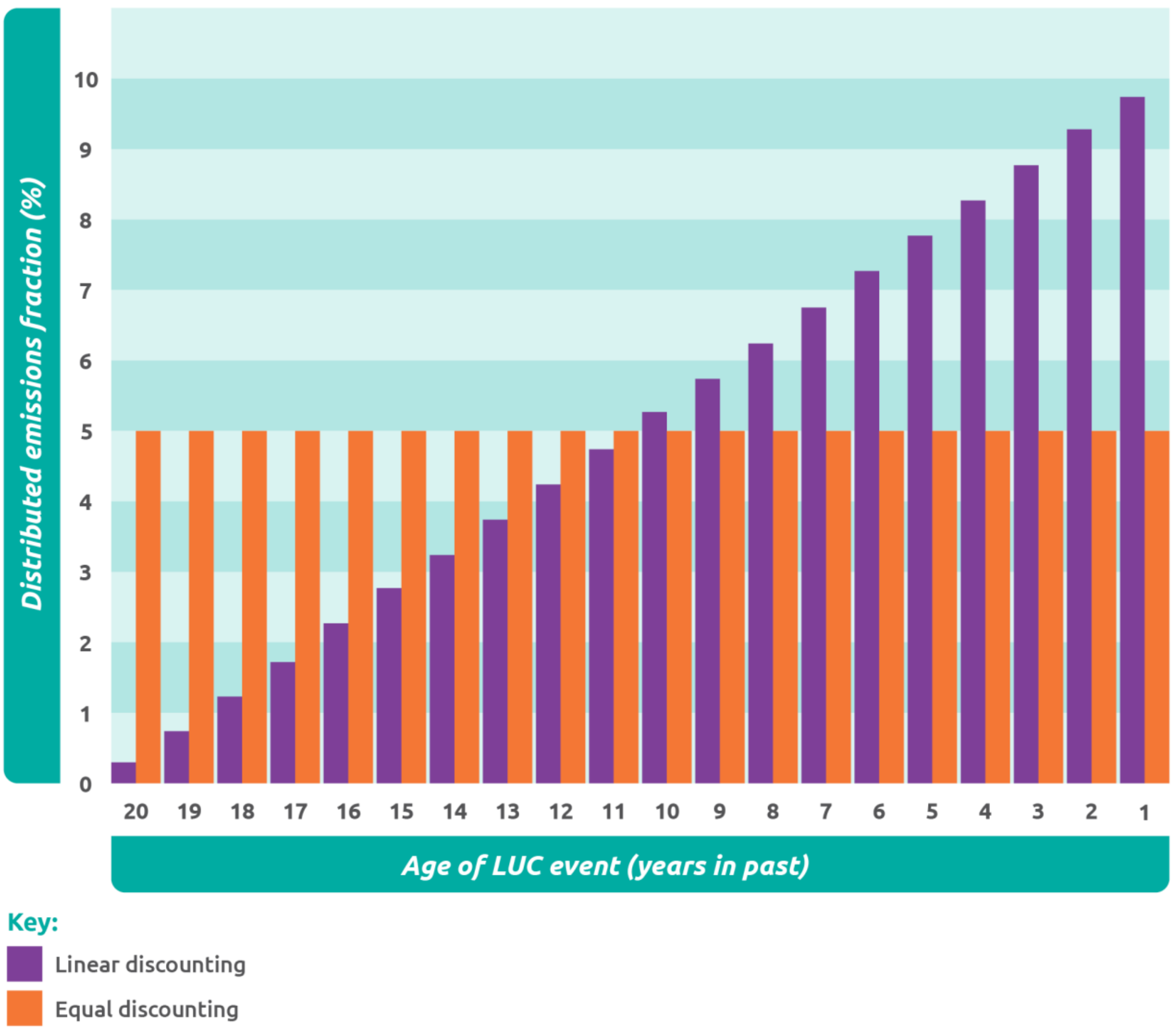
The emissions are distributed across time after the LUC events have been identified and their impact accounted year-on-year.

Accounting requirement

Companies **shall** use a linear discounting approach or an equal discounting approach[49] to distribute emissions across the assessment period in their inventory.

The calculation guidance in chapter 17 further explains these discounting methods. Figure 7.2 illustrates how the two discounting methods distribute LUC emissions across the default 20-year assessment period.

Figure 7.2 Illustration of the linear and equal discounting approaches across 20 years



Note: The sum of all years equals to 100 percent.

[49] The equal discounting approach is referred to as the "20 year constant" approach and the linear discounting approach is referred to as the "20 year decline" approach in the GHG Protocol *Product Life Cycle Standard* (Appendix B).

7.2.3 Allocating land use change emissions across products

When accounting for scope 1, 2, and 3 emissions from recent land use change (dLUC and sLUC), companies should follow the requirements and guidance below to allocate annual land use change emissions across products.

Allocating sLUC emissions across products

Where companies apply sLUC metrics to estimate land use change, companies allocate annual LUC emissions in the sourcing region or jurisdiction based on the products produced in that area for a given year. Depending on traceability of the reporting company and the data available, sLUC can be calculated at different levels of geographical resolution, including jurisdictional or sourcing region boundaries.

For a given spatial boundary, annual LUC emissions (where LUC emissions in that boundary are distributed over time in accordance with section 7.2.2) should be allocated across products based on an sLUC allocation approach. Table 7.6 describes the two possible sLUC allocation approaches, which are relevant across all production lands (e.g., cropland, pastureland, planted forests)[50]:

Table 7.6 sLUC allocation approaches

sLUC allocation approach	Explanation
Shared responsibility approach	Allocation based on occupied area. This approach allocates the recent land use change emissions to all products produced on the land area under analysis, without differentiating which product(s) expanded (or not) during the assessment period.
Product expansion approach	Allocation based on relative product expansion. This approach attributes the recent land use change emissions only to the land-based product(s) whose occupied area expanded in the land area under analysis during the assessment period. *Note:* this approach is referred to as the "crop-specific approach" in other methodologies.

Companies **shall** disclose and justify the allocation approach used to estimate sLUC (i.e., shared responsibility or product expansion approach). The allocation approach could be the one used by the company when performing an sLUC analysis or by the database or tool that developed the sLUC emission factors used by the company.

Allocating dLUC emissions across products

Where companies apply dLUC metrics to estimate land use change, there are three ways to allocate land use change emissions in an area that was used to produce multiple products over the assessment period:

[50] Nemecek et al., 2020

companies may use mass allocation, economic allocation, or allocation by area-time. For more on allocation methods, see chapter 16 (section 16.5) and the calculation guidance in chapter 17.

7.2.4 Integrating certification into LUC emissions accounting

Third-party certification programs aim to improve environmental and social outcomes related to supply chains and some (e.g., deforestation-free and conversion-free certification programs) may be relevant to accounting for emissions from recent LUC.

Certifications may be integrated in LUC accounting calculations when companies have information about the objective of the certification scheme, the timeframe and level of traceability it covers, its assurance and verification process, and the boundary covered (e.g., primary and secondary forest).

Companies that use certification to inform *Land use change emissions* accounting should consider the following:

- **Cut-off date:** The cut-off date is the date after which deforestation or conversion renders a given area or production unit non-compliant with commitments (e.g., deforestation-free or conversion-free).[51] Companies are required to use a 20-year or greater assessment period to account for *Land use change emissions*, so where the cut-off date for the certification program is less than 20 years from the reporting year, the certified volume alone cannot be used to justify the absence of *Land use change emissions*. In these cases, the certificate may still provide relevant information to support direct land use change estimates.
- **Chain of custody model:** A chain of custody model is the approach taken to demonstrate the link (physical or administrative) between the verified unit of production and the claim about the final product.[52] The chain of custody model used by the certification program can impact the ability of the reporting company to trace certified volumes to lands within their supply chain. Only certificates using models that ensure physical traceability to specific lands where the materials were produced can be used to support direct land use change accounting. For example, companies purchasing certified products that use identity preserved or segregated chain of custody models may use information from the certificate program on the spatial boundaries associated with the lands producing the certified products to evaluate land use change during the assessment period.

Companies that use certification or chain-of-custody programs **shall** report the type of certification programs or chain-of-custody models used.

See chapter 16 for more guidance on the links between certification and corporate GHG accounting.

7.2.5 Implications for target setting

Companies should seek to bring their dLUC or sLUC emissions to zero as soon as possible to align with global goals to halt deforestation and conversion of other natural ecosystems. Because the accounting period covers 20 years or more, dLUC or sLUC emissions may nevertheless persist in inventories while the LUC event(s) recede into the past (e.g., even if a company ends deforestation by 2030 in its supply chain, some level of LUC emissions may persist in the inventory until 2050).

Other actors across a landscape beyond the reporting company will influence the sLUC metric. This means that wider actions beyond the immediate supply chain will also be captured in the accounting. Companies are

[51] Accountability Framework initiative, 2019

[52] ISEAL Alliance, 2016

required to recalculate base year emissions if significant changes to data sources or methods occur—for example, if their primary LUC metric in scope 1, 2 or 3 shifts from sLUC to dLUC (chapter 12).

7.2.6 Implications for decision making

The reporting of both dLUC and sLUC emissions incentivizes companies to work to eliminate land use change on lands they own, control, or source. Companies sourcing agricultural products may reduce their dLUC emissions by switching to suppliers with less recent conversion in their operation. However, this shift may not directly benefit the climate as those producers may find other buyers for their products. Companies are, therefore, encouraged to work with existing suppliers to improve land use decisions and reduce scope 3 dLUC emissions over time. Similarly, companies that report sLUC emissions are encouraged to remain engaged in high-risk sourcing areas to reduce LUC within and beyond their own supply chains, rather than exiting these landscapes entirely.

7.3 Land tracking metrics (indirect land use change emissions, carbon opportunity costs, and land occupation)

Actions to reduce emissions—including dLUC and/or sLUC emissions—associated with land-based products can result in land use changes outside of lands owned or controlled by the company or outside their value chain.

Given the growing global competition for land and the need to avoid leakage (i.e., negative impacts on emissions and removals outside the company's inventory boundary caused by a company's activities), a complete land sector inventory must also include information on broader global land use impacts. Companies with land sector activities in their operations or value chain, including companies that report *Land management net CO_2 removals*, are required to account for at least one of the three land tracking metrics.

Accounting requirement
Companies **shall** account for and report at least one land tracking metric (*Indirect land use change emissions*, *Carbon opportunity costs*, *Land occupation*), reported separately from emissions and removals.

This section includes accounting guidance on *Indirect land use change emissions* (section 7.3.1), *Carbon opportunity costs* (section 7.3.2), and *Land occupation* (section 7.3.3). The land tracking metrics detailed in this section can help companies make decisions that reduce pressure for land use change on forests and other carbon-rich ecosystems by reducing the demand for land for food, feed, fiber, and fuel. Reducing global land demand for agricultural and forestry products is necessary for achieving climate and ecosystem production/restoration goals (box 7.2).

Section 7.4 includes additional guidance to help companies choose which land use change-related metrics to track and report. The calculation guidance in chapter 17 provides additional detail on how to calculate each metric and potential data sources.

Table 7.3 provides definitions on what constitutes scope 1, scope 2, and scope 3 land tracking metrics.

Table 7.3 Scope 1, scope 2, and scope 3 land tracking metrics

Scope	Definition
Scope 1 land tracking	Land tracking metric(s) for lands owned or controlled by the reporting company.
Scope 2 land tracking	Land tracking metric(s) for lands generating purchased or acquired electricity, steam, heating or cooling consumed by the reporting company (Note: lands upstream of energy generation are accounted for in scope 3, category 3).
Scope 3 land tracking	Land tracking metric(s) (not included in scope 2) that are a consequence of the activities of the reporting company but occur on lands owned or controlled by another company.

Accounting requirement
Companies **shall** apply the chosen land tracking metric(s) consistently across their inventory.

Box 7.2 The importance of reducing global land demand for achieving climate and ecosystem production/restoration goals

As the global population grows, and consumption patterns change, demand for food and other land-based products increases—and is projected to continue rising in coming decades.[53] Researchers have noted that increases in demand for land-based products and adequate protection and restoration of natural ecosystems (for climate, biodiversity, or other goals) can only occur in tandem if productivity of land (i.e., yields) outpaces demand growth.[54] These studies advocate "land sparing" where agricultural yields are increased to conserve remaining natural ecosystems and free up some lands for ecosystem restoration.

An alternative perspective seeks to maximize carbon stocks and biodiversity, rather than yields, on farms and other productive lands—so-called "land sharing".[55] High-yield farming critics state that merely boosting productivity does not in itself lead to ecosystem protection, and that efficiency gains can create a "rebound effect" (Jevons paradox) in which increased profitability of farming leads to more land clearing and carbon losses.[56] In addition, intensive, high-yielding production practices can involve excessive use of fertilizer, other chemical inputs, and irrigation—and potentially degrade soil and water resources and undermine long-term productivity and resilience.[57] However, lower-yielding production systems could increase overall land requirements, creating additional pressure on natural ecosystems, limiting potential for ecosystem protection and restoration, and potentially accelerating ecosystem conversion and related GHG emissions.

---

[53] Searchinger et al., 2019

[54] Williams et al., 2018

[55] Phalan, 2018

[56] Villoria et al., 2014

[57] IPCC, 2019a

Observations from multiple continents—along with modelling studies—suggest that combining high-yield agriculture with ecosystem protection has the highest potential for maximizing land-based carbon stocks while meeting future demand for land-based products.[58] Negative environmental impacts must be minimized by improving soil and water management, avoiding fertilizer overuse, reducing livestock and energy emissions, and/or implementing strategies to reduce demand.[59] In addition, both "technological" and "agroecological" approaches have potential to increase productivity while building resilience to climate change.[60]

Finally, while GHG emissions, ecosystem conversion, and land use/productivity are important indicators to measure the environmental sustainability of production of land-based products, other important impact areas include freshwater, soil health, air quality, biodiversity, and ocean health. Companies should seek to monitor and minimize trade-offs among these impact areas to ensure that progress in one area does not undermine progress in another. To help facilitate management across multiple impact areas, the Science Based Targets Network is developing corporate targets and accounting approaches for these other natural systems.[61]

7.3.1 Indirect Land Use Change Emissions

Overview and definition

Indirect land use change emissions are defined as a carbon stock decrease that takes place outside the landscape in which a product is produced or sourced, induced by change in demand for a product produced or sourced by the company. While dLUC measures recent changes on the land area where that product is produced, dLUC can be complemented by indirect land use change (iLUC) emissions to account for the land use impacts (or leakage) beyond the immediate production area due to market effects. When the amount of land dedicated to an agricultural or forestry product expands, it adds to the global demand for land and pressure on natural ecosystems, given there is a finite amount of land available.

Benefits of quantifying iLUC

Indirect land use change estimates the effect of one company's decisions on land use change elsewhere. It helps to identify additional actions that can be done by the company to reduce land pressures that might not otherwise be incentivized by measuring only dLUC. Estimating iLUC can also allow companies to show how actions they take to increase productivity, improve efficient use of land-based products, or otherwise reduce demands for land use can benefit the climate.

Several policies and programs have adopted iLUC (box 7.3) and its estimation is required for companies participating in the policies and laws described in the box. In this case, companies should continue to report on iLUC and also consider reporting on the additional land tracking metrics below (*Carbon opportunity costs* and/or *Land occupation*).

---

[58] Williams et al., 2018

[59] Phalan, 2018; Searchinger et al., 2019

[60] Ross et al., 2019; Phalan, 2018

[61] Science Based Targets Network, 2020

Challenges in quantifying iLUC

The estimation and use of iLUC can pose several challenges:

- Econometric models may be complicated, introduce additional uncertainties (e.g., through cross elasticities that estimate changes in demand across multiple goods), and be difficult or resource-intensive for companies to access and use.
- Econometric models consider only formal economic activities and leave out illegal or informal economic activities that may play a significant role in deforestation.
- iLUC emission factors across models can vary widely,[62] which can lead companies to choose emission factors without examining the true reasons for the differences between emission factors given by different models.
- Indirect LUC is used most often for bioenergy (e.g., defined as "LUC occurring elsewhere when biofuel crops displace the production of food or feed").[63] Yet, econometric iLUC models designed for bioenergy cannot readily be used for other agricultural or forestry products. Despite offering useful insights, each of the available iLUC models omits important features to define global climate effects of agricultural expansion,[64] and some may also hide perverse incentives created by the model – for example if the GHG emissions reductions are achieved through decreases in food consumption.[65] There is further room to improve data precision and to include missing topics in models, such as the identification of degraded/marginal land.[66] Some biophysical iLUC models exist, which can be applied to products other than feedstocks.[67] However, these biophysical emission factors are not readily available at the time of this publication.
- Indirect land use change can occur at both the national and global level. If companies use only national level iLUC factors, they can miss global leakage effects, because displacement and land conversion (e.g., deforestation) can occur across national borders. In cases where the country of origin is known, one approach when estimating iLUC is to account for both national and global effects is to develop the iLUC estimate using an average emission factor (i.e., 50% using the global emission factor and 50% using the country-level emission factor).

Implications for target setting

Companies should set targets to reduce iLUC. Indirect land use change emissions can be mitigated, for example, by sourcing products with low- or zero-iLUC. iLUC cannot be completely ruled out at the global level until global land use change is halted. Companies should seek to reduce iLUC wherever possible and are encouraged to use global- as well as national-level emission factors. Box 7.3 provides examples of emission-reduction initiatives requiring calculation of indirect land use change emissions.

---

[62] Woltjer et al., 2017

[63] "Sustainability of Bioenergy" 2019.

[64] Plevin, 2017

[65] Searchinger et al. (2015) show how some iLUC models estimate reduced GHG emissions through decreases in food consumption (e.g., if diversion of cropland to bioenergy production causes food prices to rise and total food consumption to drop). This could have the effect of either weakening food security, or—if the food consumption reductions are overstated by the model—overstating the projected climate benefits of the bioenergy production.

[66] de Rosa et al., 2014

[67] Schmidt, Weidema, and Brandão, 2015

Box 7.3 Examples of emissions-reduction initiatives including indirect land use change emissions

In recent years, indirect land use change (iLUC) has become a key component of a number of emissions-reduction initiatives both in government and at the corporate level, primarily for biofuel feedstocks.

In 2009, the California Air Resources Board (CARB) introduced the Low Carbon Fuel Standard initiative to reduce the carbon intensity of California's transportation fuel, and reduce dependence on petroleum. Their calculation uses the Global Trade Analysis Project (GTAP) model, an econometric model that calculates indirect land use change resulting from biofuel consumption, to track their iLUC emissions associated with bio-based energy feedstocks. A 2015 report[68] from CARB's Low Carbon Fuel Standard (LCFS) details the calculation of emission factors for each of the six main feedstock types per megajoule (MJ) of energy. Entities operating in the State of California must report under the LCFS. At present, over 500 companies are required to track their fuel-related emissions, including iLUC emissions.

In 2016, the International Civil Aviation Organization (ICAO) launched the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) to reduce emissions associated with aviation. Their iLUC emission factors are calculated based on the feedstock type as well as the method of aviation fuel production. The analysis to develop these emission factors uses both GTAP and the Global Biosphere Management (GLOBIOM) model from IIASA.[69] Today, nearly 600 airlines around the world apply the guidance or have committed to fuel emission-reduction targets.

The EU Commission's Renewable Energy Directive adopts sustainability criteria for bioenergy that defines "high-iLUC risk" feedstocks (i.e., those produced from crops that have significant recent expansion into carbon-rich ecosystems) versus "low-iLUC risk" feedstocks (i.e., those with recent productivity increases and/or grown on abandoned or degraded lands).[70] The EU Commission guidance encourages companies to source bioenergy feedstocks from "low-iLUC risk" supply chains and avoid "high-iLUC risk" ones.

Implications for decision making

Companies can follow an approach such as the EU Commission Renewable Energy Directive's approach to source feedstocks from "low-iLUC risk" supply chains and avoid "high-iLUC risk" ones (box 7.3). The benefit of such an approach is that it is simple and easily understood. While companies should source from "low-iLUC risk" supply chains, because any use of dedicated land for bioenergy contributes to global land use demand, even sourcing from a "low deforestation risk" country or supply chain can cause leakage elsewhere, meaning that an iLUC emission factor that only considers recent deforestation in one jurisdiction may be artificially low because it does not factor in global iLUC effects. Approaches that average global and country-level iLUC emission factors can help mitigate this concern.

[68] California Air Resources Board, 2015

[69] International Civil Aviation Organization, 2019

[70] European Commission, 2019

7.3.2 Carbon Opportunity Costs

Overview and definition

The majority of the world's croplands, and at least 30 percent of its pasturelands, were formerly forested.[71] As the global population continues to grow, along with demand for food, wood, and other land-based products, deforestation continues. However, pathways to limit warming below 1.5^{0}C generally require elimination of deforestation, along with large-scale reforestation, by mid-century.[72]

Therefore, almost any productive use of land has a carbon opportunity cost (COC).[73] The opportunity cost of using land for one activity (e.g., food production) is not using it to do something else (e.g., wood production, carbon storage). The carbon opportunity cost is defined as the total historical amount of carbon lost from plants and soils on lands productively used for agriculture or forestry.[74] The same quantity represents the amount of carbon that could otherwise be stored if land in production were allowed to return to its native vegetation.[75] Infrastructure (e.g., the land footprint of buildings and paved areas) also has a carbon opportunity cost.

Benefits of quantifying COC

COC can be applied to measure the net benefits to the climate of a change in land use or land management by comparing the relative climate costs and benefits of each activity. For example, more productive crops that are grown on land that would not otherwise store a large amount of carbon will have a lower COC per kg product than low-yielding crops on formerly carbon-rich lands in the tropics.

The COC can also be used to estimate the impact of a change in land management that might result in a change in yield (see example about maize intensification in chapter 17), or a shift from one crop to another. It could also capture changes in soil or vegetative carbon (although in doing so, could double-count land management emissions or removals; see chapter 8). In general, more efficient production of a crop or livestock product means that there is less pressure elsewhere to clear additional land to produce that product, and COC captures that climate benefit.

Challenges in quantifying COC

Carbon opportunity cost is a relatively new metric. It is also more complex to calculate and to communicate than dLUC or sLUC. At present, global COC factors exist for most major crops and livestock products,[76] whether they are used for food, feed, or bioenergy feedstocks.

However, the fact that a single tree, farm, or land management unit harvested can produce several different product types with varying life cycles presents a challenge of COC attribution that would be relevant for

---

[71] Searchinger et al., 2018

[72] IPCC, 2019a

[73] There are rare cases when productive land would have a zero or negative carbon opportunity cost—such as if native grassland is converted to a higher-carbon ecosystem like forest, or if crops are grown in very arid irrigated areas (e.g., deserts).

[74] Searchinger et al., 2018

[75] Searchinger et al., 2018; Schmidinger and Stehfest, 2012; Hayek et al., 2021

[76] Searchinger et al., 2018

companies that produce or purchase wood products. In addition, as ecosystems are degraded and the climate changes, simply abandoning a production area may not lead to the native vegetation being restored. Finally, companies have also identified a need for more user-friendly tools to make COC calculation easier, especially at smaller geographical scales.

Implications for target setting

To use COC as a target-setting tool, companies would have to establish a baseline COC estimate and track this metric over time. Because of the need to halt deforestation and free up lands for reforestation, companies could set a target to keep COC constant over time rather than increasing, but methods need to be further developed to calculate science-based COC reduction targets. Box 7.4 provides an example of an initiative that quantifies carbon opportunity costs and uses them for target-setting.

Box 7.4 Example of calculating carbon opportunity costs

The Cool Food Pledge is an initiative where food service companies and other large dining providers commit to reducing scope 3 agricultural value chain emissions, as well as carbon opportunity costs, by 25 percent between 2015 and 2030—and are tracking progress on an annual basis.[77]

The group uses an Excel-based calculator that includes global-level carbon opportunity cost factors from Searchinger et al. (2018) to estimate the value chain emissions and carbon opportunity costs associated with companies' annual food purchases.[78] Baseline data showed that the group of 30 companies collectively served an estimated 852 million meals per year, with scope 3 emissions from agricultural value chains estimated at more than 810,000 t CO_2e per year, and food-related carbon opportunity costs of more than 3,475,000 t CO_2e.[79]

Implications for decision making

This metric can be used to assess the land use and climate impact of a particular intervention once a company has assessed its baseline COC. This might include shifting from growing or buying one crop or livestock product to another, sourcing from one region rather than another, a land management decision that may affect yields or carbon stocks, or simply increasing or decreasing sourcing of a certain product. Intervention accounting is further discussed in chapter 11. As noted above, the COC is rarely reduced to zero, because nearly all productive land-based activities have some carbon opportunity cost.

The primary mitigation activities incentivized by COC measurement include adopting practices that lead to improved yields, shifting production and purchases toward less land-intensive products, use of less carbon-rich lands, and management practices that increase carbon stocks (e.g., agroforestry).

[77] Waite et al., 2019

[78] Waite et al., 2019

[79] Waite et al., 2020

7.3.3 Land Occupation

Overview and definition

Land occupation is a simpler approach to estimating if a company's operations and/or value chain is increasing or decreasing global pressure on forests and other natural ecosystems. "Land occupation" is defined as the amount of land required per year to produce or extract the products produced or sourced by a company. The metric is reported in hectares or other units of surface area (e.g., acres) per year, and is therefore reported separately.

Company infrastructure (e.g., buildings) also occupies land. Land occupation can be used to incentivize productivity and efficiency gains needed to meet growing demand for land-based products while easing pressure on those ecosystems.

Benefits of quantifying land occupation

Land occupation can serve as a meaningful indicator to track the contribution of a company's activities to the global demand for productive land. It can also incentivize more efficient uses of land and reduced pressure on natural ecosystems.

The primary benefit of the land occupation metric is that it is simple and relatively easy to calculate and communicate compared to the other two land tracking metrics. It requires little or no new data collection. Companies that own or manage production land report the land currently in production. For companies sourcing land-based products, if they are already calculating scope 3 emissions, they can multiply the activity data (i.e., amounts of product produced or sourced) that they already track by yield factors to estimate land occupation.

At the time of this publication, land occupation is the land tracking metric that is currently most feasible for companies measuring the impacts related to forest products.

Challenges in quantifying land occupation

The land occupation metric has three main challenges:

- First, it is not measured in units of GHG emissions, since land occupation is expressed in hectares rather than CO_2e, so it cannot be easily compared to other parts of a GHG inventory. As the examples in chapters 11 and 17 show (table 11.5; box 17.1), simply tracking land occupation can illuminate tradeoffs (e.g., intensification may increase fertilizer-related GHG emissions, but also reduce land occupation), but without also calculating GHG impacts such as potential CO_2 removals on freed-up former agricultural lands, or changes in carbon opportunity costs, the climate impacts across multiple scenarios may remain unclear.
- Second, land occupation does not distinguish between different types of land (e.g., tropical rainforest, semi-arid pasture) meaning that it has limitations when trying to understand the connections between the use(s) of the land and consequences on carbon stocks.
- Third, for forest products, "land occupation" can be unclear because total surface areas of forests under management can be vast. To resolve this, companies estimate the "clear-cut equivalent" area required to produce the wood they harvested or purchased in the reporting year. Further guidance for estimating land occupation for forest products is given in chapter 17.

Implications for target setting

Companies can set a target to decrease land occupation or keep it constant. Avoiding further growth in land occupation is important in a world where deforestation must end to meet climate goals. Companies should consider adopting targets to reduce their land occupation over time as the world needs to not only halt conversion of natural ecosystems but also restore some current productive areas. Intensity targets (i.e., focused on a goal for yield growth) may also be appropriate.

For example, a company could set a corporate yield target in line with a larger-scale (e.g., global or national) target for yield growth, that is designed to meet future food or timber needs without further land expansion. See box 7.4 for an example of a corporate land occupation target.

Box 7.4 Example of calculating land occupation

Mars has estimated that production of its raw materials (e.g., cocoa, beef, dairy, wheat, pulp and paper) occupied 2.7 million hectares of cropland and pastureland in 2015. The company has further estimated that raw material purchases account for 99% of the land occupation associated with Mars' full value chain, with the other 1% including land for factories and offices. The company recognizes that increases in demand for agricultural products drives deforestation and other ecosystem conversion. As such, Mars' effort to track land occupation accompanies its commitments to end deforestation and ecosystem conversion in its value chains, and to reduce GHG emissions from land-use change.[80]

Implications for decision making

The land occupation metric is simpler than COC yet the incentivized mitigation options are similar. Companies can pursue productivity gains and/or shifts to products that require less land area to grow in order to freeze or reduce land occupation while producing more food or other land-based products.

7.4 Comparison and selection of land use change metrics

Each land use change metric described in this chapter can be useful for decision making, provide unique insights and perspectives, and drive different actions and behaviors at the corporate level.

Table 7.7 provides a comparison between land use change and land tracking metrics, to help companies choose which land use change-related metrics to track and report.

[80] Mars, 2021b

1 **Table 7.7 Comparison of all land use change (LUC) and land tracking metrics to support decision about**
2 **which metrics to track**

Metric	Data Needs/ Availability	Levers/ Incentives	Benefits	Challenges	Product Types
Direct land use change (dLUC)	Farm-level geospatial data, land-use-change (e.g., deforestation) data from recent 20-year period in same location	Incentivizes production/sourcing from lands not recently deforested	More spatially precise information than sLUC, easy to communicate	More data-intensive than sLUC, does not necessarily incentivize more efficient uses of land	All agricultural and forest products
Statistical land use change (sLUC)	Data on region/country/province of production or sourcing, emission factors matching that location (or global if unknown)	Incentivizes production/sourcing from geographical areas not recently deforested	Relatively easy and non-data-intensive to calculate; captures some indirect LUC effects across a broader landscape	Because it captures actions of many actors over a landscape, it is a less spatially precise indicator than dLUC of a company's actions or performance over time	All agricultural and forest products
Indirect land use change (iLUC) (based on econometrics)	Maps of existing land use and yields, population projections, GDP, cross-elasticities between food and energy (Default emission factors sometimes available)	Helps identify products with lower iLUC risk (e.g., incentivizes use of residues, yield gains)	Models LUC effects due to changes in demand based on economic relationships	Econometric models can be complicated, cross elasticities and market effects can be uncertain, historically mostly used for bioenergy feedstocks	Mainly used for bioenergy feedstocks
Indirect land use change (iLUC) (biophysical only)	Global or regional product-specific productivity (NPP or otherwise)	Incentivizes yield gains, and the use of less-productive land	More transparent than econometric models, can be applied to many products	Most methods are still only used in the context of energy, not widely used outside of academia	All agricultural products
Carbon opportunity costs (COC)	Estimates of native and current carbon stocks, production amounts, yields	Incentivizes yield gains, use of less land-intensive products, use of less carbon-rich lands, and management practices that increase carbon stocks	Translates land occupation metric into GHG metric	More complex to calculate/communicate than land occupation and dLUC, native vegetation model requires assumptions, need more tools to make calculation easier for companies	All agricultural products

Metric	Data Needs/ Availability	Levers/ Incentives	Benefits	Challenges	Product Types
Land occupation	Country-level land occupation and yield data available in FAOSTAT and land use models	Incentivizes yield gains and use of less land-intensive products	Very simple to calculate and communicate	Does not translate to GHG emissions, does not distinguish between different types of land (e.g., carbon-rich vs. carbon-poor)	All agricultural and forest products; most feasible land tracking metric for forest products at time of publication

Companies do not need to track and report all five metrics and should select a combination of metrics based on their relevance to management and decision-making. In summary:

Direct land use change emissions (dLUC) and/or **statistical land use change (sLUC) emissions** are required for reporting land use change emissions within the scopes.

Land occupation and **carbon opportunity costs** each track a similar impact: the land “footprint” of a company’s operations or value chain. Land occupation is simpler to calculate and communicate but is expressed in hectares (rather than CO_2e). Carbon opportunity costs essentially convert the land occupation metric into a GHG metric by multiplying the land occupied by the carbon in that land that was lost relative to native vegetation. Because not all hectares are equal from a carbon standpoint, calculating carbon opportunity costs supplies additional insights. That said, land occupation is a simpler metric for companies to calculate than carbon opportunity costs. Either metric can be tracked and reported separately.

Indirect land use change emissions (iLUC) can complement dLUC as this metric estimates the land use change emissions caused elsewhere by a company’s demand for a commodity. Several jurisdictions require tracking of iLUC for bioenergy commodities. Economic models estimate market-mediated changes in demand for commodities based on a company’s activity, but can be uncertain.

8

Land Management Accounting

Chapter 8: Land Management Accounting

Requirements and Guidance

This chapter provides requirements and guidance on accounting for emissions and removals from land management across land uses from both a scope 1 and scope 3 perspective. This chapter covers both biogenic net CO_2 emissions and removals from carbon stock changes due to land management, as well as GHG emissions from sources specific to land management.

Land management accounting (addressed in this chapter) applies to lands remaining in the same land use. Land use change accounting, including the land tracking category, is addressed in chapter 7. Calculation guidance for estimating land carbon stock changes is provided in chapter 18, while chapter 19 provides calculation guidance for other land management GHG emissions.

Sections in this chapter

Section	Description
8.1	Introduction to land management accounting
8.2	Land management net CO_2 emissions and removals
8.3	Land management non-CO_2 emissions

Checklist of accounting requirements in this chapter

Section	Accounting requirements
8.1	• Companies **shall** account for and report *Land management net CO_2 emissions* based on annual net land carbon stock changes. • Companies **shall** account for and report *Land management non-CO_2 emissions*

8.2	• Companies **shall** account for anthropogenic land management net CO_2 emissions and removals (if applicable) using one of the following two approaches:
	  ○ Classify all lands as managed lands
	  ○ Develop and consistently apply an approach to classify lands as managed or unmanaged
	• Companies **shall** fully account for all land carbon stock changes for land designated as managed lands, including changes due to degradation and carbon stock losses from fires, storms, and other natural disturbances
	• Companies that own or control land **shall** account for land carbon stock changes from land management associated with all managed lands included in their organizational boundary
	• Companies with scope 3 land management impacts **shall** account for net land carbon stock changes on all attributable managed lands in their value chain or lands related to leased assets, franchises, and investments

- Companies **shall** use a consistent scope 3 spatial boundary to account for land use change emissions and land management carbon stock changes, by product type, based on their level of traceability
- If accounting for land management carbon stock changes at a sourcing region-level or jurisdiction-level, sourcing region or jurisdictional boundaries **shall** exclude the following types of land:
    - Lands designated as unmanaged lands by the reporting company,
    - Managed lands or land management units in land uses, forest types or crop types not relevant to the biogenic product or material,
    - Lands with legal or regulatory restrictions on harvests,
    - Lands not capable of producing sufficient volumes of the product,
    - Lands with other protective status.
- If accounting for *Land management net CO_2 removals*, companies **shall** include land carbon stock measurements representative of relevant lands and carbon pools in the company's GHG inventory base year or period and resample using consistent methods at least every 5 years to estimate carbon stock changes using measurement-based approaches or to calibrate model-based or remote sensing-based approaches.
- When estimating net land carbon stock change, companies **shall** account for the following carbon pools and land uses, at a minimum:
    - <u>Biomass carbon stock changes</u>, including aboveground and belowground biomass, on forest lands, or grasslands, croplands, wetlands and/or settlements with woody or permanent cover
    - <u>Dead organic matter carbon stock changes</u>, including dead wood and litter, on forest lands, grasslands and croplands, where management practices significantly impact woody residues.
    - <u>Soil carbon stock changes</u>, including soil organic carbon in mineral and organic soils, on grasslands and croplands, or forest lands, wetlands and settlements where management practices significantly disturb soils
- Companies may account for and report *Land management net CO_2 removals* only if the following requirements are met:
    - <u>Ongoing storage monitoring</u>: Companies **shall** account for and report *Land management net CO_2 removals* only if ongoing storage monitoring is documented in a land management plan or monitoring plan and implemented to ensure carbon remains stored on the landscape and they can detect losses of stored carbon in relevant land-based carbon pools.
    - <u>Traceability</u>: Companies **shall** account for and report scope 3 *Land management net CO_2 removals* only if they have physical traceability to the land management unit(s) where the carbon is stored [or to the first point of collection or processing facility]. This requirement is subject to open question #3 (see chapter 8, box 8.3).
    - <u>Primary data</u>: Companies **shall** account for and report *Land management net CO_2 removals* only if the net carbon stock changes are accounted for using primary data specific to the land carbon pools where the carbon is stored in the reporting company's operations or value chain
    - <u>Uncertainty</u>: Companies **shall** account for and report *Land management net CO_2 removals* only if the net land carbon stock increase is statistically significant based on quantitative uncertainty estimates.
    - <u>Reversals</u>:
        - Companies **shall** account for and report net land carbon stock losses of previously reported *Land management net CO_2 removals* in the year the losses occur, as either:

	• *Land management net CO_2 emissions*, if the carbon pools are part of the GHG inventory boundary in the reporting year, or • *Reversals from land-based storage*, if the carbon pools are no longer in the GHG inventory boundary in the reporting year. ▪ If companies lose the ability to monitor land carbon stocks associated with previously reported removals, companies **shall** assume previously reported removals are emitted and report *Reversals from land-based storage*.

8.1 Introduction to land management accounting

Management of forest lands, croplands, grasslands and other land uses influence the amount of carbon contained in land-based carbon pools and GHG emissions associated with practices on the land. This section provides an introduction of the different GHG fluxes from land management, accounting methods, and definitions for scope 1 and scope 3 land management GHG emissions and CO_2 removals.

Accounting requirement

Companies **shall** account for and report both:

- *Land management net CO_2 emissions* based on annual net land carbon stock changes, and
- *Land management non-CO_2 emissions* (i.e., CH_4, N_2O and non-biogenic CO_2 emissions).

Companies may account for and report *Land management net CO_2 removals* if the requirements for reporting removals from chapter 6 are met (see section 8.2.6 for details).

8.1.1 Land management accounting categories

Land management GHG fluxes are divided by land management biogenic CO_2 fluxes, which includes *Land management net CO_2 emissions* and *Land management net CO_2 removals*, and *Land management non-CO_2 emissions*, as described below.

Land Management Net CO_2 Emissions and Removals

Land-based carbon pools include biomass, dead organic matter, and soil, all of which contain carbon of biogenic origin. Management practices affect the growth rates, species composition, harvest rates, decay rates and other factors that can increase or decrease the total carbon stocks on the land over time.

Specific management impacts, such as harvesting, replanting, species selection, site preparation, fertilizer application, pest control and fire, impact carbon stocks over time, some immediately while others have long lasting effects. Carbon stock changes are also influenced by physical factors, such as soil type, water, climate, aspect and topography. All of these factors need to be considered when estimating net biogenic CO_2 emissions and removals resulting from land carbon stock changes, which can vary from site specific to broader regional influences on carbon stocks.

As described in chapter 4 and in section 8.1.2, this Guidance applies stock-change accounting methods to account for the net biogenic CO_2 flux based on the net land carbon stock change. Where the net land carbon stocks decrease, this results in net biogenic CO_2 emission. Where the net land carbon stocks increase, this results in net biogenic CO_2 removals. Section 8.2 and chapter 18 provides further guidance on accounting for *Land management net CO_2 emissions and removals*.

Land Management Non-CO_2 Emissions

In addition to biogenic CO_2 emissions and removals associated with land carbon stock changes, land management can be a significant source of other GHG emissions, including methane (CH_4), nitrous oxide (N_2O) and non-biogenic CO_2. GHG emissions from land management include CH_4 and N_2O emissions from livestock and manure management, N_2O emissions from N inputs to agricultural soils and soil organic matter mineralization, non-biogenic CO_2 emissions from lime and urea, CH_4 emissions from rice cultivation, reservoirs and other flooded lands, CH_4 and N_2O emissions from biomass burning, and other GHG emissions occurring on lands used for production. GHG emissions also occur across the life cycle of both agricultural inputs and products coming off the land. Section 8.3 and chapter 19 provides further guidance on accounting for *Land management non-CO_2 emissions.*

8.1.2 Stock-change and flow accounting for biogenic CO_2 emissions and removals

Under this Guidance, companies account for and report net biogenic CO_2 emissions and removals from land management using stock-change accounting methods. Stock-change accounting estimates net biogenic CO_2 emissions or removals and the associated net land carbon stock changes. Net land carbon stock changes can be calculated using either the stock-difference method (see equation 8.1) or gain-loss method (see equation 8.2).

Companies should also account for and separately report *Gross biogenic land CO_2 emissions* and may account for and report *Gross biogenic land CO_2 removals* using flow accounting methods. Flow accounting separately estimates gross biogenic CO_2 emissions and gross biogenic CO_2 removals and the associated gross land carbon stock gains and losses. Flow accounting information serves as the parameters for estimating the net land carbon stock change using the gain-loss method based (see equation 8.2).

Stock-change and flow accounting both can be used to estimate the net biogenic CO_2 flux. While only stock-change accounting is required to report on land management net CO_2 emissions and removals, accounting and reporting information based on both stock-change and flow accounting is recommended to ensure transparency on where the individual gross biogenic carbon fluxes occur, identify drivers of net carbon stock changes (e.g., types of disturbances leading to gross biogenic land CO_2 emissions or growth rates driving gross biogenic land CO_2 removals) and to supplement reporting of net carbon stock changes. The open question #1 (chapter 5, box 5.2) will further explore the tradeoffs of stock-change and flow accounting.

Stock-Difference Method

The stock-difference method quantifies the net land carbon stock change based on the change in total carbon stocks across land-based carbon pools (aboveground biomass, belowground biomass, dead organic matter and soil carbon) over time, as shown in equation 8.1.

Equation 8.1 Stock-difference method for net land carbon stock changes

$$\Delta C_L = \frac{C_{L,f} - C_{L,i}}{t_f - t_i}$$

ΔC_L	=	Net land carbon stock change in land strata, L (tonnes C yr^{-1})
C	=	Land carbon stock in land strata, L in the final year $C_{L,f}$ and initial year $C_{L,i}$ (tonnes C)
t	=	time at the final t_f and initial t_i estimate (year)

The Gain-Loss Method

The gain-loss method quantifies the net land carbon stock change based on the difference between carbon gains (gross CO_2 removals and other non-atmospheric C inputs to land-based carbon pools) and carbon losses (gross CO_2 emissions and other C transfers from land-based carbon pools) in a given period, as shown in equation 8.2.

Equation 8.2 Gain-loss method for net land carbon stock changes

$$\Delta C_L = G - L = (R_L + I_L) - (E_L + T_L)$$

ΔC_L	=	Net land carbon stock change in land strata, L (tonnes C yr^{-1})
G_L	=	Annual land carbon stock gains in land strata, L (tonnes C yr^{-1})
L_L	=	Annual land carbon stock losses in land strata, L (tonnes C yr^{-1})
R_L	=	Annual land carbon stock gains from gross biogenic land CO_2 removals in land strata, L (tonnes C yr^{-1})
I_L	=	Annual land carbon stock gains from non-atmospheric C inputs to land strata, L (tonnes C yr^{-1})
E_L	=	Annual land carbon stock losses from gross biogenic land CO_2 emissions in land strata, L (tonnes C yr^{-1})
T_L	=	Annual land carbon stock losses due to harvested C and other C transfers from land strata, L (tonnes C yr-1)

As shown in equation 8.2, land carbon stock gains include gross biogenic land CO_2 removals associated with biomass growth through photosynthesis and may include other non-atmospheric C inputs to land-based carbon pools (e.g., biochar soil amendments). Land carbon stock losses include gross biogenic land CO_2 emissions and transfers of carbon from land-based carbon pools. Gross biogenic land CO_2 emissions include emissions from mortality, disturbances and biomass burning of land-based carbon pools. Transfers of carbon from land are primarily the result of biomass harvests but may also include collection of agricultural or forestry residues and other carbon losses due to thinning, pruning or related land management practices.

8.1.3 Scope 1, 2 and 3 land management accounting categories

Companies that own or control lands account for and report the various land management accounting categories in scope 1. Companies that acquire electricity, steam, heating or cooling directly from lands (e.g., electricity generated for hydropower reservoirs) must account for *Land management non-CO_2 emissions* in scope 2. Companies that do not own or control land but their activities (e.g., purchase of land-based goods, bioenergy use, or other activities relevant to scope 3 categories) impact lands in their value chain account for and report the various land management accounting categories in scope 3 land emissions and removals.[81] Scope 3 land management emissions and removals should be properly allocated in accordance with the allocation provided in chapter 16. Table 8.1 summarizes the different accounting categories by scope related to land management and the metrics used to estimate them.

[81] Chapter 5 provides additional guidance on determining the inventory boundaries for lands within scope 1 and scope 3.

1 **Table 8.1 Summary of accounting categories associated with land management by scope**

Accounting Category	Accounting Subcategories	Companies that own or control lands	Companies that source energy from managed lands	Companies with land management impacts in their value chain
Land emissions ***Required***	**Land management net CO_2 emissions**	**Scope 1 land management net CO_2 emissions**: Net biogenic CO_2 emissions from net carbon stock decreases in land-based carbon pools on lands owned or controlled by the reporting company	N/A	**Scope 3 land management net CO_2 emissions**: Net biogenic CO_2 emissions from net carbon stock decreases in land-based carbon pools on managed lands attributable to the reporting company's value chain
	Land management non-CO_2 emissions	**Scope 1 land management non-CO_2 emissions**: CH_4, N_2O and non-biogenic CO_2 emissions from management of lands owned or controlled by the reporting company	**Scope 2 land management non-CO_2 emissions**: CH_4, N_2O and non-biogenic CO_2 emissions from management of lands used to generate purchased or acquired electricity, steam, heating, or cooling consumed by the reporting company	**Scope 3 land management non-CO_2 emissions**: CH_4, N_2O and non-biogenic CO_2 emissions from management of managed lands attributable to the reporting company's value chain
Removals ***Optional***	**Land management net CO_2 removals**	**Scope 1 land management net CO_2 removals**: Net biogenic CO_2 removals from net carbon stock increases in land-based carbon pools on lands owned or controlled by the reporting company	N/A	**Scope 3 land management net CO_2 removals**: Net biogenic CO_2 removals from net carbon stock increases in land-based carbon pools on managed lands attributable to the reporting company's value chain
Separate reporting of gross emissions and gross removals **(Separately reported from and not aggregated with net emissions or net removals above)**				
Gross emissions and gross removals[2]	**Gross biogenic land CO_2 removals**	**Scope 1 gross biogenic land CO_2 removals**: Gross CO_2 removals to land-based carbon pools on	N/A	**Scope 3 gross biogenic land CO_2 removals**: Gross CO_2 removals to land-based carbon pools on managed lands attributable to

Optional		lands owned or controlled by the reporting company		the reporting company's value chain
	Gross biogenic land CO_2 emissions	**Scope 1 gross biogenic land CO_2 emissions**: Gross CO_2 emissions from land-based carbon pools on lands owned or controlled by the reporting company	N/A	**Scope 3 gross biogenic land CO_2 emissions**: Gross CO_2 emissions from land-based carbon pools on managed lands attributable to the reporting company's value chain

8.2 Land management net CO_2 emissions and removals

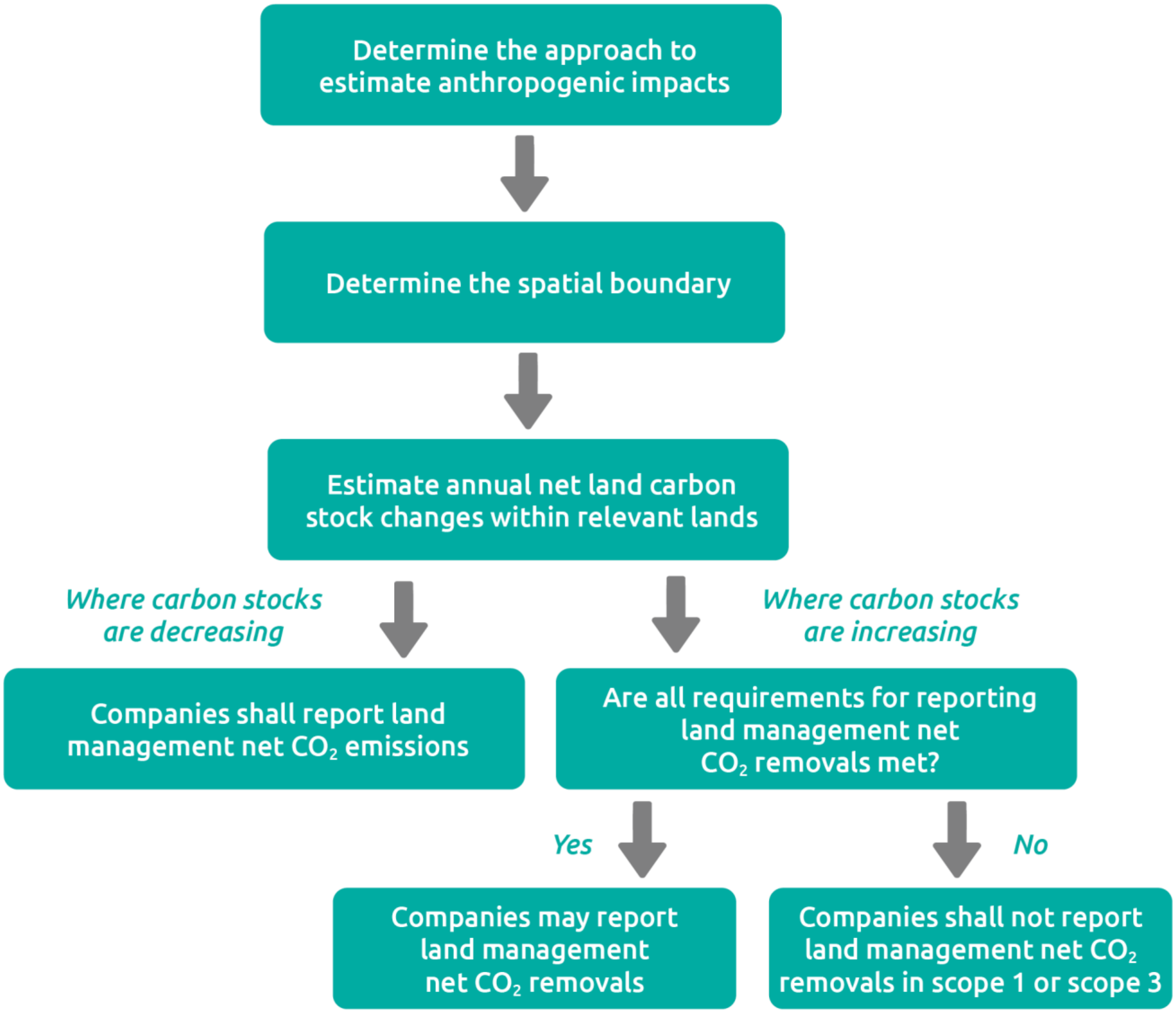
8.2.1 Accounting for and reporting land management net CO_2 emissions or removals

To account for *Land management net CO_2 emissions or removals*, companies should estimate net carbon stock changes on land that remains within the same land use category and subcategory in the reporting year. Companies can follow the decision tree in figure 8.1 for steps involved in accounting for and reporting *Land management net CO_2 emissions or removals*. Companies should first determine the approach used to estimate anthropogenic impacts on land carbon stocks (see section 8.2.2 for details). Next, they should determine the relevant spatial boundary and the monitoring frequency for data used to estimate the net land carbon stock change (see section 8.2.3 and 8.2.4 for details). Companies should then identify which carbon pools and land uses will be included in the estimate of net land carbon stock changes along with the methods applied (see section 8.2.5 and chapter 18 section 18.2 for calculation guidance).

- Where the net land carbon stocks decrease, companies **shall** report *Land management net CO_2 emissions*.
- Where net land carbon stocks increase, companies may report *Land management net CO_2 removals*, if they meet the requirements for reporting CO_2 removals in chapter 6 (see section 8.2.6 for details).

Companies should account for and report *Gross biogenic land CO_2 emissions* and may account for *Gross biogenic land CO_2 removals* based on flow accounting approaches, separately from *Land management net CO_2 emissions or removals* using stock-change accounting (see chapter 18 section 18.3 for calculation guidance).

Figure 8.1: Decision tree for land management carbon accounting and reporting



Note: Companies should also report gross biogenic land CO_2 emissions and removals from land management

8.2.2 Determining anthropogenic land impacts

Background

Companies that own or control land, or purchase products from lands owned and managed by others in their value chain, have only partial control of land carbon stock changes. In addition to anthropogenic management decisions (e.g., harvesting, replanting, and prescribed burning), land carbon stocks also change due to natural factors (i.e., natural unassisted growth and disturbances).

GHG inventories are designed to capture anthropogenic emissions and removals due to land management. Multiple approaches can be used to separate anthropogenic from natural impacts. Any approach to isolate anthropogenic from natural impacts should consistently address both emissions and removals (i.e., if certain lands are considered unmanaged then companies cannot account for emissions or removals associated with such lands).

The IPCC *Guidelines for National GHG Inventories* introduces the “managed land proxy” as an approximation for determining anthropogenic land management net CO_2 emissions and removals. The IPCC defines managed land as “land where human interventions and practices have been applied to perform production, ecological or social functions.”[82] The managed land proxy accounts for all net carbon stock changes on managed land, but acknowledges that on managed lands a combination of anthropogenic (i.e., land management) and natural factors (i.e., natural unassisted growth and natural disturbances) impact carbon stock changes.[83]

The managed land proxy only applies to estimates of net land carbon stock change and reporting on land management net CO_2 emissions or removals but does not apply to other GHG emissions. Companies do not need to account for land management net CO_2 emissions or removals associated with lands designated as unmanaged land, however they do still need to account for and report all anthropogenic non-biogenic-CO_2 GHG emissions occurring on unmanaged lands in the relevant scope (e.g., CH_4 emissions from oil and gas wells, abandoned mines, closed landfill sites).

The managed land proxy can be applied to all land uses. Most lands classified as cropland and settlements will typically meet definitions for managed lands. Forest lands, grasslands and wetland may be classified as managed or unmanaged depending on the criteria used. Other lands will typically meet definitions for unmanaged lands.

Applying the Managed Land Proxy

Accounting requirement

Companies **shall** account for anthropogenic land management net CO_2 emissions and removals (if applicable) using one of the following two approaches:

- **Classify all land as managed land:** Assume all land carbon stock changes are anthropogenic and apply the managed land proxy to all lands
- **Develop and consistently apply an approach to classify lands as managed or unmanaged:** Develop and consistently apply criteria to distinguish between managed and unmanaged lands, then apply the managed land proxy to all managed lands

Companies choosing to distinguish between managed and unmanaged lands should consider the following when developing and consistently apply criteria to distinguish between managed and unmanaged lands:

- Develop clear definitions of managed and unmanaged lands with criteria to distinguish between them that are applied consistently spatially and temporally. Unmanaged lands may include the following:
    - Lands where no industrial, commercial, residential, infrastructure construction, or other activities are conducted on the land (with the potential exception of some recreational, research, etc. activities where there is no particular intervention occurring)
    - Lands where no management plans are in place and being implemented on the land. This includes that there are no management plans that involve harvesting biomass, conservation, wildfire management, invasive species and species at risk management, or any other type of intervention on the land
    - Lands where no land use change is occurring or has occurred on the lands in the last 20 years

[82] IPCC, 2019b

[83] IPCC, 2006 (Volume 4, Chapter 2)

- Outline an approach to determine how managed and unmanaged lands are determined over time:
    - **Consistent designation:** This approach ensures consistent designation over time where once lands are designated as unmanaged following the guidance above they remain classified as unmanaged even if they are brought into management to deal with natural disturbance events (e.g., for lands deemed unmanaged that experience forest fires they should exclude both carbon stock changes associated with the natural disturbance emissions and subsequent removals from regrowth, even if post-fire management is involved).
    - **Base year recalculation for newly managed lands:** The approach allows for managed lands to be brought into the inventory boundary that were previously considered unmanaged lands. Where unmanaged lands are reclassified as managed lands this would trigger a base year recalculation following guidance in chapter 12, where companies recalculate base year emissions and removals to account for carbon stock changes on lands previously considered unmanaged land (e.g., to consider lands with salvage logging operations and associated regrowth following a wildfire as managed lands would require companies to account for relevant emissions from the natural disturbance event as managed lands as well).

In making the decision to account for carbon stock changes on all lands or developing criteria to distinguish managed and unmanaged lands, companies should consider issues such as their exposure to natural disturbance risks, the suitability of monitoring systems for differentiating anthropogenic from natural events, and potential impact on any mitigation targets. Box 8.1 provide additional background and detail on some of the challenges with separating out anthropogenic emissions and removals from land. Companies **shall** report which approach(es) have been used to account for anthropogenic land management net CO_2 emissions and removals and if companies choose to separate managed from unmanaged include a description of the definitions and criteria used to distinguished managed and unmanaged lands.

Box 8.1 Challenges in separating out anthropogenic emissions and removals on the land

There have been long-running discussions on the separation of natural and anthropogenic emissions in national greenhouse gas inventories.[84] These typically focus on 1) definitions of natural and anthropogenic events, and 2) methods for separating these effects.

Defining natural and anthropogenic events

The results of these discussions culminated in the interannual variability guidance for the managed land proxy in revised IPCC national GHG inventory guidance.[85] The intention with these guidelines is to separate the human-induced from natural effects by disaggregating the impacts of natural disturbances on carbon stock changes from the total carbon stock changes on managed lands. For the purposes of this Guidance, natural disturbances are defined as those that are not the direct result of management actions taken by the company, land managers or other actors in their value chain and that are beyond the control of, and not materially influenced by a company, land management practices or other human interventions in their value chain.

Methods for separating natural and anthropogenic impacts

Key methodological challenges for attempting to separate out anthropogenic from natural impacts on the land (e.g., reference level accounting) include:

[84] Grassi et al., 2018

[85] IPCC, 2019b (Volume 4, Chapter 1 Section 1.1)

- Natural disturbances lead to a relatively rapid loss of carbon stocks, which is then followed by a slower re-accumulation of carbon as the land recovers.
- Using a plot-based stock-difference method to estimate carbon stock changes using periodic measurements (i.e., multi-year sampling) cannot separate out what factors (i.e., anthropogenic vs. natural) influence land carbon stock changes.
- Legacy effects of carbon stocks based on past management or natural disturbances can influence the potential for emissions or removals (i.e., lands with historically low carbon stocks during a base period have more potential for removals).

Accounting for natural disturbances

Accounting requirement

Companies **shall** fully account for all land-based carbon stock changes on land designated as managed lands, including changes due to degradation and carbon stock losses from fires, storms, and other natural disturbances.

Natural disturbances may include wildfires, insect and disease infestations, extreme weather events and/or geological disturbances, beyond the control of, and not materially influenced by, a company. Many companies already have internal strategies to address natural disturbances to help ensure ongoing supply of products. In the same way, the impact of natural disturbances on carbon stock changes may also need to be considered especially when companies are seeking to meet mitigation targets.

Assessing the impact of natural disturbances is typically easier for scope 1 emissions as the company has control over the land. For scope 3 emissions the ability to apply any natural disturbance accounting rules will depend on the ability to identify those lands (see section 8.2.3). Where regional or national data are used it may have excluded natural disturbance emissions either directly (through application of accounting rules) or indirectly (through the use of methods that do not assess natural disturbances). As such, companies must ensure that natural disturbances are accounted for by understanding how the data and/or methods used to account for net land carbon stock changes on managed lands treat natural disturbances.

Reference level accounting

An alternative approach to isolate anthropogenic impacts of land management is to account for changes in carbon stocks relative to a reference level. Reference levels can be developed by projecting carbon stock changes based on historical data on carbon stocks and land management. Reference level accounting is not applied to estimate annual net land carbon stock change used to report on *Land management net CO_2 emissions or removals*.

Given that reference level accounting relies on consequential accounting methods (as opposed to inventory accounting methods used in this Guidance), the many assumptions built into developing counter-factual reference levels and the methodological complexity, reference level accounting to isolate anthropogenic impacts is optional. Where companies use reference levels or other methods to isolate anthropogenic impacts on land carbon stock changes, they may separately quantify natural disturbance emissions and natural unassisted growth and report them as additional information outside of the scopes for transparency. Such estimates are not to be factored into the accounting of net land carbon stock changes used to report on scope 1 or scope 3 *Land management net CO_2 emissions or removals*.

8.2.3 Spatial boundaries for land management carbon accounting

Spatial boundary for owned or controlled lands (scope 1)

Accounting requirement

Companies that own or control land **shall** account for net land carbon stock changes from land management associated with all managed lands included in their organizational boundary (chapter 5).

As described in section 8.2.2, companies may differentiate managed land from unmanaged land to only report the anthropogenic impacts of land management net CO_2 emissions and removals on carbon stocks in managed land.

Spatial boundary for lands in the value chain of the company (scope 3)

Accounting requirement

Companies with scope 3 land management impacts **shall** account for net land carbon stock changes on all attributable managed lands in their value chain or lands related to leased assets, franchises, and investments.

The spatial boundaries for attributable managed lands included in a company's scope 3 boundary depend on the reporting company's activity(ies), the relevant scope 3 category, and the degree of traceability to known lands or regions.

Based on the scope 3 category, lands included in the company's scope 3 boundary are either those that are attributable processes in the life cycle of products or materials the company purchases or sells (e.g., lands associated with producing crops or wood products or lands where sold agricultural inputs are applied), or specific lands that are franchises, leased assets or investments of the reporting company (if not included in scope 1).

- **For scope 3 categories related to purchased and sold products:** Attributable managed land that are associated with the product life cycle of biogenic products or materials (e.g., crops, animal products, wood products, agricultural inputs etc.) purchased, processed, used or sold by the reporting company where the specific land area may be known or unknown (i.e., scope 3 categories 1, 2, 3, 4, 5, 6, 7, 9, 10, 11 and 12)
- **For scope 3 categories related to franchises, leased assets and investments:** Specific lands associated with leased assets, franchises or investments in the value chain, if not included in scope 1 of the reporting company (i.e., scope 3 categories 8, 13, 14 and 15)

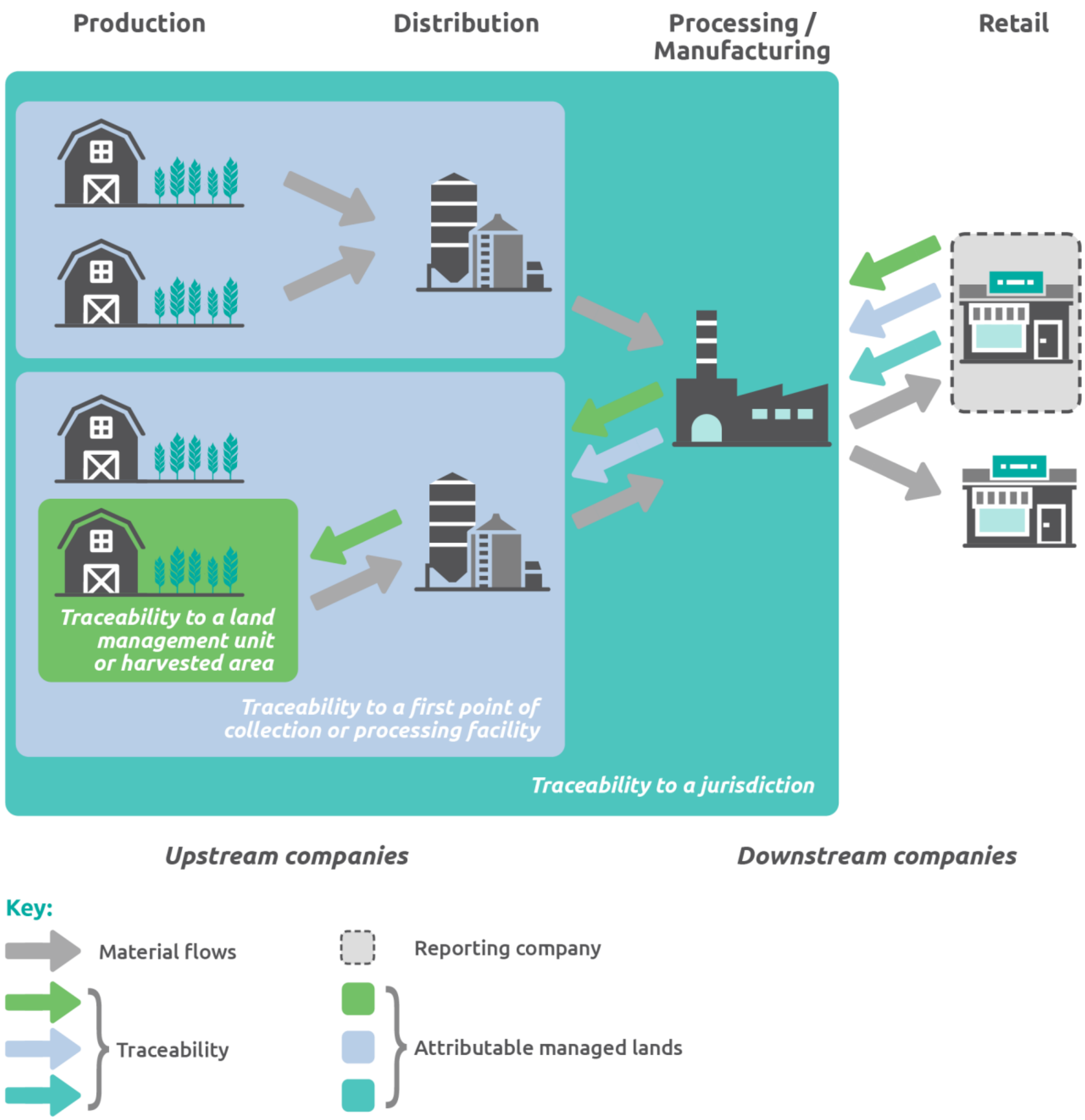
Spatial boundary for attributable managed lands in the value chain

Where there are managed lands attributable to life cycle phases of the reporting company's scope 3 inventory, the spatial boundary used to estimate land management carbon stock changes should correspond to the level of traceability a company has and the scale at which management decisions are made. Companies should account for net land carbon stock changes at a scale most relevant to management decisions associated with products in their value chain, which may depend on the product and level of traceability companies have.

When accounting for *Land management net CO_2 emissions or removals*, traceability refers to the knowledge companies have regarding the specific land area where biogenic products or materials purchased by the reporting company are produced, or where products sold by the reporting company are used to support biogenic material production (as illustrated in figure 8.2). The level of traceability can be categorized according to the following scales, from most specific to least specific:

- Harvested area of origin
- Land management unit of origin
- Sourcing region of origin
- Jurisdiction of origin
- Unknown origin

Figure 8.2 Example of attributable managed lands based on a downstream company's traceability



Note: Colors represent different levels of traceability and the associated production units to be included in the analysis of net land carbon stock changes on attributable managed land.

Some value chains allow for physical traceability to a specific land management unit or harvested area within a land management unit (e.g., a paper company tracing pulpwood back to specific forest management units (FMU) or individuals forest stands within that FMU, or a coffee retailer tracing coffee beans back to specific coffee plantations or fields within that plantation). In other cases, it might only be possible to obtain data specific to the sourcing region based on the first point of collection or distribution or the jurisdiction of origin (i.e., state, province, country, or other political region of origin). If no data on the origin of products or materials are available, companies should seek to improve data traceability in accordance with guidance in chapter 16.

Accounting requirement
Companies **shall** use a consistent scope 3 spatial boundary to account for land use change emissions and land management carbon stock changes, by product type, based on their level of traceability.

Table 8.2 illustrates the relevant scope 3 spatial boundary and metrics companies should use to account for *Land use change emissions* and *Land management net CO_2 emissions and removals* based on their traceability by product type. Companies **shall** report on the level of physical traceability they have by product type and the attributable managed lands included in the spatial boundary used to evaluate net carbon stock changes.

Table 8.2 Guidance on the scope 3 spatial boundary to be consistently applied across land metrics based on level of traceability for a given product

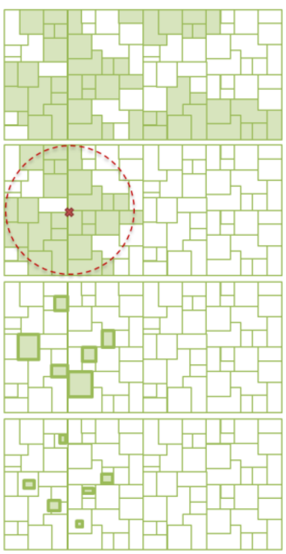
Level of physical traceability	Land use change emissions	Land management net CO_2 emissions or removals
To a jurisdiction	Use statistical land use change (sLUC) metrics to estimate *Land use change emissions* within the jurisdiction and allocate to products (e.g., secondary data from databases on sLUC emission factors by country and product)	Use the spatial boundary of attributable managed lands within the jurisdiction for the given land use to calculate net land carbon stock changes and account for *Land management net CO_2 emissions*, if net carbon stock decreases occur, and allocate to products (e.g., allocate net CO_2 emissions from forest degradation or cropland soil degradation if occurring within the jurisdiction) Not sufficient traceability to determine attributable managed lands for removals accounting.
To a sourcing region	Use sLUC metrics to estimate *Land use change emissions* within the sourcing region and allocate to products (e.g., analysis of sLUC emissions occurring within the sourcing region)	Use the spatial boundary of attributable managed lands within the sourcing region to calculate net land carbon stock changes and account for *Land management net CO_2 emissions or removals* (where removals requirements and sourcing region safeguards are met, subject to open question #3 in chapter 8, box 8.3) and allocate to products • Note that if the final guidance allows for sourcing region level accounting for removals this would only be until 2030 but then revisit the need for more precise traceability requirements
To a land management unit	Use direct land use change (dLUC) metrics to estimate *Land use change emissions* within individual land management units and allocate to products	Use the spatial boundary of individual land management units to calculate net land carbon stock changes and account for *Land management net CO_2 emissions or removals* (where removals requirements are met) and allocate to products

To a harvested area	Use dLUC metrics to estimate *Land use change emissions* within the spatial boundaries for the harvested areas and allocate to products	Use the spatial boundary for the harvested area to calculate net land carbon stock changes and account for *Land management net CO_2 emissions or removals* (where removals requirements are met) and allocate to products

At each spatial scale, allocation is needed to attribute the annual net land carbon stock changes to the products purchased or sold by the reporting company. Chapter 16 provides guidance on allocation methods.

While there is more flexibility on the spatial boundary to account for net land carbon stock changes when reporting *Land management net CO_2 emissions*, more specific data is needed to meet the permanence principle and balance accuracy and conservativeness associated with accounting for and reporting on *Land management net CO_2 removals*. Chapter 6 provides requirements on the level of traceability required to report *Land management net CO_2 removals*, with further guidance in section 8.2.6. Figure 8.3 illustrates the spatial boundary for attributable managed lands that should be included in the analysis of net land carbon stock change by level of traceability.

Figure 8.3: Illustration of relevant spatial boundary based on traceability for scope 3 accounting



Spatial Boundary	Traceability	Data Specificity	Emissions Reporting	Removals Reporting
Jurisdiction	Known subnational jurisdiction, country or political region (e.g. EU) of origin	Average national or regional secondary data for attributable managed lands in the jurisdiction	Least precise	No, requires more precise traceability and primary data
Sourcing Region	Known first collection point or processing facility	Primary data on attributable managed lands in the sourcing region(s) or secondary data representative of average management for lands within the sourcing region(s)		Subject to pilot testing question #3
Land Management Unit	Known land management units of origin (e.g. forest management unit, ranch or farm)	Primary data from producers for the specific land management unit(s)		Yes, if the company meets other removals requirements
Harvested area	Known field or forest stand of origin	Primary data from producers for the specific harvested area(s)	Most precise	Yes, if the company meets other removals requirements

Spatial boundary for known harvested area

A harvested area is a spatially explicit area of agricultural or managed forest land that was harvested at a given time to produce the relevant raw material. This narrow spatial boundary accounts only for the impacts of a discrete harvest and does not include the broader carbon flows of other managed lands that are not harvested at that point in time.

For croplands and grasslands, the harvested area can be a field where a crop or animal product is produced. Fields are smaller units managed according to a specific set of practices that make up a broader farm, plantation, ranch or grazing management unit.

For forest land the harvested area can be a forest stand where a forest product is harvested. A stand is typically managed according to a specific set of forest management practices to maintain similar composition, structure, age and size classes. A stand is a subset of a forest management unit.

Spatial boundary for known land management units

A land management unit (LMU) is a predefined, spatially explicit area of a given land use, managed according to a clear set of objectives according to a single land management plan. A land management unit could refer to the following management systems depending on the land use (see table 8.3).

Table 8.3: Examples of land management units by land use

Land use	Examples of land management units
Forest lands	A forest management unit, such as a managed natural forest, tree plantation, etc.
Grasslands	A grazing land management unit, such as a ranch, pasture, multi-paddock grazing system, etc.
Croplands	An agricultural management unit, such as a farm, plantation, orchard, vineyard, etc.

Land management units can include conservation or set aside areas that are part of the land management unit, owned by the same entity and managed according to a consistent land management plan. For example, a forest management unit could encompass multiple forest stands in different age classes as well as buffer zones or set-aside areas not intended for harvest that are included within the forest management plan to ensure ecological function as long as all lands are controlled by the same entity and managed according to the same forest management plan.

Spatial boundary for known sourcing region

A sourcing region, also known as a supply shed or supply base, is a predefined, spatially explicit land area that supplies harvested biogenic materials to the first collection point or processing facility in a value chain. A collection point is a location that receives harvested biogenic materials from land management units for processing or distribution further down the supply chain.

A sourcing region may comprise multiple land management units or be an area within a single land management unit, depending on geography and sector. A sourcing region may be situated within a single country or span multiple countries or other political boundaries. Consideration should be given to the following factors when determining the most appropriate approach to setting the spatial boundary for a sourcing region.

- **Multiple collection points:** Where multiple collection points are in close proximity and have overlapping sourcing areas, a single sourcing region covering the total area for all facilities may be appropriate.
- **Setting a consistent boundary:** Ideally the souring region boundary should not change over time, so boundaries should address both current and future sourcing needs.
- **Focus on land management units:** Land areas and their associated carbon stock changes should only be reported for those land management units from which biogenic material is sourced or sold products are used. Land management units or land uses unaffected by sourcing or use, including conservation areas or other land areas with harvest restrictions outside of relevant land management units, should be excluded.

Attributable managed lands included in the sourcing region boundary are determined as follows:

- For crops, all croplands where the crop type purchased by the reporting company were harvested in the reporting year

- For animal products, all croplands where the crop purchased by the reporting company was harvested in the reporting year
- For forest products, all managed forest lands or forest types capable of producing that forest product
- For products from sourcing regions where average land management practices are to produce that product using multi-output systems, crop rotations or intercropping, companies can use a sourcing region boundary that includes all managed lands that have produced that product in the past 5 years.

Accounting requirement

Sourcing region boundaries **shall** exclude the follow types of land:

- Lands designated as unmanaged lands by the reporting company (see section 8.2.2)
- Managed lands or land management units in land uses, forest types or crop types not relevant to the biogenic product or material
- Lands with legal or regulatory restrictions on harvests (e.g., lands in national parks or preserves)
- Lands not capable of producing sufficient volumes of the product (e.g., forest lands capable of producing <1.4 m^3 per ha)[86]
- Lands with other protective status (e.g., conservation easement)

Allocation of carbon stock changes to goods and services purchased from or sold to a given sourcing region should be consistent with the allocation guidance provided in chapter 16.

Spatial boundary for known jurisdiction

If companies cannot collect carbon stock and/or sourcing data at a land management unit or sourcing region level, spatial boundaries may be used that represent the jurisdictional boundaries from which the biogenic materials are sourced. This could be political boundaries based on a subnational jurisdiction (e.g., state or province), country or political region (e.g., the European Union) of origin. Companies should evaluate the political boundary that is most relevant to the point in the value chain where they have traceability (e.g., if the reporting company only has traceability to a manufacturing facility they should consider the political boundary most relevant to where that facility sources materials from). Where relevant, a group of countries or jurisdictions may also be applicable based on the traceability information, noting preference for the most detailed level of resolution.

When estimating carbon stock changes at a jurisdictional level, the company should follow guidance provided above for known sourcing regions on determining attributable managed lands and excluding certain lands within the jurisdiction to ensure only attributable managed lands are included in the assessment of net carbon stock changes in the jurisdiction.

Allocation of carbon stock changes to goods and services purchased from or sold within a jurisdiction should be consistent with allocation guidance provided in chapter 16.

Box 8.2 Considerations of spatial scale when accounting for scope 3 *Land management net CO_2 emissions and removals* related to forest products

[86] This example is taken from the United States Forest Service timberland definition which includes forests capable of producing in excess of 20 ft^3 per acre per year of industrial wood in natural stands.

Typically, the spatial scale selected to account for emissions and removals aims to capture the effects of a certain management regime. In the case of forest products there is considerable debate regarding the most appropriate spatial scale of analysis.[87] For some forest managers, management decisions are often made based on forest management plans specific to individual forest management units (FMUs) and the forest stands within those FMUs. However, at broader spatial scales that include small private forest owners, such as at the level of a sourcing region or jurisdiction, individual forest management decisions may be impacted by broader factors, such as economic factors that can influence a forest owner's decisions to harvest.

Accounting for forest carbon stock changes at a sourcing region-level or jurisdictional-level poses a risk of including forest lands that are not attributable to the forest products coming from that region. For example, if conservation land (which will never be harvested) is included within the spatial boundary of a jurisdiction, then wood products from that jurisdiction would be associated with removals from forest lands that are not attributable to the company's supply chain. Additionally, allowing a company to use a broad spatial scale, such as a sourcing region, to account for removals, may disincentivize companies from improving their traceability over time.

There are also drawbacks to using a FMU or forest stand spatial scale to account for *Land management net CO_2 emissions and removals* associated with forest products. Building information sharing systems to ensure physical traceability of all forest products to individual FMUs or forest stands can be difficult for downstream forest product consumers in many supply chains. Even where such traceability exists as companies purchase additional forest products, new forest lands would continually need to be added to an inventory boundary over time as wood is harvested from new FMUs or stands.[88]

While accounting at a FMU-level may be more reflective of some forest managers' decision-making, it raises issues surrounding the causality between a company's decision to purchase wood and the removals attributed to that wood. For example, consider two FMUs that are both managed to increase forest carbon stocks but one FMU is larger in size and managed by a large forest management company while the other is smaller and managed by a small private forest owner. If accounting at a FMU-level, a company that purchases 10 tons of wood from the small FMU will have less removals associated with the wood it purchases than a purchase of 10 tons of wood from the larger FMU (as the larger FMU has a larger area thus more forest growth and greater net carbon stock increases), even though the activity of purchasing 10 tons of wood is the same. Additionally, if removals accounted for at a FMU-level are attributed to harvested wood products, and companies purchasing those products claim those removals, then companies would be incentivized to buy more wood and would receive a climate benefit for doing so as opposed to sourcing recycled wood fiber with no associated CO_2 removals. Thus, the incentive to recycle would be reduced.

Taken together, there are multiple causality issues with attributing the growth of unharvested trees to harvested wood products because, at scale, incentivizing companies to buy more wood products will contribute to land use change to meet human demand for land-based products. In general, using a smaller spatial scale (e.g., FMU instead of sourcing region; harvested area instead of FMU) reduces the risk of accounting for lands that are not attributable to the forest products.

[87] Ter-Mikaelian et al., 2015

[88] Cintas et al., 2017

Spatial boundary for scope 3 franchises, leased assets and investments

The scope 3 boundary for specific lands associated with leased assets, franchises or investments includes all carbon stock changes on managed lands associated with the leased assets, franchises or investments.

8.2.4 Time considerations for land management carbon accounting

Estimating carbon stock changes in a given land area also requires a temporal boundary. *Land management net CO_2 emissions or removals* are accounted for based on the annual net carbon stock change or net carbon stock change annualized over a longer monitoring frequency as described below. The annual or annualized net carbon stock chance can be estimated based on the difference between carbon stocks at two points in time (i.e., stock-difference method) or gross carbon gains and gross carbon losses within the reporting year (i.e., gain-loss method).

Carbon stocks should be monitored annually in order to quantify annual changes. If annual monitoring within the selected spatial boundary is not possible, net carbon stock change estimates may be annualized based on longer monitoring frequencies that are representative of the land management. Companies **shall** report on the monitoring frequency used to estimate *Land management net CO_2 emissions or removals* for each relevant land use and/or activity in scope 1 or scope 3.

The monitoring frequency of carbon stocks within a given land area can vary depending on the reporting company's business goals, management objectives, land uses, carbon pools, monitoring techniques, data availability, resource for data collection or other factors influencing carbon stocks or data collection. Annualized estimates are calculated by dividing the estimated net carbon stock change by the years between monitoring years as provided by the stock-difference equation 8.1 in section 8.1.2.

When determining the appropriate monitoring frequency for estimating carbon stock changes companies should consider the following factors:

- The land management practices and frequency at which they are expected to impact carbon stocks in the measured land-based carbon pools
- The expected magnitude of carbon stock changes within the selected spatial boundary relative to the uncertainty associated with estimating carbon stock changes over that area
- Recommended monitoring techniques and protocols for the given land use, sector and carbon pools
- Cost effectiveness of the monitoring process
- Impact and frequency of unexpected events, such as natural disturbances.

Where primary data are used to estimate carbon stock changes based on measurements of carbon stocks over time within a given land area, companies should strive for an inventory or sampling protocol with annual sampling of a subset of plots or strata. Where annual data collection is not possible, resampling of plots should occur at least every 5 years to estimate the annualized carbon stock change.

Accounting requirement

If accounting for *Land management net CO_2 removals*, companies **shall** include land carbon stock measurement representative of relevant lands and carbon pools in the company's GHG inventory base year or period and resample using consistent methods at least every 5 years to estimate carbon stock changes using measurement-based approaches or to calibrate model-based or remote sensing-based approaches.

The exact interval used to resample should be justified by evidence from peer reviewed literature from the specific sourcing region about how long it takes to detect changes in carbon stocks for the specific geography, land use and carbon pools. For example, a company seeking to report on removals associated with soil carbon could account for soil carbon stock changes using model-based approaches using the following approach to monitoring:

1. Measurement of a soil carbon stock in the inventory base year or period (base year or period)
2. Estimation of annual soil carbon stock change using model-based approaches (years 1-5)
3. Measurement of soil carbon stock in year 5 to determine annualized carbon stock change and check against modeled results reported in years 1-5 (year 5)
4. Ongoing monitoring of carbon stock changes repeating steps 2 and 3 (see section 8.2.6)

Where secondary data are used to estimate annual net carbon stock changes specific to a given geography, climate, ecological zone, soil type, management type, or other factors influencing carbon stocks, estimates should be updated at least every 5 years to estimate the annual or annualized carbon stock change.

8.2.5 Carbon pools included in net land carbon stock change estimates

Accounting requirement

When estimating net land carbon stock changes companies **shall** account for the following carbon pools and land uses, at a minimum:

- **Biomass carbon stock changes,** including aboveground and belowground biomass, on forest lands, or grasslands, croplands, wetlands and/or settlements with woody or permanent cover
- **Dead organic matter carbon stock changes**, including dead wood and litter, on forest lands, grasslands, or croplands, where management practices significantly impact woody residues
- **Soil carbon stock changes**, including soil organic carbon in mineral and organic soils, on grasslands or croplands, or forest lands, wetlands and settlements where management practices significantly disturb soils

Companies **shall** report which land uses and carbon pools are included in their analysis of net carbon stock changes, including where they assume no carbon stock changes for a particular carbon pool and land use.

Companies should provide justification for carbon pools and land uses where they assume no carbon stock changes in accordance with the guidance in chapter 18.

8.2.6 Land management net CO_2 removals requirements

Land management net CO_2 removals are accounted for using stock-change accounting, in cases where the annual net carbon stock change in land-based carbon pools, including biomass, dead organic matter and soil carbon, is increasing. Chapter 6 provides general requirements that must be met for companies to report CO_2 removals in scope 1 or scope 3. The sections below provide detailed guidance for applying those requirements to *Land management net CO_2 removals*.

Ongoing storage monitoring

Accounting requirement

Companies **shall** account for and report *Land management net CO_2 removals* only if ongoing storage monitoring is documented in a land management plan or monitoring plan and implemented to ensure carbon remains stored on the landscape and they can detect losses of stored carbon in relevant land-based carbon pools.

For *Land management net CO_2 removals*, losses of stored carbon are any annual net carbon stock decreases in the land carbon pools associated with previously reported CO_2 removal. Monitoring means there is a system in place (e.g., direct measurements, remote sensing or modeled land management activities) described in a land management plan or monitoring plan to account for annual or annualized carbon stock changes using primary data specific to the carbon pools.

For *Land management net CO_2 removals*, ongoing monitoring should be implemented according to monitoring plans documented in one of the following resources:

- Land management plans for a given farm, plantation, grazing land or forest management unit
- Land management plans for a given sourcing region or landscape
- Monitoring plans developed by the reporting company or a supply chain coalition
- Monitoring program developed by other third parties with relevant expertise

For example, a forest management company may specify in their forest management plan that they will conduct forest inventories every 5 years. Similarly, a group of downstream companies in a given supply chain could work with farms implementing regenerative agriculture practices to develop a monitoring plan to conduct soil carbon sampling on a 5-year basis across a range of farms enrolled in a given program.

Land managers, supply chain partners or other entities developing a monitoring plan to account for and report *Land management net CO_2 removals* should specify the following attributes in their monitoring plan:

- Spatial boundaries for the relevant land management unit(s) or sourcing region
- Methods used to estimate carbon stock changes (see chapter 18 for details)
- Sampling approach to achieve a representative estimate of carbon stock changes
- Carbon pools included in the monitoring plan
- Frequency of monitoring and resampling plots or strata
- Data quality control procedures and instrument calibration

Additional guidance for ongoing monitoring by scope is provided below.

Scope 1 land management net CO_2 removals

Ongoing monitoring is required for lands owned or controlled by the reporting company. Ongoing monitoring may be conducted by the reporting company or a third party (e.g., supply chain coalition or aggregator) in accordance with the guidance on accounting for annual carbon stock changes provided in chapter 18.

Scope 3 land management net CO_2 removals

Ongoing monitoring is required for all land management units or attributable managed lands within sourcing regions in the value chain of the reporting company where they previously reported *Land management net CO_2 removals (subject to open question #3, box 8.3)*. Ongoing monitoring is required for all carbon pools associated with previously reported *Land management net CO_2 removals* regardless of if the company's activities are still relevant to those lands in the current reporting year. For example, if a downstream company previously reported CO_2 removals associated with cocoa production in their value chain but no longer sources from those farms or sourcing regions, they still need ongoing monitoring to ensure the carbon remains stored and detect losses of stored carbon.

Ongoing monitoring may be conducted through data sharing agreements with the entity(ies) that own(s) or control(s) the relevant land management units or lands within sourcing regions, directly by the reporting companies through agreements with the land manager(s), or by a third party (e.g., supply chain coalition or aggregator) in accordance with the guidance.

Traceability (subject to open question #3)

For scope 3 *Land management net CO_2 removals*, companies are required to have physical traceability to the land carbon pools where the CO_2 removals occur and the carbon is stored in their value chain.

Open question #3 seeks feedback on the level of traceability needed to account for net land carbon stock changes in carbon pools attributable to the products or materials (see box 8.3 for details).

Box 8.3 Open question #3 Traceability for land management removals

Given the barriers to traceability in agriculture and forestry value chains, what level of physical traceability is appropriate to account for *Land management net CO_2 removals*?

1. Land management unit or more precise traceability: Companies **shall** account for and report scope 3 *Land management net CO_2 removals* only if they have physical traceability to the land management unit(s) where the carbon is stored. Net carbon stock changes can be accounted for at the land management unit-level or harvested area-level based on the physical traceability of products to relevant spatial scales.
2. Sourcing region with safeguards: Companies **shall** account for and report scope 3 *Land management net CO_2 removals* where they have physical traceability to either of the following:
   - Land management unit(s) where the carbon is stored. With such traceability net carbon stock changes can be accounted for at the land management unit-level or harvested area-level based on the physical traceability of products to relevant spatial scales.
   - First point of collection or processing facility. With such traceability net carbon stock changes can be accounted for at the sourcing region-level subject to appropriate safeguards (i.e., attributable working lands, capturing heterogeneity, conservative assumptions, consistent allocation, avoiding double counting and reversal accounting).

During pilot testing and review, we would like to gain practical experience with data/methods and understand the implications of the two options.

We invite pilot testers to pilot test different approaches in order to learn about the feasibility and implications of each approach to inform the final decision. In particular, we invite pilot testing companies to account for and report on net land carbon stock changes at both a land management unit-level and sourcing region-level following the safeguards below for land-based products and materials (where they have the necessary data to complete both analyses), to inform the decision in the final Guidance.

If stakeholders opt for the sourcing region with safeguards option during review and pilot testing, companies accounting for *Land management net CO_2 removals* at a sourcing region level **shall** meet the following safeguards when accounting for net carbon stock changes within sourcing regions:

1. **Attributable managed lands**: the sourcing region boundary **shall** only include attributable managed lands that contributed to producing crops, animal products or forest products relevant to the reporting company. The sourcing radius from the first collection point or processing facility or other

methods used to determine the sourcing region boundary should be spatially explicit and reflect documented raw material transport distances. Attributable managed lands are determined in accordance with the guidance on scope 3 spatial boundaries provided in section 8.2.3.

2. **Capturing variability**: sampling or inventory approaches for direct measurements of net carbon stock changes in sourcing regions or data used to calibrate remote-sensing-based or model-based approaches **shall** be based on a sample size that is representative of the variation due to both natural factors (e.g., climate, vegetation, soil type, topography, etc.) and management factors (e.g., plantation forest age-classes, prescribed fire management, cropping systems, tillage practices, etc.) throughout all attributable managed lands included in the sourcing region.
3. **Conservative assumptions**: companies **shall** use conservative estimates of carbon stock changes within the uncertainty range to estimate removals at a sourcing region level.
4. **Consistent allocation**: carbon stock changes in the sourcing region **shall** be allocated to all materials consistently across the sourcing region, using physical or economic allocation, based on the annual share of relevant material outputs sourced by the first collection point or processing facility. The sum of the allocated carbon stock changes for each output of a sourcing region should equal 100 percent of the total carbon stock change from the sourcing region.
5. **Avoiding double counting**: the attributable managed lands included in the sourcing region boundary for a given biogenic raw material **shall** ensure no double counting of removals occurs with:
    a. Managed lands attributed to other biogenic raw material of the reporting company within an overlapping sourcing region (i.e., annual carbon stock increases on one given land area cannot be included in the sourcing region boundary for two separate biogenic materials). Note that where biogenic raw materials are from sourcing regions where average land management practices involve multi-output systems, crop rotations or intercropping, some managed lands can be attributed to multiple biogenic raw materials with proper allocation, or
    b. GHG credits generated on attributable managed lands in the sourcing region boundary (see chapter 13 for details).
6. **Reversal accounting**: companies that previously reported removals at the sourcing region level **shall** continue to account for annual net carbon stock changes across all attributable managed lands in the sourcing region and if annual net carbon stock decreases occur report them as emissions (if they continue to source from that region) or reversals associated with net carbon stock losses of previously reported removals (if they no longer source from that region). Emissions or reversals from losses of stored carbon **shall** be allocated using the same methods as used in previous inventories where the removals were reported.

Primary data

Accounting requirement

Companies **shall** account for and report *Land management net CO_2 removals* only if the net land carbon stock changes are accounted for using primary data specific to the land carbon pools where the carbon is stored in the reporting company's operations or value chain.

Primary data includes direct measurement of land carbon stocks, as described in chapter 18, or model-based or remote sensing-based approaches calibrated to the land management unit using primary data, as described by the calibration guidance in chapter 16.

Companies can use a variety of methods and data to meet the primary data and ongoing storage monitoring requirement. Companies should prioritize the following data types to estimate net land carbon stock changes:

- Field measurements based on sampling approaches or ground-based inventories
- Remote sensing data of biomass height, canopy cover or land management practices
- Statistical data on land management practices relevant to the given boundary (e.g., average soil tillage and residues management practices for farms by crop type in a region)

Global average data on carbon stock for a given climate type, ecological zone and soil type are not sufficient to meet the primary data requirements (i.e., IPCC Tier 1 default carbon stock and stock change factors).

To support land carbon stock change estimates, some secondary data may be used to support calculations. The following parameters used to calculate land carbon stocks or land carbon stock changes may be based on secondary data representative of lands in the spatial boundary from peer-reviewed scientific literature, government statistics, or reports published by international institutions confirming the estimated value and associated uncertainty over multiple studies:

- Root to shoot ratios to estimate belowground biomass based on aboveground biomass
- Wood density to estimate biomass from volume measurements
- Biomass, deadwood or litter carbon content to estimate mass of C from biomass
- Biomass conversion and expansion factors to estimate biomass from merchantable growing stock volume measurements

Uncertainty

Accounting requirement
Companies **shall** account for and report *Land management net CO_2 removals* only if the net land carbon stock increase is statistically significant based on quantitative uncertainty estimates.

Land management net CO_2 removal estimates must also provide quantitative estimates of uncertainty based on the sampling approach and/or modeled uncertainty used to estimate net carbon stock change across carbon pools for all attributable managed lands in the spatial boundary. Companies are required to report on the confidence level used to report the uncertainty range and significance level used to test for statistical significance. Where the probability density function of the net land carbon stock change contains a value of zero or negative values for probabilities greater than or equal to the significance level, such land carbon stock increases are not significant and cannot be reported as *Land management net CO_2 removals*.

Reversals accounting

Accounting requirement

Companies **shall** account for and report net land carbon stock losses of previously reported *Land management net CO_2 removals* in the year the losses occur, as either:

- *Land management net CO_2 emissions*, if the carbon pools are part of the GHG inventory boundary in the reporting year, or
- *Reversals from land-based storage*, if the carbon pools are no longer in the GHG inventory boundary in the reporting year.

If companies lose the ability to monitor land carbon stocks associated with previously reported removals, companies **shall** assume previously reported removals are emitted and report *Reversals from land-based storage*.

Where ongoing monitoring of land carbon stocks ends or it is no longer possible to monitor land carbon stocks associated with previously reported CO_2 removals, companies must account for and report reversals equal to the previously reported CO_2 removals (see chapter 6 for details).

Additional guidance for reversals accounting by scope is provided below.

Scope 1 land management net CO_2 removals

Where companies lose the ability to monitor land carbon stocks associated with previously reported scope 1 *Land management net CO_2 removals*, they are required to account for reversals in accordance with chapter 6.

If companies sell land where scope 1 *Land management net CO_2 removals* were previously reported, base year recalculation (see chapter 12) may lead to factoring out previously reported emissions and removals associated with such lands and reversals accounting is not needed in such cases.

Scope 3 land management net CO_2 removals

Where companies lose the ability to monitor carbon stocks for previously reported removals (e.g., change sourcing regions and no longer have access to monitoring data from suppliers) they must account for reversals in accordance with chapter 6. Companies that change suppliers and/or sourcing regions do not need to account for reversal for associated lands if they can continue to monitor land carbon stock changes, they only need to report reversals when they lose the ability to monitor carbon stocks on such lands. Options to help ensure ongoing storage monitoring in dynamic supply chains include:

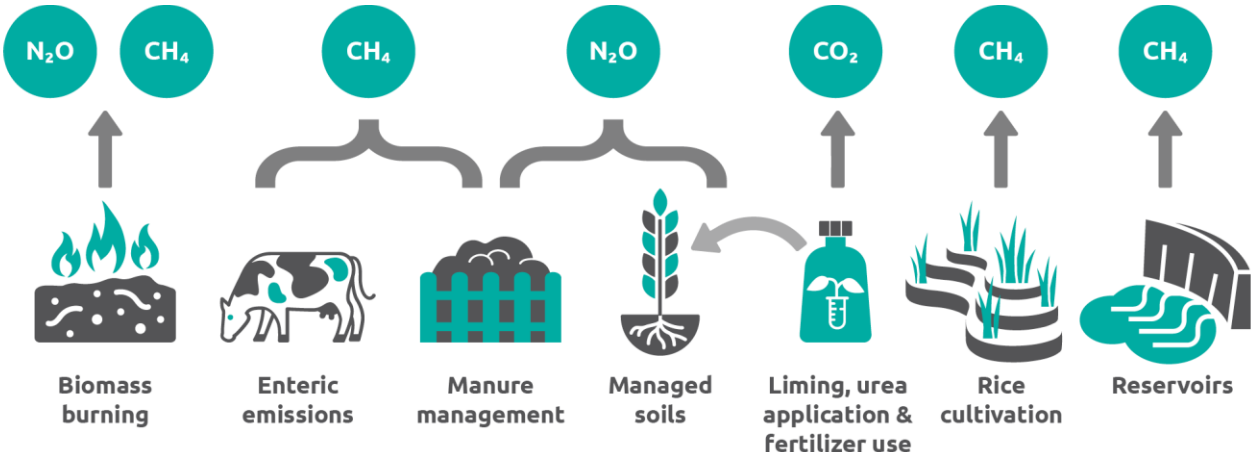
- Use of satellite imaging or other remote sensing approaches
- Accounting for net land carbon stock changes at a sourcing region scale to better ensure consistent spatial boundaries over time with changing suppliers
- Working with supply chain partnerships or new third-party programs to build ongoing storage monitoring systems for specific products and geographies
- Developing contracts with suppliers or supply chain coalitions that specify data sharing agreements to enable ongoing storage monitoring

8.3 Land management non-CO_2 emissions

Land management can also generate a variety of GHG emissions other than biogenic CO_2 from sources associated with the production of food, feed, fiber, or other biogenic product(s). *Land management non-CO_2*

emissions, also referred to as agricultural emissions, production emissions or on-farm emissions, most commonly occur from cropland management but may be relevant to other land uses including forest lands, grasslands, wetlands, settlements and other lands.

Figure 8.4: Overview of land management non-CO_2 emissions source categories



Land management non-CO_2 emissions are illustrated in figure 8.4 and include:

- CH_4 and N_2O emissions from livestock, including emissions from enteric methane fermentation and manure management
- Non-biogenic CO_2 and N_2O emissions from agricultural soils and inputs
- CH_4 and N_2O emissions from biomass burning and fires
- CH_4 emissions from rice production, reservoirs and other flooded lands
- Other CH_4, N_2O, non-biogenic CO_2, hydrofluorocarbons (HFCs), and perfluorocarbons (PCFs) emissions, including emissions from on-site fuel and energy consumption, fuel combustion, air-conditioning and refrigerant use, on-site waste or wastewater management and indirect emissions from purchased energy

Land management GHG emissions are relevant to any company in value chains that supply inputs to, produce, or purchase biogenic materials or products. The land management GHG emissions guidance provided in this chapter and chapter 19 covers emissions from sources on the land during production, and as such does not cover all processes across the value chain of land-based products (such as GHG emissions due to the processing or transportation of food or feed). For value chain impacts, companies should supplement this guidance with the *Scope 3 Standard* [89] and *Scope 3 Calculation Guidance*.[90]

[89] Available at https://ghgprotocol.org/standards/scope-3-standard.

[90] Available at https://ghgprotocol.org/scope-3-technical-calculation-guidance.

9

Accounting for Product Carbon Pools

Chapter 9: Accounting for Product Carbon Pools

Requirements and Guidance

This chapter provides requirements and guidance on accounting for emissions and removals associated with product carbon pools, in other words, accounting for biogenic and TCDR-based carbon that is physically contained in product carbon pools. Products that contain biogenic or TCDR-based carbon can keep carbon out of the atmosphere for the duration of the product's lifetime, depending on the product's use profile and end-of-life fate, before the carbon is emitted.

Note: The terminology used in this chapter is to be determined based on the outcome of open question #2 (chapter 6, box 6.3 and repeated in this chapter in box 9.2).

Sections in this chapter

Section	Description
9.1	Introduction to product use and storage pathways
9.2	Stock-change accounting for product carbon pools
9.3	Accounting for life cycle emissions associated with products
9.4	Accounting for removals with product storage
9.5	Requirements for reporting removals with product storage

Checklist of accounting requirements in this chapter

Section	Accounting requirements
9.2	• Companies **shall** account for net carbon stock changes of biogenic and TCDR-based products sold by the reporting company using either of the following two approaches and report the approach used: ○ **Simplified approach:** Assume there is no change in the total biogenic or TCDR-based carbon stock of products sold by the reporting company. ○ In this case, companies do not report net emissions or net removals from product carbon pools. ○ **Stock-change accounting approach:** Account for annual net carbon stock changes of biogenic and TCDR-based products sold by the reporting company, using the stock-change approach. ○ If the total biogenic or TCDR-based product carbon stock increases in the reporting year, companies may report *Net removals with product storage* if

	the removals requirements in section 9.5 are met *(subject to open question #2, box 9.2)*. ○ If the total biogenic carbon stock in sold products decreases in the reporting year, report *Net CO_2 emissions from biogenic product storage*. If the total TCDR-based carbon stock in sold products decreases in the reporting year, report *Net CO_2 emissions from TCDR-based product storage*.
9.3	• Companies **shall** account for all GHG emissions (including *Land management net CO_2 emissions* and *Land use change emissions*) that occur in the life cycle of products and report them as scope 1, scope 2, or scope 3 emissions (by scope 3 category), excluding gross CO_2 emissions from the biogenic or TCDR carbon content of products. • For gross CO_2 emissions from the biogenic or TCDR carbon content of products, companies **shall:** ○ Account for all direct and indirect gross CO_2 emissions across the life cycle (e.g., during processing, use, end-of-life treatment, and all other life cycle phases), and ○ Separately report these emissions under the *Gross emissions and gross removals* category, as *Gross biogenic product CO_2 emissions* or *Gross TCDR-based product CO_2 emissions* (if applicable), organized by the relevant scope 1, scope 2 or scope 3 categories to differentiate direct from indirect emissions.
9.5	• Companies may account for and report *Net biogenic removals with product storage* only if the following requirements are met: ○ Companies **shall** account for the annual net land carbon stock changes on lands where the biogenic carbon contained in products is sourced from; and ○ Companies **shall** demonstrate that there are increases or no change in land carbon stocks within attributable managed lands (or there are net carbon stock increases within attributable managed lands after factoring out carbon stock losses due to natural disturbances). • Companies may account for and report *Net removals with product storage* only if the following requirements are met: ○ Ongoing storage monitoring: Companies **shall** account for and report removals with product storage only if there is ongoing storage monitoring of the product carbon pools, as specified through a monitoring plan, to demonstrate that the carbon remains stored or to detect losses of the stored carbon. ○ Traceability: Companies **shall** account for and report removals with product storage only if the reporting company has traceability throughout the full CO_2 removal and product storage pathway, including to the sink (where CO_2 is transferred from the atmosphere to non-atmospheric pools), to the carbon pools where the carbon is stored, and to any intermediate processes if relevant. ○ Primary data: Companies **shall** account for and report removals with product storage only if the net carbon stock changes are accounted for using primary data, i.e., empirical data specific to the sinks and product carbon pools where carbon is stored in the reporting company's operations or value chain. ○ Uncertainty: Companies **shall** account for and report removals with product storage only if the removals are statistically significant and companies provide quantitative uncertainty estimates for removals with product storage, including 1) the removal value, 2) the uncertainty range for the removal estimate based on a specified confidence level, and 3) justification of how the selected value does not overestimate removals.

	○ Reversal accounting: ○ Companies **shall** account for net product carbon stock losses of previously reported *Net removals with product storage* in the year the losses occur, as either: ▪ *Net CO_2 emissions from product storage*, if the carbon pools are part of the GHG inventory boundary in the reporting year, or ▪ *Reversals from product storage*, if the carbon pools are no longer in the GHG inventory boundary in the reporting year. ○ If companies lose the ability to monitor product carbon stocks associated with previously reported removals, companies **shall** assume previously reported removals are emitted and report *Reversals from product storage*.

9.1 Introduction to product use and storage pathways

Products that contain biogenic or TCDR-based carbon can keep carbon out of the atmosphere for the duration of the product and its materials' lifetime. Therefore, maintaining storage in product carbon pools and preventing the release of carbon contained in products can help to reduce GHG emissions for the duration of product storage, depending on the product's durability and end-of-life fate.

As biogenic or TCDR-based products move through different life cycle stages, the product carbon content can be emitted during different stages of their life cycle, such as during production, the use phase (e.g., soda drink or fuels) or the end-of-life treatment (e.g., degradation of harvested wood products (HWP) in landfill). The guidance in this chapter relates to products that have the potential to maintain the storage of the carbon for a defined period of time that has an effect in decreasing the rate of global warming. For instance, HWP form product carbon pools which can be maintained, e.g., through applications with expected long-life time such as building construction and or reuse and recycling practices for furniture. On the other hand, fossil fuels, even though they contain carbon, are not accounted for their carbon storage, since the carbon is not part of a CO_2 removal and storage pathway (described further below).

To quantify and report on the full life cycle GHG emissions associated with products, including on how to account for product-related emissions in scope 1, scope 2, or scope 3 (across the fifteen scope 3 categories), companies should refer to the GHG Protocol *Scope 3 Standard*. To quantify and report product-level inventories, companies should refer to the GHG Protocol *Product Life Cycle Standard*.

This chapter provides additional guidance on how to account for and report on emissions and removals from product carbon pools, i.e., carbon pools physically contained in products. Storage of carbon in products can be through different pathways; the origin and the application of which determines how companies should account for them as described below.

9.1.1 CO_2 removal and product use or storage pathways

Storage of carbon within products is part of a removal and storage pathway if the CO_2 was recently removed from the atmosphere. CO_2 recently removed from the atmosphere and stored in product carbon pools can originate from two sources: 1) by transferring carbon that was removed from a plant through photosynthesis (biogenic carbon) from the land carbon pool to the product carbon pool, and 2) from technological CO_2 removal processes, such as direct air capture.

Transfer of biogenic carbon to the product pool

Biogenic product accounting begins with the transfer of carbon out of the land-based carbon pools and into product carbon pools (e.g., harvest). Biogenic products begin as raw products, such as logs or agricultural goods, and later through processing and manufacturing as they proceed through the value chain, they become semi-finished or intermediate and, in the end, final products. The relationship between biogenic land and product carbon is described in the IPCC *Guidelines for National Inventories* (see box 9.1).

Box 9.1 Relationship between biogenic land and product carbon

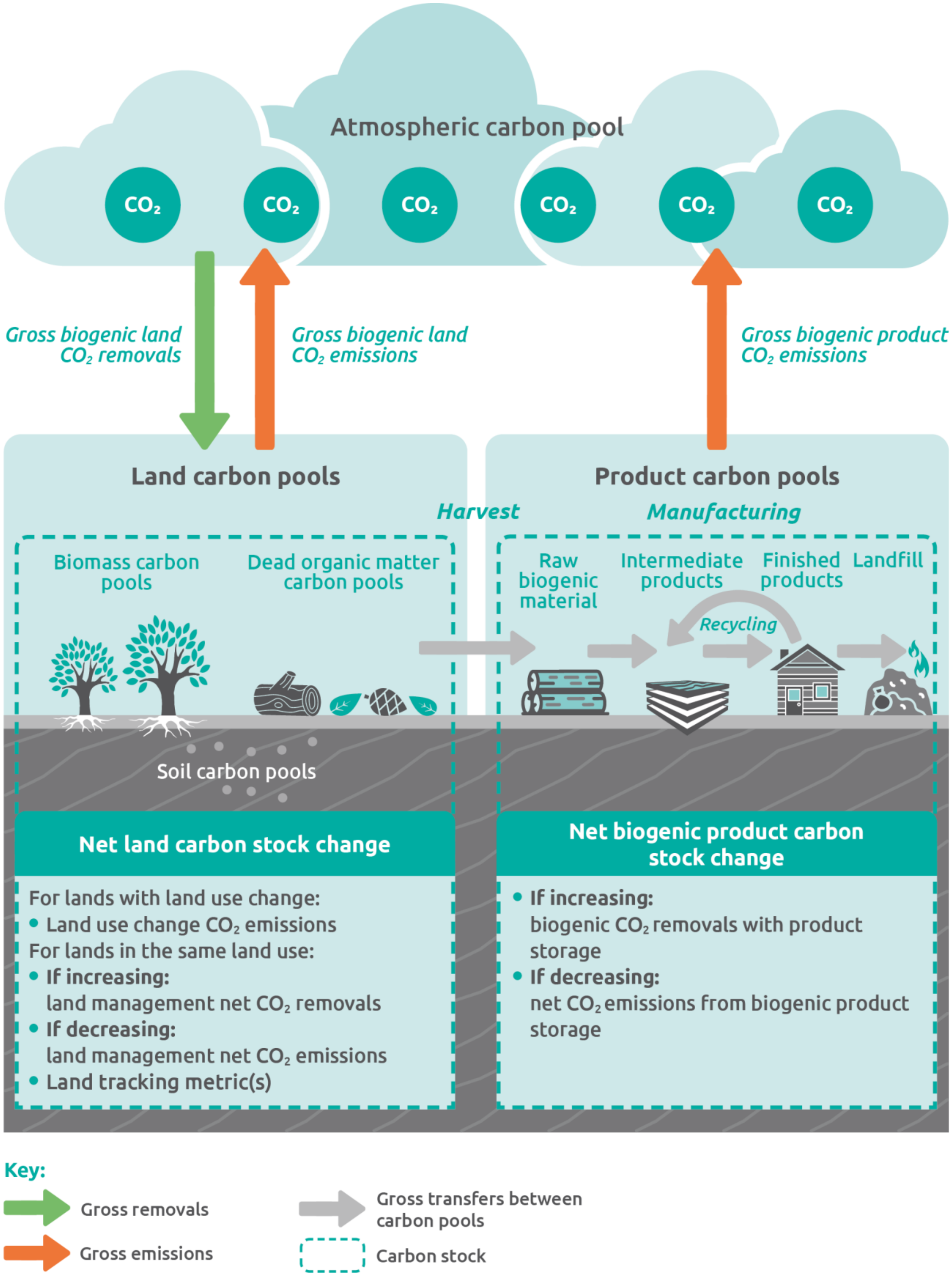
In the context of biogenic products such as harvested wood products (HWP) or bioplastics, when referring to CO_2 removals, biogenic products do not directly sequester carbon from the atmosphere. However, carbon retained in biogenic products constitutes a pool of carbon that was sequestered originally by biomass carbon pools. In this respect, the carbon from CO_2 originally sequestered by vegetation is transferred to the product carbon pool, similarly to when it is transferred from the aboveground biomass carbon pool to the litter and soil carbon pools in the AFOLU sector. The difference is that transfers of carbon from vegetation to biogenic products are always the result of anthropogenic activity.

Source: Adapted from chapter 12 of the *2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories. Volume 4: Agriculture, Forestry, and Other Land Use*, but can be applicable across all biogenic product categories.

Figure 9.1 illustrates the transfer of biogenic carbon from the atmosphere to land carbon pools, then into product carbon pools, and the associated gross removals and emissions. Carbon stored in biogenic products is emitted back to the atmosphere after the duration of product storage.

The figure includes accounting categories for net carbon stock changes across the land and product carbon pools as well as gross emissions and removals. Carbon stocks are shown within the dotted lines, while carbon flows (gross emissions, removals, and transfers between carbon pools) are shown as arrows.

1 **Figure 9.1 Example of carbon stocks and flows across land and biogenic product carbon pools**



2

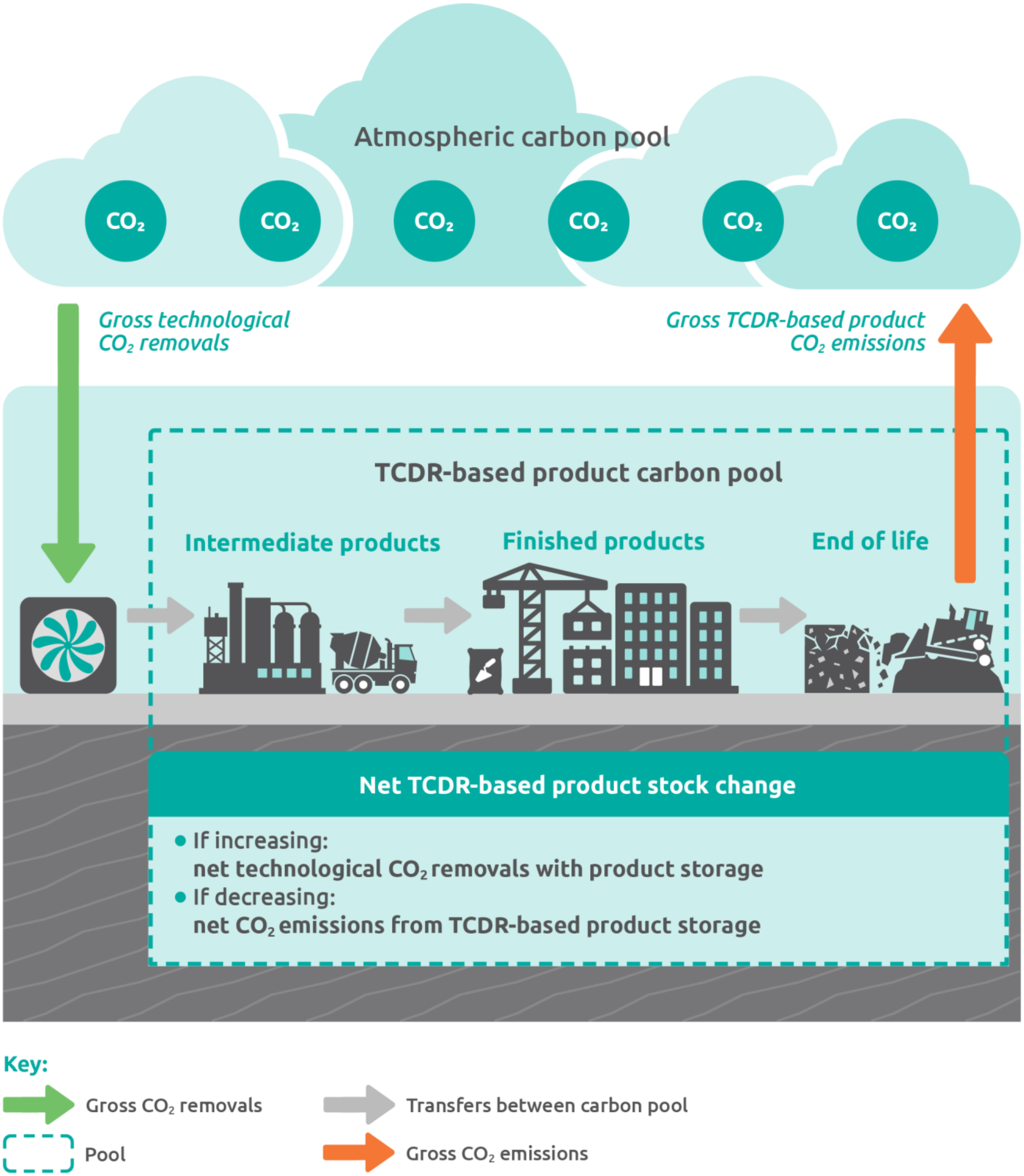
Technological carbon dioxide removal (TCDR) and product storage pathway

Products can be made from carbon or CO_2 removed through technological means such as direct air capture technology. CO_2 removal technologies can be used to generate materials for products (i.e., CO_2 removal and use pathways) and lead to either short-term carbon cycling through production of short-lived products (e.g., direct air captured CO_2-based fuels or packaging materials) or longer-term carbon cycling through production of long-lived products (e.g., direct air capture CO_2-cured cement). Carbon stored in TCDR-based products is emitted back to the atmosphere after the duration of product storage.

For some products, removals from the atmosphere can take place during the use phase, such as from enhanced weathering over time. For instance, cement and concrete can absorb CO_2 during their use phase, as calcium compounds in cement react with CO_2 to produce calcium carbonates.

Figure 9.2 illustrates an example of a TCDR-based product storage pathway. It shows direct air capture of $CO_{2,}$ transfer of the CO_2 to product carbon pools (e.g., concrete for construction), and its eventual emission to the atmosphere at the end-of-life phase of the product (e.g., demolishing the construction). The figure includes accounting categories for net carbon stock changes in the TCDR-based product carbon pool as well as gross emissions and removals. The product carbon stock is shown within the dotted lines, while CO_2 flows (gross emissions, removals, and transfers between carbon pools) are shown as arrows.

1 **Figure 9.2 Example of carbon stocks and flows across TCDR-based product carbon pools**



2 *Note:* Gross CO_2 fluxes using flow accounting are presented as arrows above the pools; stocks are presented as dotted boxes; net CO_2 fluxes using stock change accounting are presented below the pools; required reporting categories are in bold.

9.1.2 Fossil carbon products

Storage of fossil carbon in products (where carbon originates from fossil reservoirs or other carbon resources that are part of the long-term carbon cycle), is not part of a removal and storage pathway, since it does not remove CO_2 from the atmosphere. Examples include fossil fuels or petrochemical products that include fossil carbon such as fossil based plastics. Storage of fossil carbon in products for a period of time rather *prevents* the release of CO_2 emissions to the atmosphere for that period of time and is therefore reflected in a GHG inventory as a non-emission for that period of time.

9.1.3 Captured GHG and storage pathway

Carbon capture and storage in products can also take place during the production phase as a means to capture CO_2 emissions and temporarily store it in products. For instance, CO_2 emissions from cement production (fuel combustion and process CO_2) can be captured at different stages of production and sequestered into concrete as a final product. Once injected, the CO_2 and the calcium ions in cement form calcium carbonate minerals that can be stored for a long period in the concrete. If companies cannot reliably detect the sources of CO_2 emissions (i.e., fossil or biogenic), companies should account for the captured CO_2 as fossil.[91] In this way, and similar to the fossil carbon product (section 9.1.2), the captured GHG pathway and storage is not part of a removal and storage pathway, since it does not remove CO_2 from the atmosphere, but rather prevents its release to the atmosphere.

9.2 Stock-change accounting for product carbon pools

This Guidance uses a stock-change accounting approach to account for emissions and removals associated with land carbon pools (chapters 7 and 8), product carbon pools (this chapter) and geologic carbon pools (chapter 10). Under this approach, companies account for the annual carbon stock change occurring in the reporting year in land carbon pools, geologic carbon pools, and product carbon pools. The product carbon pool refers to the total carbon stock (of carbon removed from the atmosphere) stored in products sold by the reporting company.

The product carbon stock change is defined as the annual change (occurring in the reporting year) in the total biogenic or TCDR-based carbon stock contained in products sold by the reporting company in the reporting year or in past years.

Accounting requirement

Companies **shall** account for net carbon stock changes of biogenic and TCDR-based products sold by the reporting company using either of the following two approaches and report the approach used:

- **Simplified approach**: Assume there is no change in the total biogenic or TCDR-based carbon stock of products sold by the reporting company.
  - In this case, companies do not report net emissions or net removals from product carbon pools.

[91] If the captured CO_2 is a mixture of biogenic/technological carbon dioxide removal and fossil CO_2, companies should estimate the quantity of product carbon or CO_2 content coming from different pathways, and separately account for them according to the guidance provided in this chapter. Only increase in biogenic carbon product carbon pools or TCDR-based product carbon pools may count as removal in case of a net CO_2 increase in company's product carbon pools.

- **Stock-change accounting approach**: Account for annual net carbon stock changes of biogenic and TCDR-based products sold by the reporting company, using the stock-change approach.
    - If the total biogenic or TCDR-based product carbon stock increases in the reporting year, companies may report *Net removals with product storage* if the removals requirements in section 9.5 are met *(subject to open question #2, box 9.2)*.
    - If the total biogenic carbon stock in sold products decreases in the reporting year, report *Net CO_2 emissions from biogenic product storage*. If the total TCDR-based carbon stock in sold products decreases in the reporting year, report *Net CO_2 emissions from TCDR-based product storage*.

Scope 3 categories

The categories *Net removals with product storage* and *Net CO_2 emissions from product storage* are only applicable to scope 3, category 11 (Use of sold products) and scope 3, category 12 (End-of-life treatment of sold products). Values for category 11 and category 12 may not be combined but instead must be separately reported.

Companies account for net product carbon stock decreases as *Net CO_2 emissions from product storage* either in scope 3, category 11 (Use of sold products) or scope 3, category 12 (End-of-life treatment of sold products), as follows:

- *Net CO_2 emissions from product storage* are reported in scope 3, category 11 if the annual stock-change decrease occurs in the use phase of sold products.
- *Net CO_2 emissions from product storage* are reported in scope 3, category 12 if the annual stock-change decrease occurs in the end-of-life phase of sold products.

Time boundaries

Net CO_2 emissions from product storage should not be mixed with scope 3, category 11 emissions or scope 3, category 12 emissions under the *Scope 3 Standard*. Scope 3, category 11 and category 12 emissions have a different time boundary from *Net CO_2 emissions from product storage* which are quantified on an annual basis:

- The time boundary of net carbon stock changes from product carbon pools is annual. Companies account for carbon stock changes occurring in the reporting year resulting from the company's current and previous years' product sales.
- In contrast, the time boundary of scope 3 product-related emissions categories under the *Scope 3 Standard* such as category 11 (Use of sold products) and category 12 (End-of-life treatment of sold products) take a life cycle perspective (explained further in the *Scope 3 Standard*, chapter 5).

The annual approach taken in this Guidance for all carbon pools (land, product, geologic) is needed to implement the permanence principle by monitoring annual carbon stock changes to demonstrate carbon remains stored or to detect and report reversals if they occur (explained further in chapter 6).

Therefore, net emissions or net removals from product carbon pools introduced in this Guidance should not be mixed with scope 3 emissions from product-related categories such as emissions from the use of sold products (which does not have an annual time boundary), but instead should be separately reported.

Sections 9.4 and 9.5 provide information on accounting for removals from annual net product carbon stock increases. Companies are required to account for emissions from annual net product carbon stock decreases. Calculation methods for stock-change accounting from product carbon pools are provided in chapter 20.

9.3 Accounting for life cycle emissions associated with products

GHG emissions (beyond the release of the biogenic or technologically removed carbon contained in products) are emitted at each step of the product life cycle. Emissions occur from each attributable process in the product life cycle, such as raw material extraction, manufacturing, processing, transportation, use phase, end-of-life phase, etc.

Accounting requirement

Regardless of the approach chosen to account for net product carbon stock changes in section 9.2 (i.e., the simplified approach or stock-change accounting approach):

- Companies **shall** account for all GHG emissions (including *Land management net CO_2 emissions* and *Land use change emissions*) that occur in the life cycle of products and report them as scope 1, scope 2, or scope 3 emissions (by scope 3 category), excluding gross CO_2 emissions from the biogenic or TCDR carbon content of products.
- For gross CO_2 emissions from the biogenic or TCDR carbon content of products, companies **shall**:
  - Account for all direct and indirect gross CO_2 emissions across the life cycle (e.g., during processing, use, end-of-life treatment, and all other life cycle phases), and
  - Separately report these emissions under the *Gross emissions and gross removals* category, as either *Gross biogenic product CO_2 emissions* or *Gross TCDR-based product CO_2 emissions* (if applicable), organized by the relevant scope 1, scope 2 or scope 3 categories to differentiate direct from indirect emissions.

Direct and indirect emissions of CH_4 and N_2O from combustion or degradation of biogenic and/or TCDR-based products are accounted for and reported in the "emissions" category, in scope 1, scope 2, or scope 3 categories as relevant.

For further guidance on corporate-level accounting of life cycle emissions across a company's purchased and sold products, refer to the *Scope 3 Standard*. Refer to other chapters in the *Land Sector and Removals Guidance* for accounting for land impacts in the product life cycle, such as land use change (chapter 7) and land management (chapter 8). For guidance on product life cycle accounting, refer to the GHG Protocol *Product Standard*.

Gross CO_2 emissions from product carbon pools

As explained in chapter 5, companies are required to account for all direct and indirect gross CO_2 emissions from the biogenic or TCDR-based carbon contained in product carbon pools. Gross CO_2 can be emitted throughout product life cycles, including during production, processing, distribution, use, end-of-life treatment, or other life cycle stages. Gross emissions are calculated using flow accounting rather than stock-change accounting (explained in chapter 4).

Gross emissions from product carbon pools represent the CO_2 emissions from the mass of carbon contained in product carbon pools throughout the product life cycle. Gross emissions are calculated using emission factors that quantify the GHG emissions based on the product carbon content, type of material or product, and type of emission process (e.g., processing, combustion/incineration, decomposition, landfilling, etc.).

Companies should use the most accurate and representative emission factors to quantify CO_2 emissions based on the product application or fate (e.g., combustion or landfill) and product type, specifically its carbon content (e.g., bone-dry wood with 50 percent carbon content). Companies may develop product specific emission factors based on the knowledge of the product type and carbon content and life cycle stage or fate.

To ensure transparency, companies should report a description of the types and sources of data, including activity data and emission factors used to calculate emissions, and a description of the data quality of reported data.

Gross CO_2 emissions from biogenic product carbon pools are reported under *Gross emissions and gross removals* as *Gross biogenic product CO_2 emissions* and organized by the relevant scope 1, scope 2 or scope 3 categories based on where in the value chain they occur.

Gross CO_2 emissions from TCDR-based product carbon pools are reported under *Gross emissions and gross removals* as *Gross TCDR-based product CO_2 emissions* and organized by the relevant scope 1, scope 2 or scope 3 categories based on where in the value chain they occur.

Further details on calculating gross emissions from product carbon pools is provided in chapter 20.

9.4 Accounting for removals with product storage

This section provides guidance on accounting for and reporting removals with product storage. Accounting for and reporting removals with product storage is optional. Requirements for reporting removals with product storage are provided in the next section.

As described in chapter 5, unlike with an emissions source (a single process), ownership/control of removals may be attributed to different entities that own/control the sink process and the carbon pools. In cases where the sink process and carbon pools are divided between multiple companies in a value chain, removals are accounted for as indirect. In the case of products, since products are designed to be sold by the reporting company to other entities in the value chain, no single entity owns/controls both the sink and carbon pool across a product life cycle. Thus, removals with product storage should be accounted for as indirect in scope 3 (*subject to open question #2, box 9.2*), rather than direct, by all companies in the value chain.

To account for and report on removals with product storage, this Guidance uses the stock-change accounting approach and includes a set of requirements introduced in chapter 6 to determine if removals may be reported in a GHG inventory. The requirements are based on the principles underlying the GHG inventory and are needed to ensure removals meet the permanence principle through ongoing storage monitoring and to ensure that mechanisms are in place to account for and report any future reversals from carbon pools associated with previously reported removals.

Subject to meeting the requirements for reporting removals with product storage (in section 9.5) and open question #2 (box 9.2), companies may account for net product carbon stock increases as *Net removals with product storage* either in scope 3, category 11 (Use of sold products) or scope 3, category 12 (End-of-life treatment of sold products), as follows:

- *Net removals with product storage* are reported in scope 3, category 11 if the annual stock-change increase occurs in the use phase of sold products.
- *Net removals with product storage* are reported in scope 3, category 12 if the annual stock-change increase occurs in the end-of-life phase of sold products.

Values for category 11 and category 12 may not be combined but instead must be separately reported.

Removals with product storage may not be mixed or netted with scope 3, category 11 emissions or scope 3, category 12 emissions. Emissions and removals must be separately reported. Scope 3, category 11 and category 12 emissions also have a different time boundary (explained in the *Scope 3 Standard*, chapter 5) from removals with product storage which are quantified on an annual basis.

Removals with product storage calculated using the storage monitoring framework, which do not meet the requirements for reporting removals in section 9.5, may be accounted for and reported outside of the scopes in a separate reporting category of “Temporary product carbon storage”. Companies **shall** report on the methodology and assumptions if they choose to calculate and report temporary product carbon storage.

If reporting "temporary product carbon storage" outside the scopes, companies may use storage discounting frameworks (e.g., dynamic methods such as tonne-year methods) which quantify the radiative forcing impact of delaying CO_2 emissions until the end of storage period.

This draft includes an open question #2 on whether product storage, accounted for using a storage monitoring framework, should be reported in scope 3 or outside the scopes in a separate reporting category, and whether storage discounting methods or other metrics on product storage and longevity should be used to report outside the scopes (see box 9.2).

Box 9.2 Open question #2 Removals with product storage

As explained in chapters 4 and 6, the draft Guidance is based on a stock-change accounting approach, applied through a storage monitoring framework to implement the permanence principle for all carbon pools (land carbon pools, geologic carbon pools, and biogenic and TCDR-based product carbon pools). Under this approach, net emissions and net removals (based on stock-change accounting and subject to meeting the requirements for reporting removals) are included in the scopes.

Alternatively, companies may use storage discounting frameworks (e.g., dynamic methods such as tonne-year methods) which quantify the radiative forcing impact of delaying CO_2 emissions until the end of storage period and report them under a separate reporting category "temporary product carbon storage" outside the scopes.

During the pilot testing and review phase, we would like to gain practical experience with data/methods and understand the implications of the options to determine whether the current approach should be maintained or alternative approaches should be pursued in the final guidance.

We invite pilot testers to pilot test different approaches in order to learn about the feasibility and implications of each approach to inform the final decision.

Questions:

3. Should net product carbon stock changes, accounted for using a storage monitoring framework, be reported in scope 3 or outside the scopes in a separate reporting category?
    - In this case, net increases in product carbon stocks are reported as removals with biogenic or TCDR-based product storage, and net decreases in product carbon stocks are reported as net CO_2 emissions from biogenic or TCDR-based product storage.
4. Should removals with product storage, accounted for using a storage discounting framework, be reported outside the scopes in a separate reporting category (as temporary product carbon storage)? Or should other metrics be used to report on product storage and longevity?

Table 9.1 explains how to report product storage based on the type of accounting framework used.

Table 9.1 Product storage reporting according to accounting framework

Accounting framework	Requirements for reporting removals met (section 9.5)?	Reporting category
Storage monitoring framework	Yes	May be reported as "Removals with product storage" in scope 3 category 11 or category 12, or in a separate reporting category outside of scopes (Product carbon storage) *(subject to open question #2, box 9.2)*
	No	May be reported in a separate reporting category outside the scopes (Temporary product carbon storage)
Storage discounting framework	N/A	May be reported in a separate reporting category outside the scopes (Temporary product carbon storage), with methodology and assumptions reported

9.5 Requirements for reporting removals with product storage

Reporting removals with product storage is optional and subject to open question #2 (i.e., whether it should be reported in scope 3 or in a separate reporting category).

As outlined in chapter 6, this Guidance includes a set of requirements that must be met for removals to be reported in a GHG inventory: ongoing storage monitoring, traceability, primary data, uncertainty, and reversals.

These requirements also apply to removals with product storage. If companies report removals with product storage, companies **shall** ensure that removals meet all the requirements for reporting CO_2 removals described in the following sections. The requirements must be met in the reporting year as well as in future years.

If companies account for and report removals with product storage, companies are required to separately account for and report removals based on their sink processes (i.e., biogenic vs. technological CO_2 removal).

Net biogenic removals have additional considerations to ensure that biogenic carbon stored in products is sourced from lands with recent biomass growth (chapter 8) and that they do not increase the global demand for land use (chapter 7). To ensure full accounting of biogenic product life cycle emissions, companies must account for GHG emissions and land carbon stock changes associated with the lands where biogenic products are grown and harvested.

Accounting requirement

Companies may account for and report *Net biogenic removals with product storage* only if the following requirements are met:

- Companies **shall** account for the annual net land carbon stock changes on lands where the biogenic carbon contained in products is sourced from; and
- Companies **shall** demonstrate that there are increases or no change in land carbon stocks within attributable managed lands (or there are net carbon stock increases within attributable managed lands after factoring out carbon stock losses due to natural disturbances).

If biogenic carbon stored in products is from waste materials with no market value, this requirement does not apply. Companies are not required to account for net land carbon stock changes (or other GHG emissions or removals) from the process that generates waste materials or further upstream (see section 16.5.2 for more information on allocating emissions and removals from waste). All subsequent emissions in the life cycle (after the process that generates the waste) are accounted for.

Companies are required to use the same scope 3 spatial boundary they use to account for land management carbon stock changes (see chapter 8).

9.5.1 Ongoing storage monitoring

Accounting requirement
Companies **shall** account for and report removals with product storage only if there is ongoing storage monitoring of the product carbon pools, as specified through a monitoring plan, to demonstrate that the carbon remains stored or to detect losses of the stored carbon.

Ongoing storage monitoring of biogenic or TCDR-based product carbon pools is required after removals with product storage are reported.

- For **biogenic product storage**, this involves ongoing storage monitoring of the net biogenic product carbon pool based on the amount of biogenic carbon stored in products sold by the reporting company over time, and the use phase and end-of-life treatment in markets where the reporting company sells biogenic products.
- For **TCDR-based product storage**, this involves ongoing storage monitoring of the net TCDR-based product carbon pool based on the amount of technologically removed CO_2 stored in products sold by the reporting company over time, and the use phase and end-of-life treatment in markets where the reporting company sells TCDR-based products.

Ongoing monitoring should be implemented according to monitoring plans designed to obtain information regarding carbon storage in products sold by the reporting company. Companies may use a variety of data sources to support ongoing monitoring as explained in section 6.2.1. For example, a manufacturing company may conduct sampling of their sold products' use phase and end-of-life fate or could work with supply chain partners to develop monitoring plans across a range of products within the same value chain.

Ongoing storage monitoring of product carbon pools can be supported by product life cycle accounting (i.e., reporting the full life cycle gross emissions and removals), using primary data, to ensure that the life cycle data (e.g., regarding service lifetimes and end-of-life fates) are up to date. If using product life cycle accounting to support ongoing storage monitoring, the accounting should be updated once at least every five years with the most recent available primary data.

9.5.2 Traceability

In order to enable ongoing monitoring of product carbon pools and accounting of any potential reversals, it is necessary to know the carbon pools where carbon is stored to demonstrate continued storage and detect reversals or other carbon stock losses. The ability to accurately reflect carbon stock changes within carbon pools relevant to a company's operations or value chain is dependent upon a company's traceability to such carbon pools. Traceability refers to the ability of a company to identify, track, and collect information on activities in the value chain of the company related to processes and products both upstream and downstream of their own operations.

As explained in section 9.3, for products where the sink process and carbon pools are divided between multiple companies in a value chain, removals are accounted for as indirect (or in scope 3).

Accounting requirement

Companies **shall** account for and report removals with product storage only if the reporting company has traceability throughout the full CO_2 removal and product storage pathway, including to the sink (where CO_2 is transferred from the atmosphere to non-atmospheric pools), to the carbon pools where the carbon is stored, and to any intermediate processes if relevant.

The required traceability includes both:

- Upstream traceability to the sink (e.g., forest where trees are growing or DAC facility removing atmospheric CO_2), to evaluate net land carbon stock changes (if applicable) and emissions from relevant activities; and
- Downstream traceability to the carbon pools where carbon is stored (e.g., markets where long-lived products are used and their end-of-life treatment occurs), to reliably determine biogenic or TCDR-based product carbon storage and detect any reversals.

The ability to have traceability to downstream end users depends on whether products sold by the reporting company are final products or intermediate products. The eventual end use of final products is more likely to be known than for intermediate products, since the eventual end use of sold intermediate products may be unknown. For example, a company may produce an intermediate product with many potential downstream applications, each of which has a different use, end-of-life, and storage profile. In this case, the company may not have traceability to the downstream storage associated with the various end uses of the intermediate product. If such cases, companies **shall not** report removals with product storage.

9.5.3 Primary data

Primary data on product carbon stock changes is essential to provide accurate estimates of CO_2 removals, their potential reversals and the associated uncertainty. Specific primary data needs include carbon content, service life (storage duration) or half-life, decay rates, and end of life treatment and fate of the products specific to the product type and value chain in which the CO_2 storage occurs.

Primary data should consist of direct measurement of the carbon stock within the company's operations or value chain, information received from suppliers or consumers, model-based approaches using primary data inputs, or peer-reviewed published literature data that are specific to the reporting company's value chain, product type, and region. Such data must be recent (e.g., not older than 10 years).

Data on product carbon stock changes can be based on a sampling protocol to collect primary data for a representative sample of products to achieve a given level of precision at a given confidence level (e.g., within 20% of the mean at a 95% confidence interval).

Accounting requirement

Companies **shall** account for and report removals with product storage only if the net carbon stock changes are accounted for using primary data, i.e., empirical data specific to the sinks and product carbon pools where carbon is stored in the reporting company's operations or value chain.

Companies must use primary data specific to their operations or value chain. For example, companies may not use global average default data (e.g., on half-lives or decay rates) but instead must use regionally specific and product-type specific published data.

Companies reporting product carbon stock changes should strive to improve data availability and accuracy over time via (e.g., through customer surveys and studies of end-of-life fates within specific markets). Chapter 16 provides additional guidance regarding different data types (primary and secondary) and examples of their application in model-based approaches.

9.5.4 Uncertainty

Given the uncertainty associated with measuring removal and product storage pathways, quantitative estimates of uncertainty are needed to apply the GHG accounting principles of accuracy and conservativeness when accounting for CO_2 removal and storage pathways.

Accounting requirement
Companies **shall** account for and report removals with product storage only if the removals are statistically significant and companies provide quantitative uncertainty estimates for removals with product storage, including 1) the removal value, 2) the uncertainty range for the removal estimate based on a specified confidence level, and 3) justification of how the selected value does not overestimate removals.

Companies **shall** report the uncertainty range associated with removal/storage estimates based on a specified confidence level (e.g., an estimate of 100 t CO_2-eq may have an uncertainty range of 92 to 108 t CO_2-eq based on a 95% confidence interval). An uncertainty range is the range of possible values, for a specified confidence level, that contain the true value for the estimate. Companies are required to report on the confidence level used to report the uncertainty range and significance level used to test for statistical significance.

Companies **shall** only report removals with product storage if they are statistically significant. Where the probability density function of the product carbon stock change contains a value of zero or negative values for probabilities greater than or equal to the significance level, such product carbon stock increases are not significant and cannot be reported as removals. Uncertainty ranges for removal estimates that include zero or negative values for CO_2 removals are not statistically significant.

Where the uncertainty range for the CO_2 removal estimate is large due to data collection constraints or natural variability in the system, companies **shall** apply the principle of conservativeness to ensure CO_2 removal values are not overestimated. Companies should provide justification for how the estimated value uses conservative assumptions and values given the uncertainty range, methods and underlying data.

Quantitative uncertainty estimates should follow IPCC national inventory guidance on uncertainty quantification or peer-reviewed statistical methods for estimating uncertainty. Where data underlying CO_2 removal estimates do not include an uncertainty analysis, companies should report on assumed uncertainty in the underlying data based on best available data or expert judgement. Uncertainty estimates can be combined using error propagation, Monte Carlo simulations or other peer-reviewed statistical methods for estimating uncertainty.

Some examples of practices to improve accuracy and ensure conservativeness when estimating CO_2 removals and their uncertainty ranges include:

- Collecting data to estimate uncertainty where currently available datasets do not provide quantitative estimates of uncertainty
- Increasing sample size or improving sampling design of data collection protocols

- Undertaking a sensitivity analysis to understand which parameters have the largest influence on modeled results and improving data collection for such parameters
- Choosing values at the lower end of an uncertainty range where a given variable or parameter has a positive correlation with CO_2 removal estimates
- Choosing values at the higher end of an uncertainty range where a given variable or parameter has a negative correlation with CO_2 removal estimates

9.5.5 Reversal accounting

Accounting requirement

Companies **shall** account for net product carbon stock losses of previously reported *Net removals with product storage* in the year the losses occur, as either:

- *Net CO_2 emissions from product storage*, if the carbon pools are part of the GHG inventory boundary in the reporting year, or
- *Reversals from product storage*, if the carbon pools are no longer in the GHG inventory boundary in the reporting year.

If companies lose the ability to monitor product carbon stocks associated with previously reported removals, companies **shall** assume previously reported removals are emitted and report *Reversals from product storage*.

Net CO_2 emissions from product storage or *Reversals with product storage* are reported either in scope 3, category 11 (Use of sold products) and/or scope 3, category 12 (End-of-life treatment of sold products), depending on where in the value chain the losses occur.

If ongoing monitoring ends, or companies lose the ability to monitor carbon stocks associated with previously reported removals with product storage, companies must account for and report reversals from product storage (reported as emissions) equal to the previously reported CO_2 removals (see chapter 6 for details).

Companies that change suppliers or customers and/or change sourcing or operating regions do not need to account for reversals associated with product carbon pools if they can continue to monitor product carbon stock changes. Companies only need to report reversals if they lose the ability to monitor carbon stocks from such pools. Options to help ensure ongoing storage monitoring in dynamic supply chains include:

- Use of digital tracking methods
- Working with supply chain partnerships or engage in programs to increase traceability of product carbon pools and build ongoing storage monitoring systems for specific products and geographies
- Developing contracts with suppliers or supply chain coalitions that specify data sharing agreements to enable ongoing storage monitoring

10

Accounting for Geologic Carbon Pools

Chapter 10: Accounting for Geologic Carbon Pools

Requirements and Guidance

This chapter provides requirements and guidance on accounting for emissions and removals from carbon storage in geologic reservoirs from both a scope 1 and scope 3 perspective. For background on different types of geologic storage and for calculation methods to estimate emissions and geologic carbon storage, refer to chapter 21.

Sections in this chapter

Section	Description
10.1	Introduction to geologic storage pathways
10.2	Accounting for emissions and removals from geologic storage pathways
10.3	Requirements and guidance on geologic storage

Checklist of accounting requirements in this chapter

Section	Accounting requirements
10.1	• For geologic storage pathways with enhanced oil and gas recovery, companies **shall** account for all downstream GHG emissions associated with the extraction, processing, transportation, distribution, storage and use (i.e., combustion) of oil, natural gas or other hydrocarbons produced from the geologic reservoir and report such emissions in scope 1, scope 2, and/or scope 3.
10.2	• Companies **shall** account for all life cycle GHG emissions that occur throughout the geologic storage pathway (i.e., cradle to grave), including GHG emissions from the product life cycle(s) associated with the stored CO_2 or carbon, and report them in the corresponding reporting category in scope 1, scope 2, and/or scope 3. • Companies may account for and report *Net biogenic removals with geologic storage* only if the following requirements are met: ○ Companies **shall** account for the annual net land carbon stock change on lands where the biogenic CO_2 or carbon stored in geologic reservoirs is sourced from; and ○ Companies **shall** demonstrate that there are increases or no change in land carbon stocks within attributable managed lands (or there are net carbon stock increases within attributable managed lands after factoring out carbon stock losses due to natural disturbances). • To report scope 1 *Net removals with geologic storage* when no single entity owns or controls both the sink and the pool of the CO_2 removals:

	○ The multiple entities involved in the geologic removal and storage pathway **shall** develop a contractual agreement which specifies: 1. The ownership (rights) of the CO_2 sinks and pools and resulting removals, and the responsibility (obligations) of the GHG sources and resulting emissions (including any reversals) across the entire geologic removal and storage pathway; and 2. Which single entity accounts for the removals as scope 1, and mechanisms to avoid double counting. • In such cases, a single ton of CO_2 removal with geologic storage **shall not** be reported by more than one entity under scope 1.
10.3	• Companies may account for and report *Net removals with geologic storage* (or not report emissions associated with captured GHG with geologic storage) only if the following requirements are met: ○ <u>Ongoing storage monitoring</u>: Companies **shall** account for and report *Net removals with geologic storage* (or no emissions associated with captured GHG with geologic storage) only if ongoing storage monitoring is in documented in a monitoring plan to ensure carbon remains stored in geologic reservoirs and they can detect losses of stored carbon from relevant geologic carbon pools. ○ <u>Traceability</u>: Companies **shall** account for and report *Net removals with geologic storage* (or no emissions associated with captured GHG with geologic storage) only if they have traceability to the entity(ies) providing CO_2 inputs to the injection site or geologic storage hub system and the entity(ies) operating the CO_2 injection site(s) and geologic storage reservoir(s). ○ <u>Primary data</u>: Companies **shall** account for and report *Net removals with geologic storage* (or no emissions associated with captured GHG with geologic storage) only if net CO_2 removals with geologic storage, captured CO_2 with geologic storage and life cycle emissions for the capture CO_2 or carbon stored in the geologic reservoir(s) are accounted for using primary data specific to the CO_2 injection site(s), geologic storage reservoir(s), and CO_2 or carbon inputs into the geologic storage reservoir(s). ○ <u>Uncertainty</u>: Companies **shall** account for and report *Net removals with geologic storage* (or no emissions associated with captured GHG with geologic storage) only if the net CO_2 removals with geologic storage or captured CO_2 with geologic storage is statistically significant based on quantitative uncertainty estimates. ○ <u>Reversals accounting</u>: ▪ Companies **shall** account for net geologic carbon stock losses of previously reported *Net removals with geologic storage* in the year the losses occur, as either: • *Net CO_2 emissions from geologic storage*, if the carbon pools are part of the GHG inventory boundary in the reporting year, or • *Reversals from geologic storage*, if the carbon pools are no longer in the GHG inventory boundary in the reporting year. ▪ If companies lose the ability to monitor geologic carbon stocks associated with previously reported removals, companies **shall** assume previously reported removals are emitted and report *Reversals from geologic storage*.

10.1 Introduction to geologic storage pathways

A geologic storage pathway refers to the consecutive and interlinked stages associated with the acquisition and storage of carbon in geologic reservoirs. A geologic storage pathway includes:

- raw material extraction or production,
- transportation, distribution and processing of fuels or feedstocks,
- processes associated with CO_2 or carbon capture,
- processing, transportation and distribution of captured CO_2 or carbon,
- injection and storage of CO_2 or carbon in a geologic reservoir, and
- downstream processes associated with production from the reservoir (e.g., production, refining, transportation, and use (combustion) of oil and natural gas produced from enhanced oil and gas recovery).

Storage of carbon in geologic reservoirs can have different impacts on the climate depending on:

- the origin of the stored CO_2 or carbon (e.g., captured fossil CO_2 from an industrial point source, captured biogenic CO_2 from an industrial point source, direct air capture CO_2 removed from the atmosphere),
- GHG emissions associated with the life cycle processes in the geologic storage pathway, and
- the permanence of the geologic storage.

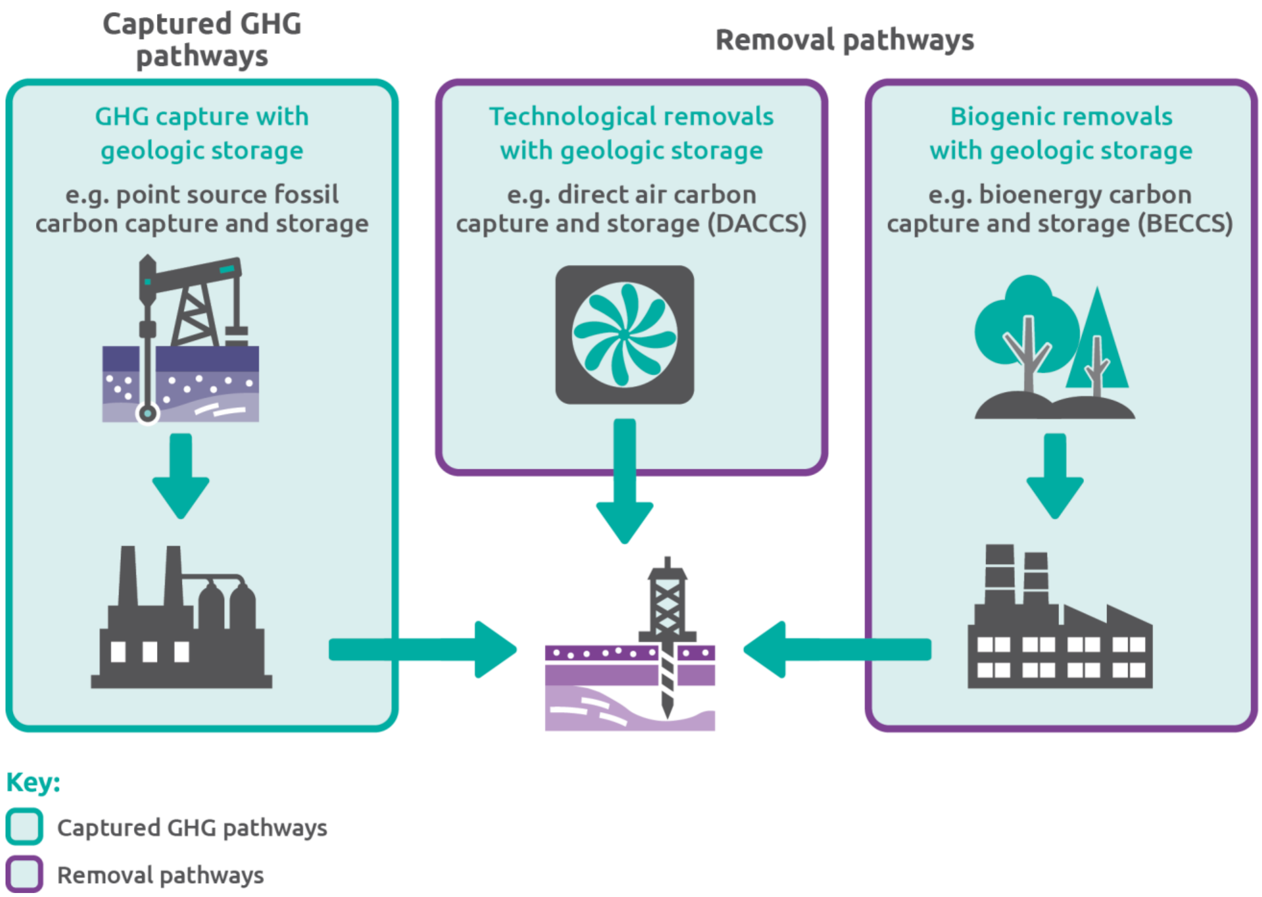
Table 10.1 provides descriptions and examples of different geologic storage pathways based on the origin of the stored CO_2 or carbon. Figure 10.1 provides an illustration of geologic storage pathways. The following sections describe the various geologic storage pathways and their relative impacts on the climate.

Table 10.1 Description of geologic storage pathways

Geologic storage pathway	Type of geologic storage	Pathway description	Example	Does this constitute as a removal?
Captured GHG pathway	Captured GHG	GHGs are created but captured from an industrial point source prior to release to the atmosphere and stored in geologic reservoirs	Point source fossil carbon capture and storage (CCS)	No
Removal pathway	Technological removals with geologic storage	CO_2 removed from atmosphere via technological sinks and stored in geologic reservoirs	Direct air carbon capture and storage (DACCS)	Yes*
	Biogenic removals with geologic storage	CO_2 removed from atmosphere via biogenic sinks, harvested and used as a product then biogenic CO_2 is captured and stored in geologic reservoirs	Bioenergy carbon capture and storage (BECCS)	Yes*

*Note: *Reporting net removals with geologic storage is subject to meeting the removal requirements in this chapter.*

Figure 10.1 Illustration of geologic storage pathways



10.1.1 Captured GHG pathways

Captured GHG pathways occur where GHGs are captured prior to release to the atmosphere and stored in geologic reservoirs, rather than being emitted from a facility. This requires technological solution(s) to capture and separate the GHGs at a source. This impact is reflected in a GHG inventory as reduced emissions over time if, in previous years, emissions were released from a company's operations or value chain and in the reporting year GHGs are instead captured and stored.

In 'captured GHG' pathways, companies do not report emissions in the respective scope 1, scope 2 or scope 3 category for any CO_2 that is captured and stored (if they meet the geologic storage requirements in section 10.3). Any GHGs not captured and all emissions from the capture process must be accounted for. The 'captured GHG' pathway requires ongoing storage monitoring of geologic reservoirs to detect potential losses (emissions) and is subject to reversals accounting and the other requirements for geologic storage described in section 10.3.

In contrast to 'captured GHG' pathways, renewable energy pathways do not generate greenhouse gas emissions from combustion, do not require ongoing storage monitoring of CO_2 in geologic reservoirs, and do not have a risk of future reversals of stored CO_2. 'Captured GHG' pathways require that companies meet the requirements in section 10.3, whereas renewable energy pathways do not.

Fossil carbon capture and storage (CCS)

In a fossil CCS pathway, CO_2 from industrial and energy-related sources is captured on site at a point source. The capture process can involve purifying the CO_2 before transportation and injection into geologic reservoirs.

Geologic storage pathways where carbon is derived from fossil fuels or other carbon resources that are part of the long-term carbon cycle (e.g., CO_2 capture from cement production) are not accounted for as CO_2 removals. Instead, capture of fossil CO_2 from a point source prevents emissions by capturing and storing the CO_2. All GHG emissions from fugitive losses and processes associated with the geologic storage pathway must be accounted for.

10.1.2 CO_2 removal and storage pathways

Carbon or CO_2 stored in geologic reservoirs can be accounted for as CO_2 removals if the CO_2 originates from biogenic or technological sinks that are part of the short-term carbon cycle (e.g., CO_2 is removed from the atmosphere in the reporting year or is associated with recent biomass growth). Removals with geologic storage are net increases in geologic carbon stocks from biogenic or technologically removed CO_2.

Removals with geologic storage can be separately accounted for and reported as:

- *Net technological removals with geologic storage*, if stored CO_2 is derived from technological removal pathways (e.g., DACCS), or
- *Net biogenic removals with geologic storage*, if stored CO_2 is derived from biogenic removal pathways (e.g., BECCS).

Direct air carbon capture and storage (DACCS)

DACCS removes CO_2 from ambient air and then separates it into a relatively pure stream of CO_2, which is stored in geologic formations. DACCS uses air with very low CO_2 concentration and typically has a high thermal and/or electrical energy demand. DACCS does not need to be coupled with an emission source and can be placed near a geologic storage location.

Bioenergy or biogenic carbon capture and storage (BECCS or Bio-CCS)

Biomass removes carbon from the atmosphere as it grows. Where land carbon stocks are stable or increasing, the gross CO_2 removals associated with biomass growth can be transferred to storage in harvested biogenic products, then upon use biogenic CO_2 or carbon is captured and stored in geologic carbon pools.

BECCS relies on technologies where biomass is converted into energy (heat, electricity, or fuel) and the biogenic CO_2 produced from the bioenergy conversion is captured. BECCS facilities must be located close to geologic storage reservoirs or transport CO_2 to the geologic storage location.

Over the geologic storage pathway, BECCS may provide a net benefit to the climate if GHG emissions over the complete removals and geologic storage pathway (from growing, harvesting, transporting, and processing of the biomass and capturing, transporting, and storing the CO_2) are less than the biogenic carbon stored in geologic reservoirs. The process must also not increase the global land carbon footprint or increase land competition for food as monitored through the land tracking metrics (see chapter 7 for details).

10.1.3 Geologic storage with enhanced oil and gas recovery

In some geologic storage pathways, CO_2 is also used for enhanced oil and gas recovery to extract additional fossil carbon resources (e.g., oil or natural gas). Enhanced oil or natural gas recovery is a process where CO_2 is injected into an oil and gas reservoir to serve as a solvent and/or to maintain or increase reservoir pressure. Once injected, CO_2 moves through the reservoir and mobilizes oil. Some of the CO_2 is produced with oil and brine extracted from the reservoir and then is reinjected in a closed loop cycle. This process results in CO_2 storage in the reservoir (see chapter 21 for additional background).

For complete accounting of the climate impact of geologic storage pathways with EOR, companies must account for GHG emissions and CO_2 removals on a cradle-to-grave basis.

Accounting requirement

Companies accounting for geologic storage pathways with enhanced oil and gas recovery **shall** account for all GHG emissions associated with the extraction, transportation, distribution and use (i.e., combustion) of oil, natural gas, or other hydrocarbons produced from the geologic reservoir and report such emissions in scope 1, scope 2, and/or scope 3.

The change in annual net geologic carbon stocks is determined based on the CO_2 inputs injected into the reservoir, the fossil carbon removed from the reservoir, fugitive CO_2 emissions at the injection or recovery site, and recycling of CO_2 reinjected back into the formation. Of the CO_2 inputs, companies must determine the share of the increase that comes from biogenic or technological CO_2 sinks (relevant to removals) as opposed to CO_2 from fossil or other non-atmospheric carbon origins (not relevant to removals).

Alternative methods to quantify the global impact of EOR production using consequential or intervention GHG accounting methods, including displacement of non-EOR oil and gas production, are described in chapter 11.

10.2 Accounting for emissions and removals from geologic storage pathways

10.2.1 Geologic storage pathway emissions

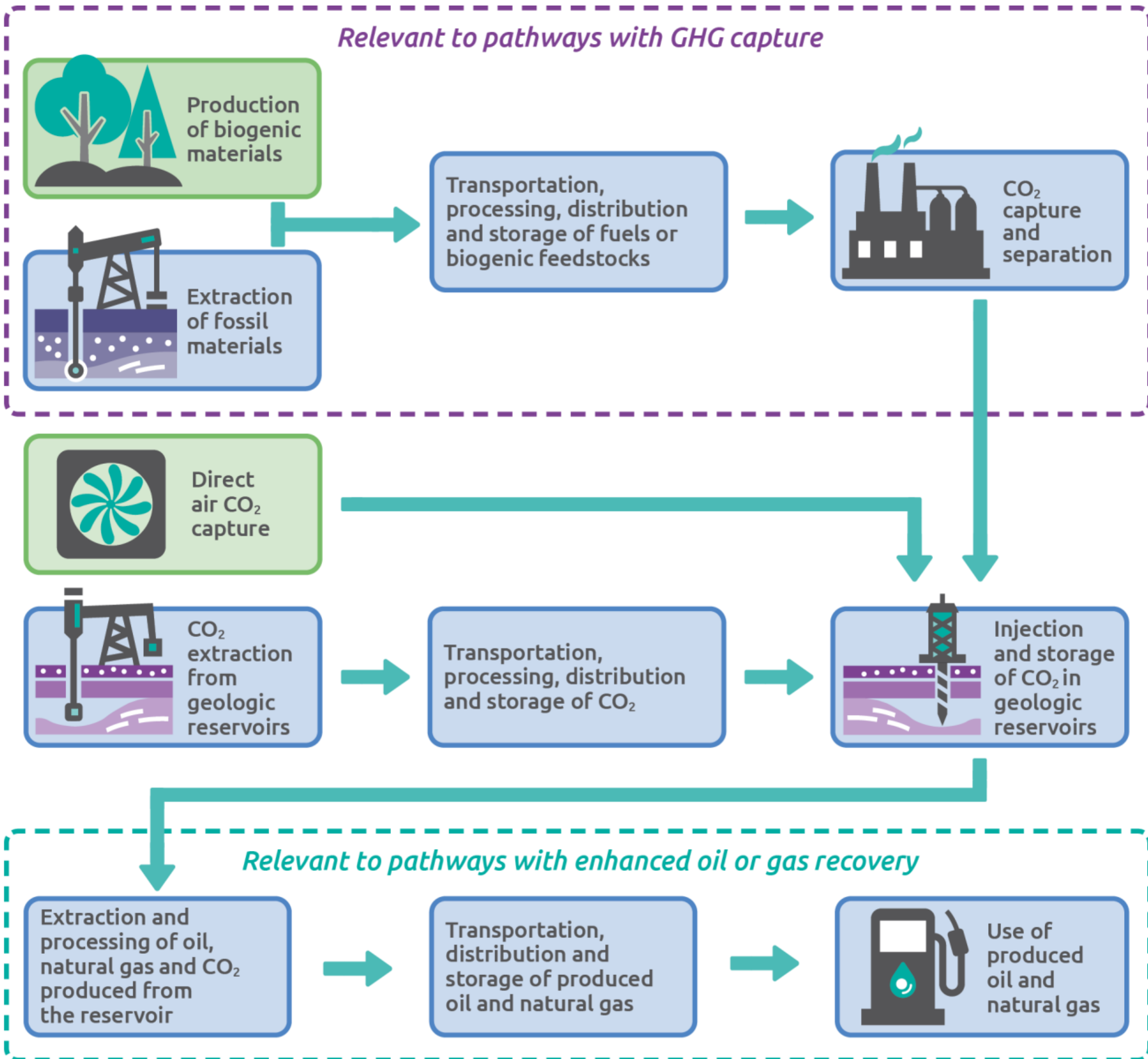
Accounting requirement

Companies **shall** account for all life cycle GHG emissions that occur throughout the geologic storage pathway (i.e., cradle to grave), including GHG emissions from the product life cycle(s) associated with the stored CO_2 or carbon, and report them in the corresponding reporting category in scope 1, scope 2 and/or scope 3.

Figure 10.2 illustrates the attributable processes for geologic storage pathways. Life cycle GHG emissions associated with geologic storage pathways include:

- GHG emissions from extracting and/or producing materials associated with captured CO_2 (i.e., biogenic materials, fossil fuels or other raw materials).
- GHG emissions from transporting, processing, distributing and storing materials associated with captured CO_2 (i.e., biogenic materials, fossil fuels or other raw materials).
- GHG emissions from extracting CO_2 from geologic reservoirs.
- GHG emissions associated with direct air capture or emission capture technologies.
- GHG emissions from processing, transporting, distributing, storing, and injecting captured CO_2 into the geologic reservoir.
- Fugitive CO_2 emissions from the injection or production wells or other carbon losses from the geologic reservoir (e.g., in the form of extracted fossil fuels).
- GHG emissions associated with extraction, processing, transportation, distribution, storage and use (i.e., combustion) of oil, natural gas or other hydrocarbons produced from the geologic reservoir.

Figure 10.2 Attributable processes for geologic storage pathways



Key:

- Attributable processes with removals in geologic storage pathways
- Attributable processes in geologic storage pathways
- Relevant to pathways with GHG capture
- Relevant to pathways with enhanced oil or gas recovery

Source: Adapted from Núñez-López et al. 2019

To determine the appropriate scope 3 categories to account for emissions from geologic storage processes, stored CO_2 should be treated as a product. For example, a facility with carbon capture technologies should report GHG emissions from the transportation of captured CO_2 from the facility to a geologic reservoir in scope 3, category 9 (Downstream transportation and distribution), and any GHG emissions from injection into geologic reservoirs or GHG emissions associated with oil and gas produced through enhanced oil recovery in scope 3, category 12 (End-of-life treatment of sold products).

In cases where companies supply, or are in value chains that supply, only a portion of the CO_2 inputs to the injection site or a geologic storage hub system, companies should allocate GHG emissions from the attributable processes in the geologic storage pathway (e.g., GHG emissions from transportation of CO_2, or operations of the injection facility) based on physical allocation of the volume of CO_2 supplied (see chapter 16 for further guidance on allocation).

10.2.2 Captured GHG geologic storage pathways

GHGs that are captured and stored, and meet the geologic storage requirements in section 10.3, do not have to be reported as emissions. Companies with captured GHGs in their value chain must account for any GHG emissions from processes in the geologic storage pathway in scope 1, scope 2, and/or scope 3, including any fugitive emissions of captured GHG, following the guidance in chapter 21.

Companies that own or control a facility that captures GHGs that are then stored in a geologic reservoir:

- Do not report scope 1 emissions associated with the GHGs that are captured and stored and meet the geologic storage requirements in section 10.3.
- Report any fugitive emissions of captured GHGs that are released at that facility in scope 1
- Report emissions from other processes in the geologic storage pathway and any fugitive emissions of captured GHGs in the relevant scope 3 category.
- If GHGs were emitted from the facility in prior years, the captured GHGs will be reflected as a reduction in scope 1 emissions compared to previous years.

Companies that purchase electricity, steam, heat or cooling from a facility that captures GHGs that are then stored in a geologic reservoir:

- Do not report scope 2 emissions associated with the GHGs that are captured and stored and meet the geologic storage requirements in section 10.3.
- Report any fugitive emissions of captured GHGs that are released at that facility in scope 2
- Report emissions from other processes in the geologic storage pathway in scope 3, category 3 (fuel- and energy-related activities).
- If GHGs were emitted from the facility in prior years, the captured GHGs will be reflected as a reduction in scope 2 emissions compared to previous years.

Companies that otherwise have facilities in their value chain that capture GHGs that are then stored in a geologic reservoir:

- Do not report scope 3 emissions associated with the GHGs that are captured and stored and meet the geologic storage requirements in section 10.3.
- Report any fugitive emissions of captured GHGs that are released at that facility in scope 3
- Report emissions from processes in the geologic storage pathway and any fugitive emissions of captured GHGs in the relevant scope 3 category.
- If GHGs were emitted from the facility in prior years, the captured GHGs will be reflected as a reduction in scope 3 emissions compared to previous years.

10.2.3 Net removals with geologic storage

Net removals with geologic storage are accounted based on the net carbon stock increases in geologic reservoirs derived from biogenic or technological sinks. Chapter 21 provides methods and calculation guidance to account for removals with geologic storage as well as other GHG emissions from processes in the geologic storage pathway.

Net biogenic removals with geologic storage

To report removals with geologic storage, companies are required to meet the requirements and criteria for reporting removals, including ongoing storage monitoring, traceability, primary data, and uncertainty (described in section 10.3).

Net biogenic removals have additional considerations to ensure that biogenic CO_2 or carbon captured and stored in geologic reservoirs is sourced from land with recent biomass growth (chapter 8) and that they do not increase the global demand for land use (chapter 7). To ensure full accounting of biogenic product life cycle emissions, companies must account for GHG emissions and land carbon stock changes associated with the lands where biogenic products are grown and harvested.

Accounting requirement

Companies may account for and report net biogenic removals with geologic storage only if the following requirements are met:

- Companies **shall** account for the annual net land carbon stock change on lands where the captured biogenic CO_2 or biogenic carbon stored in geologic reservoirs is sourced from; and
- Companies **shall** demonstrate that there are increases or no change in land carbon stocks within attributable managed lands (or there are net carbon stock increases within attributable managed lands after factoring out carbon stock losses due to natural disturbances).

If captured biogenic CO_2 or biogenic carbon stored in geologic reservoirs is from waste materials with no market value, this requirement does not apply. Companies are not required to account for net land carbon stock changes (or other GHG emissions or removals) from the process that generates waste materials or further upstream (see section 16.5.2 for more information on allocating emissions and removals from waste). All subsequent emissions in the life cycle (after the process that generates the waste) are accounted for.

Companies can follow guidance in chapter 7 on accounting for land tracking metrics and chapter 8 to determine attributable managed land in the value chain of biogenic material production.

Scope 1 net removals with geologic storage

A removal is accounted for as a scope 1 *Net removal with geologic storage* if the reporting company owns or controls both the sink (that transfers CO_2 from the atmosphere) and the pool (that stores the CO_2 or carbon). When defining scope 1 removals with geologic storage, ownership or control can be defined in the form of direct ownership or control or through contractual ownership or control (for example, through as CO_2 storage as a service).

Geologic storage pathways may present circumstances where no single entity owns or controls all the relevant processes (i.e., both sink and pool). In cases where no single entity would report scope 1 *Net removals with geologic storage* according to the definition above, the multiple entities involved in a geologic storage pathway may draw up contracts that specify the ownership (rights) of the CO_2 sinks and pools and resulting removals, and the responsibility (obligations) of the GHG sources and resulting emissions, across the entire geologic removal and storage pathway, including to specify which single entity accounts for removals as scope 1.

Accounting requirement

To report scope 1 *Net removals with geologic storage* when no single entity owns or controls both the sink and the pool of the CO_2 removals, the multiple entities involved in the geologic removal and storage pathway **shall** develop a contractual agreement which specifies:

1. The ownership (rights) of the CO_2 sinks and pools and resulting removals, and the responsibility (obligations) of the GHG sources and resulting emissions (including any reversals) across the entire geologic removal and storage pathway; and
2. Which single entity accounts for the removals as scope 1, and mechanisms to avoid double counting.

In such cases, a single ton of CO_2 removal with geologic storage **shall not** be reported by more than one entity under scope 1.

Where such arrangements exist, companies **shall** report a description of the contractual arrangement and avoidance of double counting of scope 1 removals between all entities in the geologic removal and storage value chain.

Table 10.2 provides examples and descriptions of scope 1 removals with geologic storage.

Table 10.2 Examples of scope 1 net removals with geologic storage

Example	Description
DACCS	A company owns/controls both 1) the direct air capture facility, 2) the geologic reservoir or owns/controls the stored CO_2 and 3) meets the geologic storage requirements described in section 10.3
BECCS	A company owns/controls 1) the land where biomass is grown, 2) the BECCS facility, 3) the geologic reservoir or owns/controls the stored CO_2 and 4) meets the geologic storage requirements described in section 10.3

Scope 3 net removals with geologic storage

A removal is accounted for as a scope 3 net removal with geologic storage in cases where the sink (that transfers CO_2 from the atmosphere) and/or the pool (that stores the CO_2 or carbon) is not owned or controlled by the reporting company, but by another entity in the value chain.

Table 10.3 provides examples and descriptions of scope 3 removals with geologic storage.

Table 10.3 Examples of scope 3 net removals with geologic storage

Example	Description
DACCS	• A company owns/operates a direct air capture facility and transfers the CO_2 for long-term storage in a geologic reservoir owned/controlled by another entity, where the company that owns/controls the DAC facility does not have control over the stored CO_2
DACCS/BECCS	• A company operates a geologic reservoir and acquires biogenic or technologically removed CO_2 for long-term storage
BECCS	• A landowner/land manager removes CO_2 from atmosphere through tree growth and sells the harvested biomass to a BECCS facility that combusts the biomass, captures the biogenic CO_2 and transfers it to a geologic storage company for long-term storage, if the landowner/land manager knows the eventual fate of the biomass is geologic storage • A company owns/operates a biomass power plant that sources biomass, combusts the biomass, captures the biogenic CO_2, and transfers it to a geologic storage company for long-term storage, if the BECCS operator has visibility upstream to the land and downstream to the geologic storage • A company purchases electricity, steam, heating or cooling from a biomass power plant that captures biogenic CO_2 and transfers it to a geologic storage company for long-term storage (scope 3, category 3)

Table 10.4 describes what reporting categories to use when reporting removals from geologic storage, based on the ownership or control of the geologic reservoir storing the carbon, and the sink or facility that captures fossil CO_2.

Table 10.4 Example of reporting categories for geologic carbon storage based on ownership and control

Entity that owns or controls the sinks or facility that captures CO_2	Entity that owns or controls the CO_2 stored in geologic reservoirs	Examples	Relevant reporting category for reporting company *
CO_2 sinks owned or controlled by the reporting company	CO_2 stored in geologic reservoirs owned or controlled by the reporting company	Company that both owns the direct air capture facility and manages the geologic reservoir or owns/controls the stored CO_2 (DACCS)	Scope 1 removals with geologic storage (technological)
	CO_2 stored in geologic reservoirs is owned or controlled by	Farmer whose harvested biomass is sold to an ethanol facility with biogenic CO_2 capture that is then stored in a geologic reservoir (BECCS)	Scope 3 removals with geologic storage (biogenic)

	another entity in the value chain of the reporting company	Direct air capture company that does not manage the geologic reservoir or have ownership or control of the stored CO_2 (DACCS)	Scope 3 removals with geologic storage (technological)
CO_2 sinks in the value chain of the reporting company	CO_2 stored in geologic reservoirs owned or controlled by the reporting company	Geologic storage company that acquires captured biogenic CO_2 from a biomass power plant (BECCS)	Scope 3 removals with geologic storage (biogenic)
		Geologic storage company that acquires technologically removed CO_2 from a direct air capture facility (DACCS)	Scope 3 removals with geologic storage (technological)
	CO_2 stored in geologic reservoirs is owned or controlled by another entity in the value chain of the reporting company	Biomass power plant capturing biogenic CO_2 and transferring it to a geologic storage company (BECCS), if the company knows the origin of the biomass and that geologic storage is the eventual fate of the CO_2	Scope 3 removals with geologic storage (biogenic)
		Company purchasing electricity, steam, heating or cooling from a biomass power plant capturing biogenic CO_2 and transferring it to a geologic storage company (BECCS)	
CO_2 derived from fossil carbon captured in facilities owned or controlled by the reporting company	CO_2 stored in geologic reservoirs is owned or controlled by another entity in the value chain of the reporting company	Fossil fuel power plant capturing fossil CO_2 and transferring it to a geologic storage company (CCS)	No emissions reported in scope 1 for the captured and stored CO_2
CO_2 derived from fossil carbon captured in the value chain of the reporting company	CO_2 stored in geologic reservoirs owned or controlled by the reporting company	Geologic storage company that acquires captured fossil CO_2 from a fossil fuel power plant (CCS)	No emissions reported in scope 3 for the captured and stored CO_2
	CO_2 stored in geologic reservoirs is owned or controlled by another entity in the value chain of the reporting company	Company purchasing electricity, steam, heating or cooling from a fossil fuel power plant capturing fossil CO_2 and transferring it to a geologic storage company (CCS)	No emissions reported in scope 2 for the captured and stored CO_2

Note: * If the requirements for reporting removals or captured CO_2 with geologic storage are met (see section 10.3)

10.3 Requirements and guidance on geologic storage

Chapter 6 provides general requirements that must be met for companies to report CO_2 removals in scope 1 or scope 3. Similarly, companies with, or in value chains with, facilities that capture CO_2 must meet the geologic storage requirements to account for captured CO_2 that ultimately is stored in geologic reservoirs.

For example, a company involved in a DACCS value chain would need to meet the geologic storage criteria to report removals with geologic storage. Similarly, a company with fossil carbon capture and storage would need to meet the criteria to not report emissions associated with CO_2 captured and stored in the respective scope.

Companies may account for and report *Net removals with geologic storage* or captured GHG emissions with geologic storage only if the following requirements in section 10.3.1 to 10.3.5 are met. The sections below provide detailed guidance for applying the geologic storage requirements to report no emissions associated with captured CO_2 that is stored in geologic reservoirs or net removals with geologic carbon.

10.3.1 Ongoing storage monitoring

Accounting requirement

Companies **shall** account for and report *Net removals with geologic storage* (or no emissions associated with captured GHG with geologic storage) only if ongoing storage monitoring is in documented in a monitoring plan to ensure carbon remains stored in geologic reservoirs and they can detect losses of stored carbon from relevant geologic carbon pools.

Ongoing storage monitoring of geologic carbon storage is required, after *Net removals with geologic storage* are reported, to ensure carbon remains stored and to capture reversals at the following scales:

- **Scope 1 removals with geologic storage:** Ongoing storage monitoring of both biogenic or technological sinks and geologic reservoirs owned or controlled by the reporting company.
- **Scope 3 removals with geologic storage:** Ongoing storage monitoring of geologic reservoirs in the value chain of the reporting company where the company previously reported removals with geologic storage.

Ongoing storage monitoring procedures for geologic storage should, at minimum, comply with all applicable regulatory requirements for CO_2 storage and well permitting to ensure permanence of stored carbon. At the end of operations geologic storage operator may close injections wells following regulatory requirements. After injection well closure, where regulations include provisions for the transfer of liabilities associated with geologically stored CO_2 to the state and the geologic storage operator demonstrates that storage is permanent without risk of CO_2 losses from the reservoir, post-closure monitoring may follow regulatory guidance.

The monitoring needed to detect any emissions from the geologic reservoir will differ depending on the geology of the reservoir, the CO_2 injection technologies, the methods used to estimate stored carbon and the monitoring technologies used. Ongoing monitoring should be detailed through a monitoring plan that details the following elements, in addition to the guidance provided in chapter 21:

- Site characterization that includes a description of the geologic reservoir, expected CO_2 trapping mechanisms and location of known wells into the reservoir.
- How the CO_2 injection, geologic carbon storage and monitoring complies with all applicable laws and regulations.

- Methods used to detect any fugitive CO_2 emissions from the injection or production wells.
- Methods used for subsurface monitoring of geologic carbon stocks to confirm the fate of stored carbon and detect any fugitive CO_2 emissions.
- Frequency of monitoring.
- Data quality control procedures and instrument calibration.

Detected net geologic carbon stock losses must be accounted for and reported as reversals in accordance with the reversals accounting guidance in section 10.3.5. Chapter 21 contains additional guidance and methods for monitoring geologic reservoirs for fugitive GHG emissions and stored carbon.

10.3.2 Traceability

Traceability is needed to ensure a complete life cycle assessment (i.e., cradle-to-grave) of the geologic storage pathway and identification of the relevant geologic carbon stock changes.

Accounting requirement
Companies **shall** account for and report *Net removals with geologic storage* (or no emissions associated with captured GHG with geologic storage) only if they have traceability to the entity(ies) providing CO_2 inputs to the injection site or geologic storage hub system and the entity(ies) operating the CO_2 injection site(s) and geologic storage reservoir(s).

Companies that are in the value chain of a geologic storage pathway but do not own or control the geologic reservoir must have traceability to the specific geologic reservoir(s) where carbon associated with their value chain is stored. For captured CO_2, companies should report the net amount of CO_2 (in tons) at each custody transfer, where the net amount is the difference between CO_2 inputs and outputs, corrected by any changes in composition of the CO_2 stream, if applicable.

Companies that are in the value chain of a removal and geologic storage pathway but to not manage lands with biogenic sinks or facilities with technological sinks (e.g., forest where trees are growing or DAC facility removing atmospheric CO_2) must have traceability to evaluate net land carbon stock changes on attributable managed land and other life cycle GHG emissions associated with the stored CO_2 or carbon.

10.3.3 Primary data

Accounting requirement
Companies **shall** account for and report *Net removals with geologic storage* (or no emissions associated with captured GHG with geologic storage) only if net CO_2 removals with geologic storage, captured CO_2 with geologic storage and life cycle emissions for the capture CO_2 or carbon stored in the geologic reservoir(s) are accounted for using primary data specific to the CO_2 injection site(s), geologic storage reservoir(s), and CO_2 or carbon inputs into the geologic storage reservoir(s).

Data used to assess CO_2 inputs, net CO_2 removals with geologic storage and captured CO_2 with geologic storage for the geologic storage reservoir or across all geologic carbon pools in the geologic storage hub should preferably come from direct measurements at the reservoir(s) and data from CO_2 input suppliers within the geologic storage pathway to provide the most accurate estimates.

The following primary data should be collected for evaluation of the geologic storage reservoir:

- Geophysical data (seismic surveys, natural seismicity).
- Well data (well logs, flow tests, geomechanical data).
- Reservoir properties data (reservoir pressure and temperature, core data, reservoir fluids data, petrophysical data, geochemical data).

For companies in a geologic storage value chain operated as a hub with multiple geologic reservoirs, they can meet primary data requirements by using data provided by the hub operator on a hub-average basis across the different reservoirs. For estimates of net CO_2 removals with geologic storage or captured CO_2 with geologic storage in geologic storage hubs this can be allocated based on the amount and type of CO_2 inputs supplied by the reporting company, or other entities in the reporting company's value chain to the hub.

The more primary data available, the more accurate description of the subsurface carbon storage can be provided. Where primary data are not available, secondary data from other known locations of similar geology may be used to supplement geologic storage estimates. Additional guidance on data and methods for accounting for geologic storage pathways is provided in chapter 21.

10.3.4 Uncertainty

Accounting requirement
Companies **shall** account for and report *Net removals with geologic storage* (or no emissions associated with captured GHG with geologic storage) only if the net CO_2 removals with geologic storage or captured CO_2 with geologic storage are statistically significant based on quantitative uncertainty estimates.

Uncertainty estimates for geologic storage should include:

- Uncertainty ranges associated with direct measurement of CO_2 inputs at the CO_2 injection well.
- Uncertainty ranges for the amount of CO_2 inputs sourced from biogenic or technologically removed carbon.
- Uncertainty ranges for the annual net CO_2 removals with geologic storage or captured CO_2 with geologic storage for the geologic storage reservoir or across all geologic carbon pools in the geologic storage hub.
- Quantitative risk assessments of the permanence of geologic carbon storage.

For companies in a geologic storage value chain operated as a hub with multiple geologic reservoirs, they can use uncertainty data provided by the hub operator on a hub-average basis.

10.3.5 Reversal accounting

Companies in geologic storage value chains ensure carbon remains stored through their ongoing storage monitoring of annual net carbon fluxes in geologic reservoirs. Such net geologic carbon losses could be due to fugitive CO_2 losses detected from wells or after seismic events, or from net carbon losses associated with produced oil and gas from EOR operations.

Accounting requirement

Companies **shall** account for net geologic carbon stock losses of previously reported *Net removals with geologic storage* in the year the losses occur, as either:

- *Net CO_2 emissions from geologic storage*, if the carbon pools are part of the GHG inventory boundary in the reporting year, or
- *Reversals from geologic storage*, if the carbon pools are no longer in the GHG inventory boundary in the reporting year.

If companies lose the ability to monitor geologic carbon stocks associated with previously reported removals, companies **shall** assume previously reported removals are emitted and report *Reversals with geologic storage*.

If ongoing monitoring ends, or companies lose the ability to monitor carbon stocks associated with previously reported *Net removals with geologic storage*, companies must account for and report reversals (reported as emissions) equal to the previously reported *Net removals with geologic storage* (see chapter 6 for details). Where companies have closed the injection site in accordance with regulations and demonstrated that storage is permanent without risk of CO_2 losses from the reservoir, post-closure monitoring may follow regulatory guidance and companies do not need to assume all carbon stocks associated with previously reported removals are emitted.

11

Evaluating the Impact of Actions

Chapter 11: Evaluating the Impact of Actions

Requirements and Guidance

All major business decisions and actions have a potential impact on climate change. These impacts can occur within a company's scope 1, scope 2, and scope 3 inventory as well as beyond the inventory boundary. Impacts outside of scope 1, 2 and 3 include leakage, avoided emissions, and other system-wide impacts.

This chapter provides requirements and guidance on estimating and reporting the GHG impacts of corporate actions using intervention accounting methods. This information is reported outside the scopes in a GHG inventory report to inform decision-making, provide transparency, and ultimately help maximize a company's net positive impacts on climate change.

If emission reductions or removals from actions are credited for the purpose of transferring GHG claims between entities, companies should refer to chapter 13 for requirements and guidance on accounting for and reporting on GHG reduction or removal credits. This chapter provides requirements and guidance on evaluating GHG impacts of actions to inform decision making, rather than crediting.

Sections in this chapter

Section	Description
11.1	Introduction to evaluating GHG impacts
11.2	Identifying actions to evaluate
11.3	Evaluating GHG impacts of actions
11.4	Using results for decision making
11.5	Evaluating how actions affect GHG inventories
11.6	Examples of evaluating GHG impacts of actions

Checklist of accounting requirements in this chapter

Section	Accounting requirements
11.3	• If companies implement actions that could have a potentially significant negative impact (i.e., increase GHG emissions and/or decrease removals) outside the scope 1, 2 and 3 boundary, companies **shall** estimate the impacts on GHG emissions and removals resulting from the action using intervention accounting methods (including land tracking metric[s] in chapter 7) and report the impacts separately from the scopes.

11.1 Introduction to evaluating GHG impacts

Evaluating impacts is important to inform corporate decisions, such as choosing which materials or energy sources to produce or consume, or which strategies, investments, practices, or activities to implement.

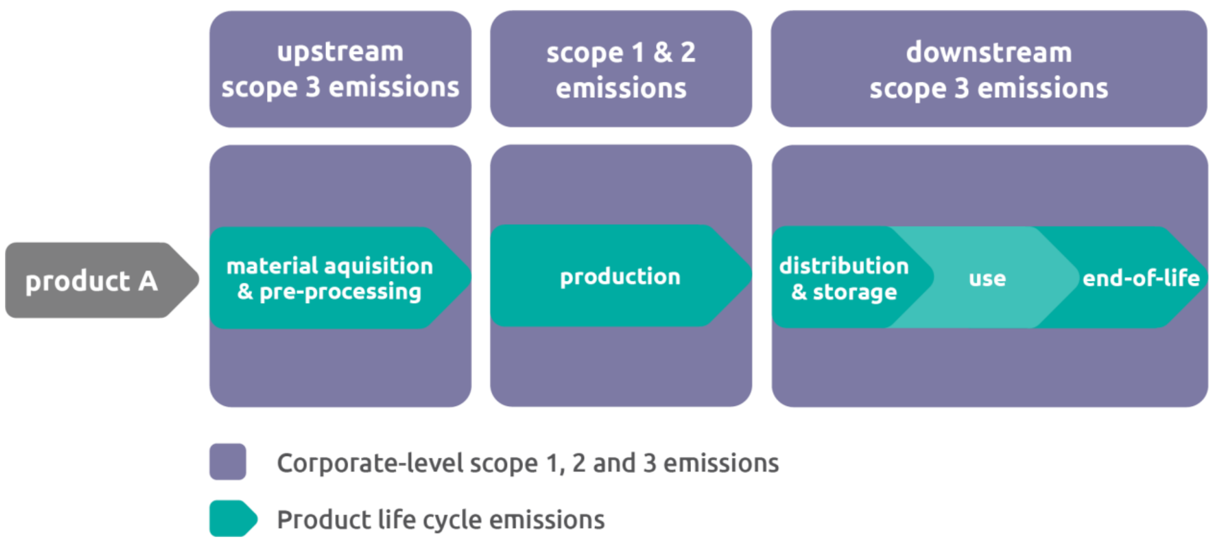
To evaluate GHG impacts of corporate actions, companies should:

- take a full value chain or life cycle perspective to evaluate the GHG emissions and removals associated with materials, energy sources, practices or activities across scope 1, scope 2 and scope 3 and the full life cycle of products, and
- apply intervention accounting methods, which estimate the total net GHG impacts of actions compared to a counterfactual baseline scenario

Evaluating impacts through a value chain or life cycle perspective

A full value chain or life cycle perspective is important to understand whether an action increases or decreases emissions and removals at different stages of a product's life cycle and to avoid tradeoffs. For example, companies should not implement actions that reduce their scope 1 inventory while increasing their scope 3 inventory, reduce emissions in one life cycle stage but increase them in another, or have no net benefit across scopes 1, 2 and 3. Figure 11.1 illustrates the relationship between a corporate value chain and a product life cycle.

Figure 11.1 Relationship between a corporate GHG inventory and a product GHG inventory (for a company manufacturing Product A)



Source: Adapted from GHG Protocol *Scope 3 Standard*

Evaluating system-wide impacts with intervention accounting

Companies should also understand the system-wide impacts of their actions by looking beyond the scope 1, 2 and 3 emissions inventory and beyond a typical product life cycle assessment. Impacts not captured in a scope 1, 2 and 3 emissions inventory can include:

- avoided emissions (emissions that would have otherwise happened, but that, as a result of a company's activities, did not happen),

- avoided removals (removals that would have otherwise happened, but that, as a result of a company's activities, did not happen),
- leakage (negative impacts on emissions and removals outside the company's inventory boundary caused by a company's activities to reduce emissions or increase removals within the inventory boundary),
- market-mediated effects (such as substitution or displacement effects resulting from supply and demand dynamics), and
- indirect land use change (land use change emissions caused by a company's activities that occur outside of a company's value chain),
- carbon opportunity costs (the difference between the current carbon stock of managed land and the native vegetation carbon stock of that land, showing the potential for CO_2 removal if the land were reforested or otherwise reverted to native vegetation)
- other system-wide effects.

To understand and evaluate these impacts, companies should use intervention accounting methods (also known as project accounting methods), which estimate the systemwide impacts of actions relative to counterfactual baseline scenarios. These methods assess the GHG impacts of an action compared to the conditions most likely to occur in the absence of the action. Companies should use the results to ensure that actions lead to global net GHG benefits (discussed in section 11.4).

This is particularly important in the land sector, for a variety of reasons, including:

- An absence of human activity, relative to current agriculture or forestry activities, could lead to both a reduction in emissions and an increase in removals, as a native ecosystem (e.g., forest, wetland) naturally regenerates and carbon is sequestered in vegetation and soils.
- The global demand for land-based products is growing, along with deforestation and conversion of other natural ecosystems. Therefore, reducing production on one area of land could result in leakage (in which a new area of land is cleared to replace the lost agricultural or forest products).
- The increase in productivity on one area of land (such as by adding fertilizer or with mechanization) could increase scope 1, 2 and 3 emissions but avoid land conversion elsewhere – potentially leading to global net GHG benefits.

Due to these specific land sector issues, this Guidance includes a category of land tracking metrics in chapter 7, including *Indirect land use change emissions*, *Carbon opportunity costs*, and *Land occupation*. Companies should include one or more of these land tracking metrics when assessing the impacts of an action.

Comparison of inventory and intervention accounting methods

The GHG Protocol *Corporate Standard*, *Scope 3 Standard*, and the previous chapters of this Guidance use inventory accounting methods to compile a company's annual GHG inventory, whereas this chapter uses intervention accounting methods.

Inventory accounting methods track GHG emissions and removals within a defined inventory boundary over time relative to a historical base year. Intervention accounting methods estimate the impact of actions (changes in emissions and removals resulting from an action), without regard to a defined GHG inventory boundary.[92]

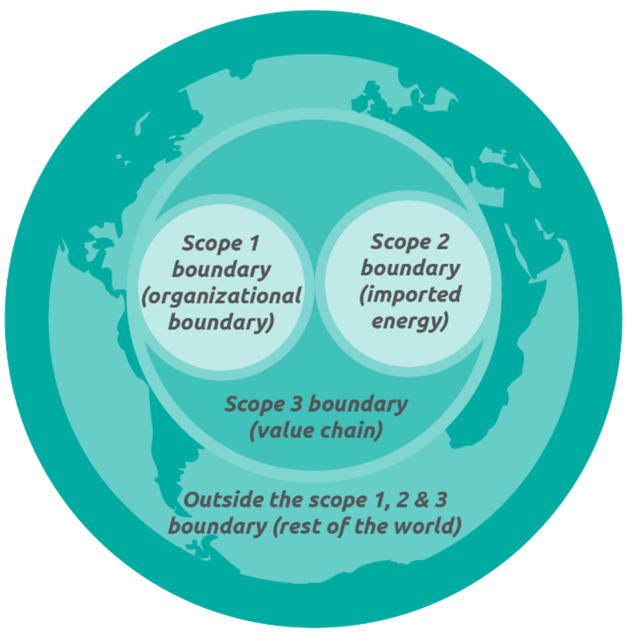
[92] In life cycle assessment, inventory methods correspond to attributional methods and intervention methods correspond to consequential methods.

Inventory accounting methods meet a variety of objectives, including accounting for total emissions and removals annually within a defined GHG inventory boundary, setting and tracking progress toward targets, and identifying 'hot spots' to focus mitigation efforts. However, inventory accounting methods do not capture all climate impacts from company activities, since impacts can occur outside of the inventory boundary. Figure 11.2 illustrates a GHG inventory boundary that includes scope 1, scope 2, and scope 3, as well as impacts that can fall outside the scopes.

While inventory accounting methods do not capture system-wide changes caused by a company's actions, intervention methods can be used to do so since they are not limited to a defined GHG inventory boundary. Intervention accounting methods define an assessment boundary by identifying which sources and sinks are expected to be affected by an action, either positively or negatively, both inside and outside of the company's GHG inventory boundary. Positive impacts are those that decrease GHG emissions and/or increase GHG removals. Negative impacts are those that increase GHG emissions and/or decrease GHG removals.

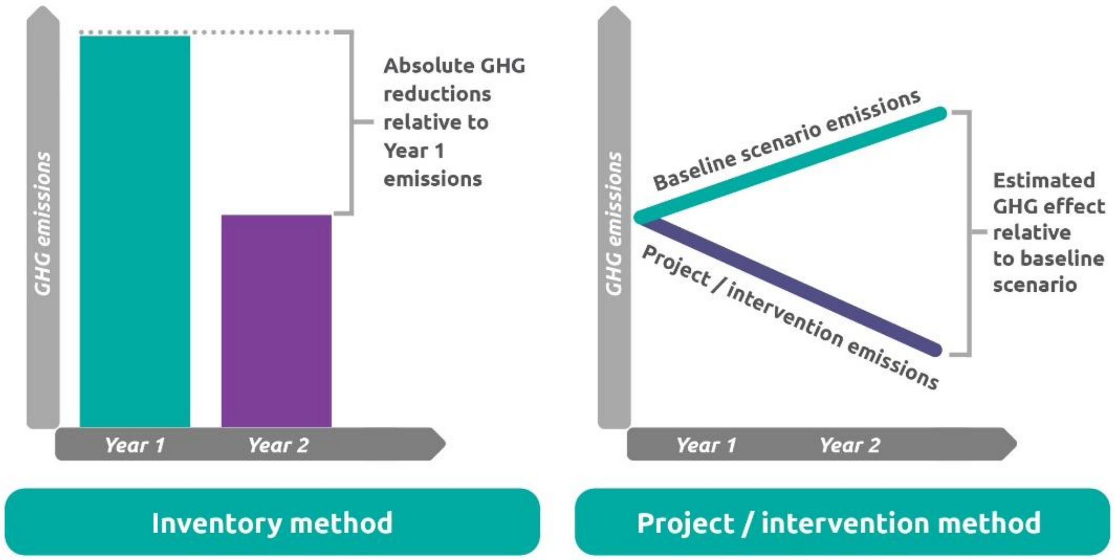
Intervention accounting enables companies to consider a broader range of system-wide impacts of their actions relative to counterfactual scenarios. Companies can use the results to determine which of their actions have the greatest total net positive impact. Intervention methods are therefore best suited for decision making. See figure 11.3 for a comparison of inventory and intervention accounting. For more information on the project or intervention method, see the GHG Protocol *Project Protocol* and *Policy and Action Standard*.[93]

Figure 11.2 Impacts across different boundaries



[93] Available at https://ghgprotocol.org/standards/project-protocol and https://ghgprotocol.org/policy-and-action-standard.

Figure 11.3 Comparison of inventory and project or intervention accounting methods



11.2 Identifying actions to evaluate

Companies should first identify significant actions to evaluate. Actions can include projects, strategies, investments, purchases and sales, and other activities that have significant effects on GHG emissions, removals, land use, land use change, land carbon stocks, production of land-based products, or other activities included in this Guidance.

Actions can have positive impacts by reducing emissions or increasing removals, or negative impacts by increasing emissions or decreasing removals. Actions with positive impacts are mitigation actions. See table 11.1 for examples of mitigation actions.

Companies do not need to evaluate all actions. Instead, companies should identify and assess the actions expected to have the most significant potential impacts (either positive or negative) on emissions and removals. To further prioritize, companies should adopt a risk-based approach and identify actions that might have significant negative impacts outside the scope 1, scope 2, and scope 3 boundary. This approach helps ensure that actions taken to improve the GHG inventory have net positive effects overall.

Table 11.1 Examples of mitigation actions to reduce GHG emissions and/or increase GHG removals in a company's GHG inventory

Type of actions	Examples of sectors	Examples of actions
Actions to reduce scope 1 emissions (land sector)	• Agriculture • Forestry	• Reduce enteric fermentation • Improve manure management • Reduce emissions from manure left on pasture • Reduce fertilizer emissions and increase nitrogen use efficiency in agriculture and forestry • Reduce methane emissions from rice production • Reduce agricultural or forestry energy emissions • Improve forestry practices to reduce emissions (e.g., through reduced impact logging) • Reduce emissions from land-use change by avoiding forest and other natural ecosystem conversion and degradation

Actions to increase scope 1 removals (land sector)	• Agriculture • Forestry	• Integrate trees and perennial crops on agricultural lands (e.g., agroforestry, silvopasture) • Improve forest management (e.g., reforestation, improve productivity, enrichment planting) • Improve agricultural soil carbon management to increase soil carbon stocks • Establish conservation set-asides
Actions to increase scope 1 removals (outside land sector)	• Direct air capture	• Use direct air capture technology or enhanced weathering to remove CO_2 from the atmosphere and store it in geological reservoirs
Actions to reduce scope 3 emissions within the value chain	• Food and Beverage • Furniture • Construction & Real Estate • Paper Products	• Work with agriculture or forest product producers in the value chain to implement actions listed above under actions to reduce scope 1 emissions • Reduce consumption, including through efficiency and reducing losses and wastes across the value chain • Shift sourcing to products with lower GHG emissions
Actions to increase scope 3 removals within the value chain (land sector)	• Food and Beverage • Furniture • Energy (bioenergy) • Transport (biofuels)	• Work with agriculture or forest product producers in the value chain to implement actions listed above under actions to increase scope 1 removals • Engage with suppliers to improve land management practices which increase carbon storage on sourcing lands • Increase proportion of carbon stored in long-lived products (e.g., construction timber or furniture) versus short-lived products (e.g., paper or bioenergy) and increase product longevity through reuse and better design • Use bioenergy with carbon capture and storage (BECCS) in place of conventional bioenergy for industrial, transport and energy sectors (e.g., using sustainable biomass such as wastes and residues to produce electricity and capturing and storing the emissions in geologic reservoirs instead of releasing them to the atmosphere)
Actions to increase scope 3 removals within the value chain (outside land sector)	• Producers or purchasers of technologically removed CO_2 products	• Remove CO_2 from the atmosphere through direct air capture or enhanced weathering processes and store it in long-lived CO_2-based products (e.g., concrete used in construction) • Purchase CO_2 from direct air capture processes for CO_2 based products, chemicals, fuels, etc. rather than fossil-based sources of CO_2

Source: Examples of removal actions adapted from Mulligan et al. (2020).

11.3 Evaluating GHG impacts of actions

After identifying significant actions, companies should evaluate their GHG impacts using intervention accounting methods, following the guidance and requirements in this section.

Defining the scope

Intervention accounting methods can be used to estimate impacts of actions in the future or to evaluate impacts in the past. Companies should decide if they want to evaluate the impacts of actions that have already been implemented and/or potential actions that are being considered or planned.

Companies can evaluate actions either through a:

- forward-looking (or *ex-ante*) assessment, to inform decision making by estimating future impacts of implemented or potential actions, or
- backward-looking (or *ex-post*) assessment, to evaluate the effectiveness of actions after implementation by estimating impacts to date.

Companies should also decide if they want to evaluate other types of impacts in addition to GHG emissions and removals. Intervention accounting methods can incorporate other environmental, social and economic impact categories relevant to decision making in addition to GHG impacts.[94]

Steps to estimate GHG impacts using intervention accounting methods

In general, companies should follow these steps to apply intervention accounting methods and evaluate GHG impacts of significant actions:

1. Define the action, whether the evaluation is backward looking (or *ex-post*) or forward-looking (or *ex-ante*), the assessment period, and what types of impacts to assess
2. Identify impacts of the action to define the "with action" intervention scenario
    a. Consider the potential GHG impacts of the action to quantify, including impacts that are positive and negative, intended and unintended, and that occur within scopes 1, 2 and 3, within the chosen land tracking metric(s), and outside of the scopes
    b. Determine which impacts of the action are significant and should be included in the assessment (based on the whether they are likely to occur and be significant in size), and which sources, sinks, and pools are expected to change as a result of those impacts

[94] Other potential impact categories related to corporate actions include ecosystem protection, climate adaptation and resilience, biodiversity, reduction of air and water pollution, job creation and poverty reduction, agricultural productivity, food security, human health, energy access, waste, soil quality, and more. For guidance on how to incorporate these other impact categories, see the Initiative for Climate Action Transparency (ICAT) Sustainable Development Methodology (ICAT 2020), available at https://climateactiontransparency.org/icat-toolbox/sustainable-development/.

3. Define a counterfactual "without action" baseline scenario, representing the conditions most likely to occur in the absence of the intervention, for example, through project-specific or performance standard baseline approaches[95, 96]
4. Estimate GHG emissions and removals in the "with action" intervention scenario and in the "without action" baseline scenario
5. Calculate the difference between the two scenarios to estimate the net impact of the action
6. Assess the uncertainty of the results, quantitatively or qualitatively

For additional guidance on applying intervention methods, refer to:

- The *GHG Protocol for Project Accounting* (for project-scale actions) and supplementary *Land Use, Land-Use Change, and Forestry Guidance for GHG Project Accounting* [97]
- GHG Protocol *Policy and Action Standard* [98] (for actions of any scale)
- Other chapters in this Guidance for calculating land sector emissions and removals (chapters 3-10 and 16-21 as relevant) and chapters 7 and 17 for guidance on land tracking metrics

Section 11.6 provides examples of using intervention accounting methods to quantify impacts of actions.

Evaluating positive and negative impacts

Actions can have a combination of positive and negative GHG impacts, and ultimately, the net GHG impact of an action can be positive or negative. Table 11.2 provides examples of positive and negative GHG impacts of interventions, which depend on the difference between the intervention scenario and the baseline scenario.

---

[95] For guidance on project-specific and performance standard baseline approaches, see the *GHG Protocol for Project Accounting* and *GHG Protocol Land Use, Land-Use Change, and Forestry Guidance for GHG Project Accounting*, available at https://ghgprotocol.org/standards/project-protocol.

[96] In the land sector, where ecosystems can regenerate if left alone, there is also another type of counterfactual baseline scenario: a 'without human activity' baseline scenario, which represents the conditions most likely to occur on the land if human activity were to cease. The carbon opportunity cost metric described in chapter 7 captures this type of counterfactual scenario, and as shown in chapter 17, can also be used in intervention accounting to compare multiple scenarios.

[97] Available at https://ghgprotocol.org/standards/project-protocol

[98] Available at https://ghgprotocol.org/policy-and-action-standard

Table 11.2 Examples of impacts quantified using intervention methods

Action	Intervention scenario (with action)	Baseline scenario (without action)	GHG impact (difference)
Capturing methane from landfills	Capturing landfill methane and using it for energy to displace fossil fuel use	Landfill methane would have been released to the atmosphere; fossil fuels would have been used for energy	• Positive GHG impact: avoided methane emissions from landfills • GHG impact of displacement of fossil fuels depends on the difference between life cycle emission factors for the fossil fuel displaced versus the landfill gas combusted
		Landfill methane would already have been captured, e.g., because local/national laws require landfill gas be captured	• No GHG impact from landfills: difference between the baseline scenario and intervention scenario is zero
Extended forest rotation	Choosing to delay harvest by X years	Harvesting according to a planned rotation period	• Positive GHG impact: increased CO_2 removals from additional forest growth for X years • Negative GHG impact: possible increased harvesting elsewhere due to market effects
Deciding whether to harvest timber	Harvest	No harvest	• Negative GHG impact: decreased land carbon stock (increased emissions) compared to baseline scenario • Positive GHG impact: removals may increase due to higher post-harvest forest growth rates; if harvest is efficient, it may displace inefficient harvest elsewhere, which may provide the same amount of wood with lower land and GHG impacts
Conversion to protected land	Converting managed forest to protected forest	Production of forest products on managed lands	• Positive GHG impact: increased removals and decreased future emissions from long-term additional forest growth and maintenance of carbon stocks • Negative GHG impact: possible increased harvesting elsewhere due to market effects
Increased agricultural yields	Doubling yield through use of new fertilizer and practices	Current yield	• Negative GHG impact: increased GHG emissions from fertilizer use • Positive GHG impact: decreased land use change emissions from decreased pressure for land clearing elsewhere
Reducing emissions in the agricultural supply chain	Work with existing suppliers to improve practices to reduce GHG emissions while maintaining yields	Existing suppliers use high-GHG agricultural practices	• Positive GHG impact: existing suppliers reduce their GHG emissions by changing practices

	Shift to new suppliers that use low-GHG practices with similar yields		• No immediate direct GHG impact: existing suppliers continue high-GHG practices, while new suppliers continue low-GHG practices. • Possible GHG impact: May lead to indirect GHG benefits over time if market demand for improved supplier performance leads to broader adoption of improved practices.
Reducing food loss and waste	Changing practices to reduce food loss and waste at any part of the food supply chain (production, handling/storage, processing/packaging, distribution/market)	Current level of food loss and waste	• Positive GHG impact: reduced need for food production, avoiding agricultural production emissions and decreasing pressure to clear land
Using waste/ residues for bioenergy	Using forest or agricultural waste/residues for bioenergy to displace fossil fuels	Waste/residues would have decomposed within a few years; fossil fuels would have been combusted	• Positive GHG impact: avoided emissions from decomposition • Negative GHG impact: Carbon losses on the land (dead organic matter or inputs to soil carbon) • GHG impact of displacement of fossil fuels depends on the difference between life cycle emission factors for the fossil fuel displaced versus the biomass combusted
Dedicating land to producing bioenergy crops	Using dedicated cropland to grow bioenergy crops, which are used to displace fossil fuels	Cropland would have produced food, given growing global demand for food; fossil fuels would have been consumed	• Negative GHG impact: land conversion elsewhere due to market effects of displaced food production • GHG impact of displacement of fossil fuels depends on the difference between life cycle emission factors (fuel combustion, extraction, refining, transportation, etc.) for the fossil fuel displaced versus the bioenergy feedstock
Using wood in place of concrete/steel in buildings	Wood used in building construction	Concrete and steel used in building construction; forest would have remained unharvested	• GHG impact of displaced construction materials (e.g., concrete, steel) depends on the difference between life cycle emission factors for the concrete and steel displaced versus the wood, and the impacts of any market effects of material displacement/substitution • Negative GHG impact: carbon loss in the forest versus a no-harvest scenario

Accounting for positive impacts

If actions have a positive impact (i.e., reduce GHG emissions and/or increase removals) outside the company's scope 1, 2 and 3 boundary, companies may estimate and report the impacts of actions using intervention accounting methods and report these impacts separately from the scopes.

GHG reduction or removal opportunities may lie beyond a company's scope 1, scope 2, and scope 3 inventories. For example, some companies may track not only the emissions that arise from the use of their products (scope 3, category 11), but also the avoided emissions in society that result from the use of their products and solutions compared to alternative products and solutions. Avoided emissions may also arise when accounting for emissions from recycling (scope 3, category 5 or 13) or from other activities.

Any estimates of avoided emissions must be reported separately from a company's scope 1, scope 2, and scope 3 emissions, rather than included or deducted from the scope 1, scope 2 or scope 3 inventory. For guidance on quantifying avoided emissions from the use of sold products, refer to the *Scope 3 Standard* (box 9.4) and Russell 2018.[99]

Accounting for negative impacts

An action taken to reduce emissions or increase removals within the inventory boundary could have unintended negative impacts outside the inventory boundary (e.g., leakage) that negate its positive impacts.

Accounting requirement
If companies implement actions that could have a potentially significant negative impact (i.e., increase GHG emissions and/or decrease removals) outside the scope 1, 2 and 3 boundary, companies **shall** estimate the impacts on GHG emissions and removals resulting from the action using intervention accounting methods (including land tracking metric[s] in chapter 7) and report the impacts separately from the scopes.

Reporting this information allows companies and their stakeholders to understand impacts both within and beyond the company's inventory boundary. Doing so provides context to reported changes in the company's GHG inventory and ensures the GHG inventory report is relevant – that is, that it appropriately reflects the GHG emissions and removals of the company and serves the decision-making needs of users, both internal and external to the company. This in turn helps to maximize positive impacts to the climate and minimize any negative impacts not captured by the scope 1, scope 2, and scope 3 inventory.

[99] Russell 2018. *Estimating and Reporting the Comparative Emissions Impacts of Products*. Available at https://ghgprotocol.org/estimating-and-reporting-avoided-emissions.

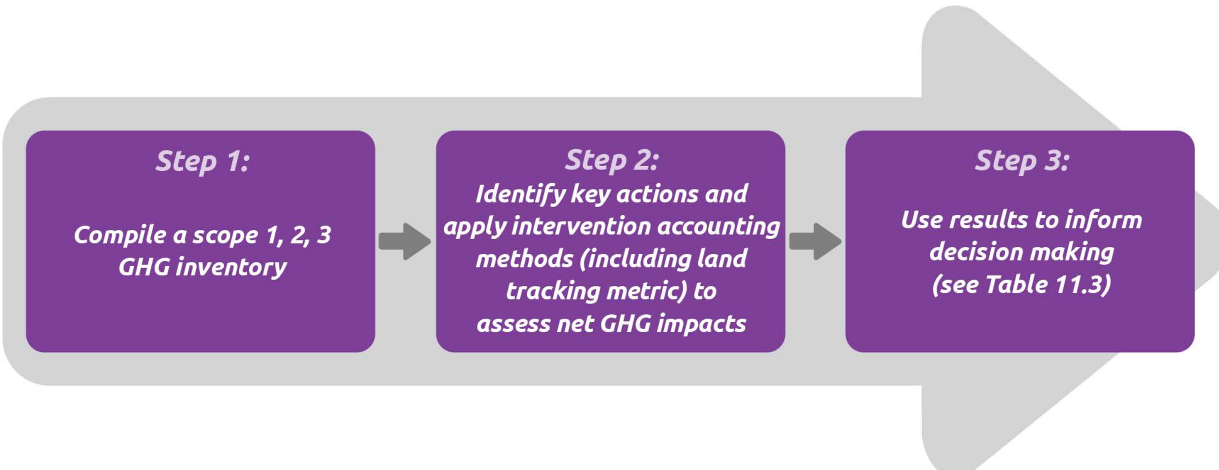
11.4 Using results for decision making

Companies should use intervention accounting methods to complement inventory accounting to inform decisions and mitigation strategies (see figure 11.4).

Companies should implement actions that have the greatest net positive GHG impacts (i.e., the largest reductions in GHG emissions and increases in GHG removals) globally and, if assessed, the least negative other environmental, social, and economic impacts.[100]

See table 11.3 for guidance on using the results of inventory and intervention accounting methods to inform decision making.

Figure 11.4 Using intervention accounting methods to complement inventory accounting and inform decision making



[100] For guidance on using multicriteria analysis for decision making across multiple environmental, social and economic impacts, see the Initiative for Climate Action Transparency (ICAT) Sustainable Development Guidance (ICAT 2020), chapter 14, available at https://climateactiontransparency.org/icat-toolbox/sustainable-development/.

Table 11.3 Using results of inventory and intervention accounting methods to inform decision making

Inventory accounting results within scope 1, scope 2, scope 3	Intervention accounting results across scope 1, scope 2, scope 3 and beyond[1]	Guidance
Action **improves** the scope 1, 2 and 3 GHG inventory	Action leads to net **positive** GHG impacts	**Implement action** Companies may estimate and report GHG emissions and removals impacts resulting from the action (using intervention accounting methods and including land tracking metric[s]) separately from the scopes.
	Action leads to net **negative** GHG impacts For example, due to leakage	**Do not implement action** Consider alternative actions with net positive impacts. If implemented, companies should redesign the action or implement complementary measures to minimize possible negative impacts (e.g., leakage) outside the inventory boundary. If companies implement actions that could have a potentially significant negative impact on GHG emissions and removals outside the scope 1, 2 and 3 boundary, companies **shall** estimate the GHG impacts resulting from the action using intervention accounting methods (including land tracking metric[s] in chapter 7) and report the impacts separately from the scopes.
Action **does not improve** the scope 1, 2 and 3 GHG inventory	Action leads to net **positive** GHG impacts For example, due to avoided impacts or substitution/ displacement effects	**Implement action** Companies may estimate and report GHG impacts resulting from the action (using intervention accounting methods and including land tracking metric[s]) separately from the scopes.
	Action leads to net **negative** GHG impacts	**Do not implement action**

Note: [1] The GHG assessment boundary is not limited to the scopes in intervention accounting.

11.5 Evaluating how actions and other factors lead to changes in GHG inventories

In addition to evaluating the impact of individual actions, companies may want to understand why the overall GHG inventory changes over time and how individual actions contribute to those changes.

GHG inventories change over time in part due to companies' actions and in part because of changes in companies' value chains or other external factors that are not related to planned actions of reporting companies. For example, scope 2 emissions may decrease if more renewable energy is fed into the national grid. In GHG inventory accounting (as opposed to intervention accounting), all change over time matters, independent of whether that change results from planned action or external factors.

Nevertheless, companies may find it useful to understand how their actions have affected their inventories and to attribute changes in GHG inventories to specific actions. This can help companies evaluate whether their actions are on track to achieve a certain level of emission reduction or removal for a given timeline in their GHG inventory, taking into account changes in the inventory that are unrelated to their actions.

To evaluate how actions affect GHG inventories, companies can use factor analysis or decomposition analysis.[101] These tools are helpful when multiple parameters counteract each other, such as a tree planting scheme that does not progress as fast as expected, but is compensated by exceptionally favorable weather so that those trees that have been planted grow faster than expected. This information can be used to inform the design of new actions or to make changes to current actions to maximize positive GHG impacts.

11.6 Examples of evaluating GHG impacts of actions using intervention accounting methods

This section provides two examples of evaluating the impact of actions on emissions and land tracking metrics. Box 11.1 provides an example of evaluating the impact of a food waste reduction program, while box 11.2 provides an example of evaluating a strategy to intensify maize production.

[101] For an example of decomposition analysis, see the GHG Protocol *Policy and Action Standard*, page 132, available at https://ghgprotocol.org/policy-and-action-standard.

Box 11.1 Example of quantifying impacts of a food waste reduction program

A hospitality company that hosts conferences with large buffets decides to reduce food waste by using smaller serving pans and portion sizes, eliminating trays, and preparing food on-demand instead of in advance.

The company currently sources 5,370 tonnes of food for its buffets annually. They use emission factors from a standard database, multiplied by the various types of food they source, to estimate that scope 3 emissions associated with those food purchases are 12,000 t CO_2e per year. Similarly, they use standard data on yields to estimate that the food is sourced from 2,616 hectares of land per year.

They assume that the food waste reduction measures would reduce the purchase of beef and milk by 10 percent and of corn and vegetables by 5 percent.

The company estimates that these food purchase reductions would reduce both scope 3 emissions and land occupation by about 9 percent—and also save costs.

Therefore, as scope 3 emissions and land occupation both decline in this scenario, the company decides to pursue the food waste reduction measures.

Food type	Amount purchased (t)	Production-related GHG emission factor (kg CO_2e/kg)*	Total production related GHG emissions (t CO_2e)	Land occupation factor (m^2/kg)	Total land occupation (ha)
Baseline scenario					
Beef	145	41.35	6,000	126.45	1,834
Milk	1,345	2.23	3,000	2.05	276
Maize	2,062	0.97	2,000	1.74	359
Vegetables	1,818	0.55	1,000	0.81	147
Total	**5,370**		**12,000**		**2,616**
Food waste reduction scenario					
Beef	131	41.35	5,400	126.45	1,651
Milk	1,211	2.23	2,700	2.05	249
Maize	1,959	0.97	1,900	1.74	341
Vegetables	1,727	0.55	950	0.81	140
Total	**5,028**		**10,950**		**2,381**
Impact of the action			**Emissions reduced by 1,050**		**Land occupation reduced by 235**

Notes: * Land use and emission factors from Poore and Nemecek (2018) for North America in Cool Food calculator (Waite et al. 2019). Emission factors include emissions from farm, feed, processing, transport, packaging, and upstream losses to the point of purchase by a food service operator.

1 **Box 11.2 Example of quantifying impacts of intensifying maize production**

A company currently growing 1,800 tonnes of unfertilized maize per year across 1,000 hectares in West Africa wants to increase its business by producing 4,500 tonnes of maize per year. It explores two options to increase its maize production: intensifying production on its existing land holdings by adding nitrogen fertilizer (and reforesting any freed-up land), or acquiring and clearing additional lands for maize production at current yields.

In addition to cost differences, the company considers potential climate impacts of these options by exploring three scenarios:

- Baseline scenario: Currently, the unfertilized fields yield 1.8 t/ha/year of maize or 1,800 t/year of maize overall. The company estimates its scope 1 (agricultural production) emissions of 0.06 t CO_2e per t of maize, or a total of 108 t CO_2e/year.
- Scenario 1 (intensification): The company estimates that adding 100 kg N/ha/year of fertilizer would more than triple yields to 6 t/ha/year, so the production of the 4,500 t of maize requires only 750 hectares—allowing the company to reforest 250 hectares. Scope 1 emissions (due to increased fertilizer production and use) would rise to 0.30 t CO_2e per t of maize, or 1,350 t CO_2e, an increase of 1,242 t CO_2e from the baseline scenario. Additionally, over the next 20 years, the company conservatively estimates that reforestation would sequester an average of 2 tC/ha/year, equating to removals of 7.33 tCO_2/ha/year or 1,833 tCO_2/year over 250 hectares. Therefore, while scope 1 emissions would increase, the scope 1 removals would be greater than the increase in emissions, leading to net emissions of -483 t CO_2e/year (in other words, a net removal of 483 t CO_2e/year) and a net GHG reduction versus the baseline scenario of 591 t CO_2e/year.
- Scenario 2 (expansion): The company estimates that it would need to acquire and clear an additional 1,500 hectares of farmland to expand production to 4,500 t of maize at current unfertilized yields. In this case, scope 1 emissions from agricultural production would only slightly rise to 270 t CO_2e/year, an increase of 162 t CO_2e/year. However, the company also estimates that the clearance of an additional 1,500 hectares of forest for maize production would emit an average of 9.35 tCO_2e/ha/year distributed over the next 20 years, for total land use change emissions of 14,025 t CO_2e/year. Total emissions would be 14,295 t CO_2e/year, with a net increase in GHG emissions of 14,187 t CO_2e/year relative to the baseline scenario.

After assessing these options, the company decides to pursue the intensification option (Scenario 1) to realize its maize production goal, due to its net GHG benefits compared with the baseline scenario and expansion option (Scenario 2).

Scenario	Baseline scenario: Unfertilized maize	Scenario 1 (intensification): add 100 kg N/ha/year	Scenario 2 (expansion): achieve production increase through cropland expansion
(a) **Total land occupation (ha)**	1,000	750	2,500
(b) **Crop yield (t/ha)**	1.8	6.0	1.8
(c) **Total maize produced (t)** **(c = a * b)**	1,800	4,500	4,500
(d) **Scope 1 agricultural production emission factor (t CO_2e/t maize produced)**	0.06	0.30	0.06
(e) **Scope 1 agricultural production emissions (t CO_2e)** **(e = c * d)**	108	1,350	270
(f) **Scope 1 carbon stock change factor (t CO_2 /ha/year)**	0	-7.33 (net removal)	9.35 (net emission)
(g) **Change in land occupation relative to baseline (ha)**	n/a	-250 (decrease)	1,500 (increase)
(h) **Scope 1 land use change emissions (if +) OR land management removals (if -)** **(h = f * g)**	0	-1,833	14,025
(i) **Scope 1 net emissions (t CO_2e)** **(i = e + h)**	108	-483	14,295
(j) **Net GHG impact of scenario relative to baseline (t CO_2e**	n/a	-591 (implement action)	14,187 (do not implement action)

Notes: All metrics are per year. Example adapted from Searchinger et al. (2018), using yield response assumptions from Fischer et al. (2014), Scope 1 production emission factors from Bryngelsson et al. (2016), land use change emissions from Searchinger et al. (2018), and removals from forest growth from Harris et al. (2021).

12

Setting Targets and Tracking Progress

Chapter 12: Setting Targets and Tracking Progress

Requirements and Guidance

Targets are key elements of companies' strategies and roadmaps towards reducing their climate impacts. This chapter provides requirements and guidance on setting corporate targets for land sector GHG emissions, CO_2 removals, and land tracking metrics. It also provides requirements and guidance for setting a base year or base period and tracking progress over time.

Sections in this chapter

Section	Description
12.1	Introduction to setting targets for land sector GHG emissions, CO_2 removals, and land tracking metrics
12.2	Setting GHG emission targets for land emissions
12.3	Setting targets for removals, or net targets that include removals
12.4	Setting targets for land tracking metrics
12.5	Setting targets or sub-targets for gross emissions and gross removals
12.6	Setting targets for temporary carbon storage
12.7	Setting targets for external compensation or contributions
12.8	Base year recalculations to enable consistent performance tracking over time
12.9	Accounting for changes in emissions, removals, and land tracking metrics over time

Checklist of accounting requirements in this chapter

When companies set target(s) for GHG emissions, removals, land tracking metrics, and/or other metrics and track performance over time, companies **shall**:

Section	Accounting requirements
12.1	• Set separate targets for emissions, independent of any removals. Companies should set separate removal targets or net targets that include removals.
12.2	• Choose a base year or base period and specify their reasons for choosing that particular year or period
12.3	• For companies that set net targets: set separate land net targets (for land emissions and removals) vs. non-land net targets (for non-land emissions and removals) • For companies with removal targets or net targets: develop a reversals accounting policy and account for reversals of previously reported removals in their target accounting
12.7	• If companies sell GHG credits from within their organizational boundary that are used as offsets or compensation, or if such credits are sold in the company's value chain: companies **shall** use emissions and removals values adjusted for sold credits when accounting for progress toward a GHG target to avoid double counting. (See chapter 13 for further requirements and guidance for preventing double counting of credits.)
12.8	• Recalculate base year or base period emissions, removals, and land tracking metrics when significant changes in the company structure or inventory methodology occur • Develop a base year or base period recalculation policy, establish the significance threshold that triggers base year recalculations, apply the recalculation policy in a consistent manner, and clearly articulate the basis and context for any recalculations

12.1 Introduction to setting targets for land sector GHG emissions, CO_2 removals, and land tracking metrics

The land sector accounts for about one-quarter of annual global net GHG emissions, and also removes about 30 percent of annual global CO_2 emissions in terrestrial sinks.[102] The land sector is therefore indispensable to global strategies to reach net-zero or net-negative emissions this century and limit warming in line with Paris Agreement goals. Companies that produce or source land-based products, as well as those who undertake activities that enhance biogenic and/or technological removals and storage in their operations or value chain, have an important role to play in setting and achieving targets in line with global climate goals and tracking performance against those targets over time.

[102] IPCC, 2019a.

This section provides an overview of various types of targets, general steps and recommendations for setting targets, and explains which accounting categories are included in different types of targets.

Companies using this Guidance may also be participating in a GHG target setting program or initiative. For example, the Science Based Targets initiative (SBTi) provides target setting requirements and guidance building on the GHG accounting and reporting foundation provided by Greenhouse Gas Protocol standards. Companies that participate in a target setting program that complies with and builds on the GHG Protocol standards should follow the guidance provided in this chapter in addition to the requirements specified by the target setting program. Companies that prepare and report GHG inventories based on GHG Protocol standards, but do not participate in a target setting program such as the Science Based Targets initiative (SBTi), should follow the guidance provided in this chapter to set their GHG targets.

12.1.1 Types of targets

Emissions reduction is at the heart of achieving global climate targets, and the starting point for corporate targets. Companies should set clearly defined targets to reduce emissions, ideally in line with global climate goals. Companies should also set complementary targets to increase removals. CO_2 removals play an important role in balancing residual GHG emissions and – for companies in the land sector or technological removal sector – can be used to reach net-negative emissions (i.e., net removals). Setting targets for land tracking metric(s) also encourages more efficient use of land and prevents displacement or leakage effects to help avoid further land conversion.

Companies should set targets for all relevant reporting categories in this guidance, including:

- Land sector GHG emissions (section 12.2)
- CO_2 removals, as part of removal targets or net targets that include removals (section 12.3)
- Land tracking metric(s) (*Indirect land use change emissions*, *Carbon opportunity costs*, and/or *Land occupation*) (section 12.4)
- Gross emissions and gross removals (section 12.5)
- Temporary carbon storage, if relevant (section 12.6)
- External compensation or contributions (section 12.7)

Accounting requirement
When companies set target(s), companies **shall** set separate targets for emissions, independent of any removals. Companies should set separate targets for removals or net targets that include removals.

The following section details the steps involved in setting a target. Target setting programs may provide additional requirements for target design and communication.

12.1.2 General steps and recommendations for setting targets

Companies should follow the general steps in table 12.1 when setting a GHG target. Target setting is an iterative process and steps can be followed in a different order.

Companies should set targets with an overall objective of reducing total cumulative GHG emissions, since climate change is driven by total cumulative GHG emissions to the atmosphere. Table 12.1 provides a summary of target design recommendations for setting corporate targets aligned with the global need to limit cumulative emissions in line with 1.5°C pathways. Guidance on each element, and specific information by type of target (emissions, removals, land tracking targets), is provided in sections 12.2 – 12.7.

Table 12.1 Summary of general target setting steps and recommendations

Target setting steps	Recommendation
1. Determine which targets to set *(Reference: sections 12.2, 12.3, 12.4)*	• Set separate targets for emissions, independent of any removals, to maintain a focus on reducing emissions to the atmosphere, while separately increasing CO_2 removals through separate removal or net targets • Set separate emissions targets for land emissions vs. non-land emissions • If setting net targets that include emissions and removals: set separate land net targets (for land emissions and removals) vs. non-land net targets (for non-land emissions and removals) • Set separate targets by scope • Set targets for land tracking metric(s) to minimize land use changes not captured in emissions or removals targets
2. Define the target boundary *Which GHGs to include? Which direct and indirect emissions (and removals, if applicable)? Which geographical operations? Treat business types separately? Which emissions and removals to include in net targets? (Reference: sections 12.2.1, 12.3.1, 12.3.2, 12.4)*	• Set a comprehensive target boundary that includes all GHG emissions, gases, scopes (scope 1, scope 2, and scope 3) and scope 3 categories • If setting net targets that include emissions and removals: only include removals that are equivalent in terms of climate change impact with the emissions included in the same target boundary, i.e., only include removals that meet the permanence principle by either: o permanently removing CO_2 from the atmosphere and storing it in non-atmospheric pools for timescales equivalent to the atmospheric lifetime of CO_2 (or other GHG the removal is neutralizing), or o meeting all requirements in chapter 6 to implement a storage monitoring framework (i.e., ongoing storage monitoring, traceability, primary data, uncertainty, and reversals accounting), to reflect the company's contribution to the global carbon budget and cumulative emissions which drive long-term temperature change.
3. Define the target type *Set an absolute and/or intensity target? (Reference: sections 12.2.2, 12.3.3)*	• Set absolute emission reduction targets at a minimum; companies can supplement absolute targets with intensity targets
4. Choose the base year or base period *Use a single base year or multi-year base period? Which year or period? (Reference: sections 12.2.3, 12.3.4)*	• Use a representative base year or base period (unless the target is expressed without reference to a base year, e.g., to achieve net-zero or net-negative emissions by a certain year) • Use a base period, rather than a single base year, for land sector emissions, given significant interannual variability that can occur in land-based carbon pools
5. Define the target completion date *Set a long- and/or short-term target? What is the target year or period? (Reference: sections 12.2.4, 12.3.5)*	• Set a combination of short-term and long-term targets in line with 1.5° pathways

6. Define the length of the target commitment period *Set a single-year or multi-year target? What type of multi-year target?* *(Reference: sections 12.2.5, 12.3.6)*	• Set multi-year targets that limit emissions over many consecutive years, rather than limiting emissions only in a single year
7. Decide on the target level *What is business-as-usual? What is the level of ambition required to reach global climate targets? What level of GHG mitigation is consistent with a science-based pathway for limiting global temperature rise below dangerous levels (e.g., 1.5°C above pre-industrial temperatures)? How do all the above steps influence the decision?* *(Reference: sections 12.2.6, 12.3.7)*	• Set a GHG emission reduction target to reduce scope 1, scope 2 and scope 3 emissions in line with a 1.5° pathway • Set a separate removal or net target in line with global need to increase removals as part of a 1.5° pathway • Inform the target level by using reference levels for land carbon pools that project business-as-usual trends to factor out non-additional and non-anthropogenic impacts on carbon stocks and flows (e.g., natural growth of forests), such that progress against the target represents additional (company-driven) and anthropogenic (human-induced) mitigation action taken to meet GHG targets
8. Develop reversals accounting policy: *Establish a policy and account for reversals* *(Reference: section 12.3.8)*	• For companies setting removal targets or net targets: account for any reversals of previously reported removals as part of a company's target accounting and determination of whether a target has been met
9. Track and report progress *Establish a GHG inventory system, make regular performance checks, and report information in relation to the target*	• Establish a comprehensive inventory and data management system to enable ongoing monitoring, reporting and verification • Compile a GHG inventory annually, undertake third-party assurance, and report the inventory and progress toward targets publicly on an annual basis
10. Consider additional mitigation action external to the target boundary *Set compensation or contribution targets to enable financing additional mitigation action outside the target boundary?* *(Reference: section 12.7)*	• In addition to meeting GHG targets across the company's scope 1, scope 2 and scope 3 inventory, companies should invest in external compensation or contributions to achieve additional mitigation outside the target boundary as a supplement to the company's GHG reduction and removal targets, to help reach the global 1.5° goal.

For more information on target setting, see:

- GHG Protocol *Corporate Standard* (chapter 11: Setting a GHG Target)
- GHG Protocol *Scope 3 Standard* (chapter 9: Setting a GHG Reduction Target and Tracking Emissions Over Time)
- GHG Protocol *Mitigation Goal Standard* [103] (chapter 4: Designing a Mitigation Goal; chapter 5: Estimating Base Year Emissions; and chapter 6: Accounting for the Land Sector)
- Science-Based Targets initiative

[103] The GHG Protocol *Mitigation Goal Standard* is intended primarily for national and subnational government agencies involved in setting and tracking mitigation goals, but companies and other organizations may also find the guidance useful when designing and tracking progress toward targets.

12.1.3 How targets correspond to accounting categories

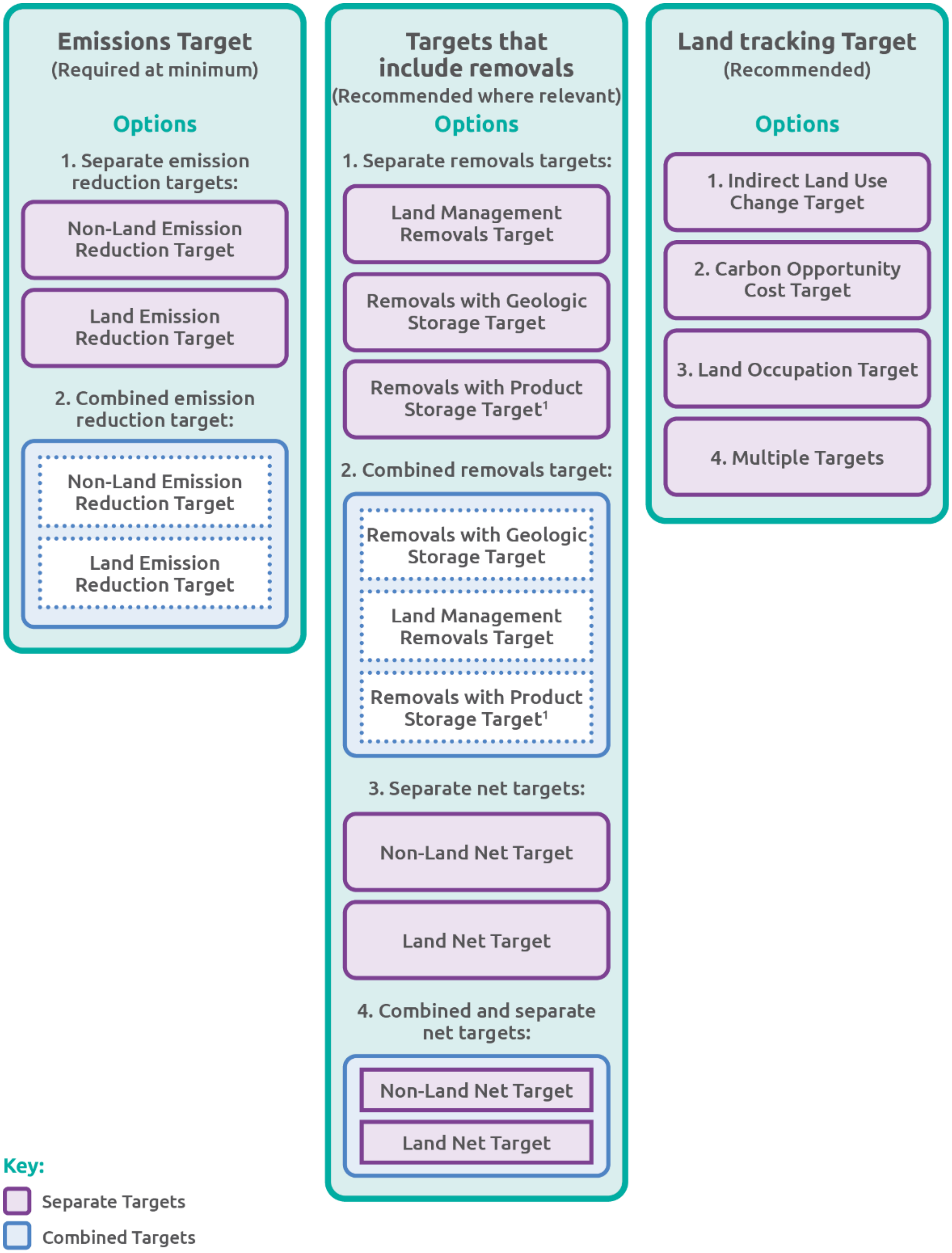
This Guidance includes several accounting categories (first defined in chapter 4 and explained in previous chapters), including emissions, removals, and land tracking metrics. Figure 12.1 outlines options for setting targets for emissions, removals, and land tracking metrics.

Table 12.2 shows the accounting categories that are included in each type of targets. Table 12.2 includes additional target categories not included in figure 12.1; companies should set targets for these additional categories where relevant.

Companies should set a series of disaggregated targets (e.g., land targets vs non-land targets, emissions targets vs removal targets or net targets), as applicable to the reporting company, given the unique nature of the different accounting categories. Setting multiple disaggregated targets increases transparency, provides more detailed information for decision making, and better highlights connections between specific activities and target performance.

Disaggregated targets can also be combined into aggregated targets for communication purposes. In this case, sub-targets can be nested as part of broader targets. For example, land emissions targets and non-land emissions targets can be combined into an overall emissions target (described in section 12.2). However, companies should account for target progress and achievement separately for each target at a disaggregated level.

Figure 12.1 Setting targets for emissions, removals, and land tracking metrics



Note:
[1] Inclusion of removals with product storage is subject to open question for pilot testing #2.

Table 12.2 Which accounting categories are included in different types of targets

Targets[1]		Accounting categories included in target boundary[2]
Emissions targets **(Section 12.2)**	**Non-land emission reduction target**	• Stationary combustion emissions • Mobile combustion emissions • Process emissions • Fugitive emissions • Net CO_2 emissions from geologic storage[3]
	Land emission reduction target	• Land use change emissions[3] • Land management net CO_2 emissions (biogenic)[3] • Land management non-CO_2 emissions
	Combined emission reduction target	• All emissions accounting categories included above in 'non-land emissions target' and 'land emissions target'
Removals targets (if applicable) **(Section 12.3)**	**Net removals with geologic storage target**	• Net removals with geologic storage[3]
	Land management removals target	• Land management net removals[3]
	Net removals with product storage target *(subject to open question #2, chapter 6, box 6.3)*	• Net removals with product storage[3] *(subject to open question #2, chapter 6, box 6.3)*
Net targets (if applicable) **(Section 12.3)**	**Non-land net target**	Non-land emissions: • Stationary combustion emissions • Mobile combustion emissions • Process emissions • Fugitive emissions • Net CO_2 emissions from geologic storage[3] Non-land removals:[3] • Net removals with geologic storage TCDR-based product carbon storage net removals *(subject to open question #2, chapter 6, box 6.3)*:[3] • Removals with TCDR-based product storage • Net CO_2 emissions from TCDR-based product storage
	Land net target	Land emissions:[3] • Land use change emissions • Land management net CO_2 emissions (biogenic) • Land management non-CO_2 emissions Land removals:[3] • Land management net removals

		Biogenic product carbon storage net removals *(subject to open question #2, chapter 6, box 6.3)*:[3] • Removals with biogenic product storage • Net CO_2 emissions from biogenic product storage
Land tracking targets **(Section 12.4)**	**Targets for selected land tracking metric(s)**	• Indirect land use change • Carbon opportunity costs • Land occupation
Additional targets **(Sections 12.5 – 12.7)**	**Targets for gross emissions and gross removals** (Section 12.5)	Gross biogenic product emissions:[4] • Gross biogenic product CO_2 emissions (e.g., from combustion) Gross biogenic land emissions and removals:[4] • Gross biogenic land CO_2 emissions • Gross biogenic land CO_2 removals Gross TCDR emissions and removals:[4] • Gross technological CO_2 removals • Gross TCDR-based product CO_2 emissions • Gross CO_2 emissions from geologic storage
	Targets for temporary carbon storage (Section 12.6)	• Temporary land carbon storage • Temporary product carbon storage • Temporary geologic carbon storage
	Targets for external compensation or contributions (Section 12.7)	• External compensation • External contributions

Notes:

[1] The categories included in a target is subject to additional criteria and requirements by target setting programs (e.g., which types of removals are eligible to be included in net targets).

[2] This table outlines categories without regard to scopes or whether each category is direct or indirect for a given company. Companies are required to report categories separately based on scopes and whether they are direct or indirect. Some categories are reported in the scopes, while others are required categories reported separately from the scopes. For more information see chapters 5 and 14.

[3] Using stock change accounting for emissions and removals of biogenic and technologically removed CO_2 (described in chapter 4), where removals meet the removals requirements in chapter 6.

[4] Using flow accounting for emissions and removals of biogenic and technologically removed CO_2 (described in chapter 4).

TCDR = technological carbon dioxide removal

12.2 Setting GHG emission targets for land emissions

Companies with land sector activities in their operations or value chain should set a GHG emission reduction target for land sector emissions.

Land emissions include:

- *Land use change emissions* (using direct and/or statistical land use change)
- *Land management net CO_2 emissions* (from net carbon stock decreases)
- *Land management non-CO_2 emissions* (from agricultural and forestry production practices)

Companies should also set emission reduction target(s) for all other non-land emissions – including stationary combustion, mobile combustion, process, and fugitive emissions – in the company's GHG inventory.

Companies should set separate emissions targets for land emissions vs. non-land emissions. Separate emissions targets are recommended due to the higher variability, higher levels of uncertainty, and natural (non-anthropogenic) influence on land carbon stock changes compared to non-land emissions (e.g., from fossil fuel combustion).

Companies may also set an overall GHG emission reduction target that includes land GHG emissions and non-land GHG emissions.

To set emissions targets, companies should specify the target design elements described in the sections below.

Companies **shall** report the following information about their GHG emissions target:

- Target boundary
- Target type
- Target base year/period, with justification
- Target year(s)
- Whether the target is a single-year or multi-year target
- Target level
- Progress in reaching target

12.2.1 Target boundary

The target boundary defines which greenhouse gases, scopes, geographic operations, sources, and activities are covered by the emission reduction target. Companies should clearly define the boundary of their target(s) and may set a variety of targets and sub-targets.

To ensure comprehensive coverage and GHG management, companies should include all emissions reported in the GHG inventory in the target boundary. Companies can do this by setting:

- Separate targets for scope 1 emissions, scope 2 emissions, and scope 3 emissions (following the *Scope 3 Standard*), which together cover all scope 1, 2 and 3 emissions, and where scope 1, 2 and 3 emissions include land emissions following this Guidance,
- Multiple emission reduction sub-targets, such as separate targets for scope 1 land emissions and non-land emissions, scope 2 land emissions and non-land emissions, scope 3 land emissions (by scope 3 category) and scope 3 non-land emissions (by scope 3 category), or
- A single comprehensive GHG emission reduction target that includes all scope 1, scope 2, and scope 3 emissions (following the *Scope 3 Standard*), where scope 1, 2 and 3 emissions include land emissions following this Guidance.

In general, multiple disaggregated targets can increase transparency, provide more detailed information for decision making, and can more easily highlight connections between performance and specific activities.

Separate targets for each scope, or for each scope 3 category, can be designed around unique mitigation opportunities for each scope or category and provide additional transparency to stakeholders.

On the other hand, disaggregated targets can increase complexity and make data collection and communication more difficult. Fewer, more aggregated targets are simpler to communicate and more flexible, but provide less transparency and detail for decision making.

To maximize the benefits of both approaches, companies should set a series of disaggregated targets that are also aggregated to a smaller number of targets, so the company can track and demonstrate overall progress as well as more detailed progress. In all cases, companies should ensure comprehensive coverage of GHG emissions in the target boundary and ensure transparent and disaggregated reporting (as required in chapter 14).

12.2.2 Target type

An absolute target is expressed as either a total level of emissions or a reduction in total GHG emissions compared to emissions in the base year or period. In contrast, an intensity target is expressed as a reduction in the ratio of GHG emissions relative to a business metric, such as output, production, sales or revenue.

Companies should set absolute GHG targets at a minimum. Absolute targets correspond with the need to reduce cumulative emissions to the atmosphere in line with the global carbon budget. Companies may find it useful to set both absolute and intensity targets. For example, companies may establish an absolute target at the corporate level and a combination of intensity targets at lower levels of the company, or an absolute target for scope 3 emissions and intensity targets for individual product categories.

12.2.3 Target base year or period

Establishing a reference point is necessary to track performance consistently and meaningfully over time. For GHG targets, performance is measured against a base year or period. Target achievement is determined by the difference between emissions in the target year(s) and emissions in the base year or average annual emissions in the base period.

Accounting requirement
Companies **shall** choose a base year or period and specify their reasons for choosing that particular year or period.

Several considerations can help a company select an appropriate base year or period[104]:

- Verifiable data exist for the base year or period across all sources and activities
- The base year or period is representative of a company's typical emissions profile
- The target has sufficient forward-looking ambition and does not unduly take credit for past progress

Companies should choose the most recent representative year or period for which verifiable data exist.

[104] SBTi, 2020

Companies should consider setting a base period, rather than a single base year, for land emissions, given significant interannual variability that can occur in land-based carbon pools. In this case, base period emissions should be annualized by calculating average annual emissions over the base period.

To enable consistency and comprehensiveness, companies should aim to use the same base year for all scopes, metrics, and targets. Companies that have previously established a base year for certain scopes and targets may choose a more recent year for any additional targets they establish using this guidance (e.g., the first year for which companies have complete and reliable data).

Accounting requirement

Companies **shall** also develop a base year recalculation policy (see section 12.8).

12.2.4 Target completion date: short-term or long-term

The target timeframe determines whether the target is relatively short- or long-term. In general, companies should set a combination of short-term and long-term targets.

Companies should set long-term targets (e.g., up to 2050), since they facilitate long-term planning and large capital investments with significant GHG benefits and can be aligned to global climate goals. Companies should also set shorter-term targets (e.g., between 5-10 years from the date when the target is set) to match the decision horizons of the business, to identify more immediate opportunities, and increase accountability through frequent measurement of progress. Companies should consider setting target years aligned with relevant national or international target years (e.g., 2030).

12.2.5 Target commitment period: single-year or multi-year targets

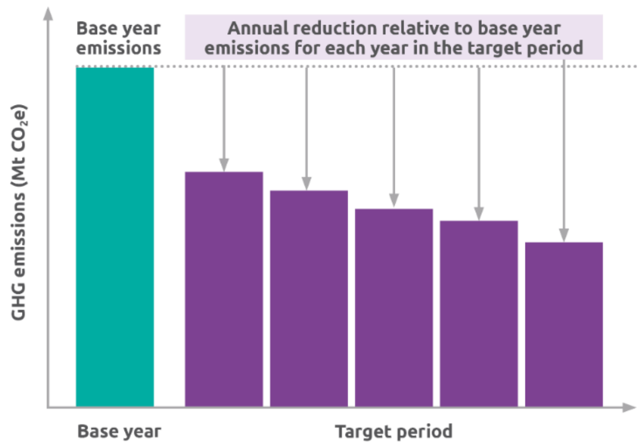
Single-year targets aim to achieve an emissions target by a single year (e.g., 2030), while multi-year targets limit emissions for multiple consecutive years over a defined target period (e.g., for each year from 2025 to 2040).

Companies should set multi-year targets that limit emissions over multiple consecutive years, rather than only for a single year. Multi-year targets can be defined as average, annual, or cumulative multi-year targets:

- An annual multi-year target is a commitment to reduce annual emissions by a specific amount each year for multiple consecutive years (see figure 12.2). For example, an annual multi-year target might specify a reduction of 40 percent below base year emissions in 2025, 42 percent by 2026, 44 percent by 2027, and so on.
- An average multi-year target is a commitment to reduce annual emissions by an average amount over multiple consecutive years (see figure 12.3).
- A cumulative emissions target is a commitment to limit total cumulative emissions over multiple consecutive years to a fixed absolute quantity (see figure 12.4).[105]

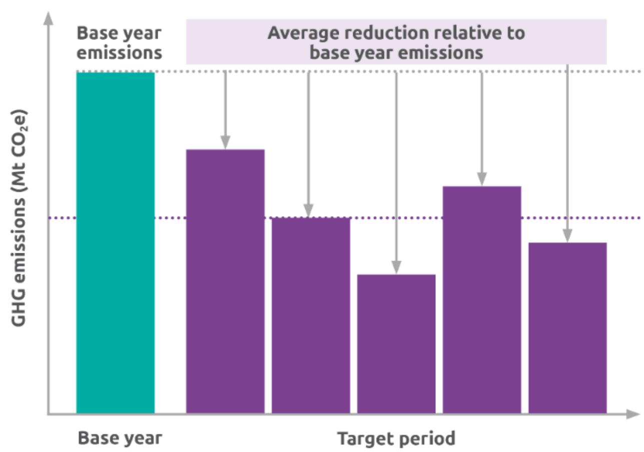
[105] Adapted from GHG Protocol *Mitigation Goal Standard*

Figure 12.2 Example of an annual multi-year target



Source: GHG Protocol *Mitigation Goal Standard*

Figure 12.3 Example of an average multi-year target



Source: GHG Protocol *Mitigation Goal Standard*

Figure 12.4 Example of a cumulative multi-year target

Source: GHG Protocol *Mitigation Goal Standard*

Companies should set multi-year targets that limit emissions across multiple consecutive years for several reasons:

- Climate change is driven by cumulative global emissions; therefore, a company's emissions in each reporting year, not only in a single target year, contribute to climate change.
- It ensures that companies prioritize mitigation efforts across multiple years, rather than pursuing mitigation efforts in only one year (e.g., 2030) at the expense of mitigation efforts in all other years.
- It avoids situation where a company delays emitting activities until after a single target year is achieved, for example, delaying a major harvest event or land use change.
- It avoids situations where target year emissions unexpectedly fluctuate from previous years – since significant variations in land emissions can occur due to weather, natural disturbances, or other factors from one year to the next.

12.2.6 Target level

The target level is the numerical value of the target, expressed as an absolute emissions level or a percent reduction relative to the target base year or period, and represents the level of ambition of the reduction target. To inform the numerical value of the target, companies should examine potential GHG reduction opportunities and estimate their effects on total GHG emissions.

In general, companies should set an ambitious target that reduces emissions significantly below the company's business-as-usual emissions trajectory and is in line with a science-based pathway for limiting global temperature rise below dangerous levels (e.g., 1.5°C above pre-industrial temperatures).

To limit warming to 1.5°C, global CO_2 emissions across all sectors need to be cut in half by 2030 from 2010 levels and reach net-zero emissions by around 2050. Methane and nitrous oxide emissions also need to be greatly reduced globally to limit warming to 1.5°C.[106] Corporate targets for scope 1, scope 2, and scope 3 emissions should be in line with these 1.5°C emission reduction pathways.

A goal in line with climate science can drive greater innovation within the company and the value chain and is seen as most credible by stakeholders. The Science Based Targets initiative (SBTi)[107] provides science-based emission reduction pathways for different sectors, including forest, land, and agriculture (FLAG) related sectors.

Refer to box 12.2 for guidance on using reference levels when setting the target level for land carbon pools.

Box 12.2 Using reference levels to inform the target level for land carbon pools

To inform the target level for land carbon pools, companies should use reference levels that project business-as-usual trends to determine what level of corporate mitigation action is ambitious and additional to ongoing trends. Reference levels are forward-looking projections based on historical data (from a selected base period or reference period) on management practices and external factors expected to drive emissions and removals in the future.

Reference levels can help address unique complexities and challenges presented by land carbon pools compared to non-land categories in a company's GHG inventory, including:

[106] IPCC, 2018

[107] Available at https://sciencebasedtargets.org

- Difficulty in separating additional (beyond current trends) and anthropogenic (human-induced) influences from non-anthropogenic (natural) influences on land carbon stocks, since existing forests, for example, naturally grow without human intervention
- Influence of historical factors such as age-class distributions and legacy effects of past management practices on current and future carbon stocks and flows

These impacts can be overlooked when setting targets relative to a base year or period. When emissions are compared over time relative to historical levels, long-term trends and non-anthropogenic influences can obscure the impacts of a company's mitigation actions. This presents a risk that reported progress is not additional to what would have occurred without the target.[108]

Companies should take precautions to minimize risks of including non-additional and non-anthropogenic impacts in the target accounting by either:[109]

- increasing the target level to compensate for non-additional or non-anthropogenic impacts included in the accounting, and/or
- accounting for land carbon pools under a separate target, rather than as part of a broader GHG target.

Reference levels can be used to increase the target level by setting the target above and beyond business-as-usual trends. This ensures that progress against the target represents additional, company-driven action and anthropogenic (rather than natural) efforts to reduce emissions and increase removals.

Companies should report the data, assumptions, methods used to develop reference levels, and justify any assumptions. Companies should develop a reference level recalculation policy that articulates the basis for any recalculations in reference levels. Companies should recalculate reference levels if significant changes occur, and in such cases, companies should set a new target with a higher level of ambition to compensate.

For more information and guidance on reference levels, see Grassi et al. (2018)[110], Forsell et al. (2018)[111], and the GHG Protocol *Mitigation Goal Standard* (chapters 5-6).

12.3 Setting targets for removals, or net targets that include removals

Companies that report removals in the GHG inventory should set a separate target for increasing CO_2 removals or a separate net target that includes emissions and removals. Such targets are in addition to and separate from setting an emission reduction target (section 12.2).

Removals can include:

- *Net removals with geologic storage*: removals stored in geologic reservoirs
- *Land management net removals*: removals stored in land-based carbon pools
- *Net removals with product storage*: removals stored in product carbon pools *(subject to open question #2, chapter 6, box 6.3)*

Both emission reductions and removals are needed to meet global climate goals. Setting separate emission reduction targets and removal or net targets ensures that companies do not substitute necessary emission

[108] GHG Protocol *Mitigation Goal Standard* (chapter 6)

[109] GHG Protocol *Mitigation Goal Standard* (chapter 6)

[110] Available at https://doi.org/10.1186/s13021-018-0096-2

[111] Available at https://ec.europa.eu/clima/policies/forests/lulucf_en

reductions with removals, but instead pursue both emission reductions and removals in line with 1.5°C pathways.

Companies setting net targets should follow the guidance in both section 12.2 (on emissions) and this section (on removals) when including both emissions and removals in a net target.

Companies **shall** report the following information about their removal target or net target:

- Whether the target is a removal target or net target
- Target boundary, including
  - Whether scope 1 and/or scope 3 removals are included in the target boundary
  - Types of removals included in the target boundary: *Land management net removals*, *Net removals with geologic storage*, or *Net removals with product storage (subject to open question #2, chapter 6, box 6.3)*; and biogenic or technological removals
  - Eligibility requirements and limits on the quantity of removals included in the targets
- Target type
- Target base year/period, with justification
- Target year(s)
- Whether the target is a single-year or multi-year target
- Approach for accounting for reversals of previously reported removals
- Target level
- Progress in reaching target

12.3.1 Target boundary for removal targets

Removal targets are targets to increase removals stored in non-atmospheric carbon pools.

Companies that report scope 1 removals and/or scope 3 removals should determine which removals across scopes to include in the removal target boundary. Companies should set separate targets for scope 1 removals and scope 3 removals.

The removal target boundary defines which removals, scopes, geographic operations, sinks, pools, and activities are covered by the removal target. Companies should determine which types of removals (see chapter 6) to include in the removal target boundary and disclose and justify their inclusion.

Companies should clearly define the boundary of their target(s) and may set a combination of targets and sub-targets. Where relevant, companies should set separate targets for increasing removals with geologic storage, land-based storage, and product-based storage. Where relevant, companies should also set separate targets for biogenic and technological removals.

12.3.2 Target boundary for net targets

Net targets include emissions and removals within the same target boundary.

Land and non-land net targets

Accounting requirement
Companies that set net targets **shall** set separate land net targets (for land emissions and removals) vs. non-land net targets (for non-land emissions and removals)

Separate net targets are required due to the higher variability, higher levels of uncertainty, and natural (non-anthropogenic) influence on land carbon stock changes compared to non-land emissions (e.g., from fossil fuel combustion) and non-land removals (e.g., with geologic storage).

Companies should account for target progress and achievement separately for land net targets vs. non-land net targets. This ensures that land emissions and removals are not accounted toward non-land target progress, and vice versa. In addition to tracking progress toward separate targets, companies may report progress toward a combined net target that includes both land and non-land GHG emissions and removals, if relevant.

Determining emissions and removals to include in the target boundary

The net target boundary defines which emissions, removals, scopes, geographic operations, sources, sinks, pools, and activities are covered by the net target. Companies should clearly define the boundary of their net target(s) and may set a combination of targets and sub-targets.

Companies should include all emissions reported in the GHG inventory (as described in section 12.2) in the target boundary for each net target.

Companies should determine which types of removals (see chapter 6) to include in the net target boundary and disclose and justify their inclusion.

Companies should only include removals in a net target boundary that are equivalent in terms of climate change impact with the emissions included in the same target boundary. To do so, companies should only include removals that meet the permanence principle, according to one of the two approaches listed in table 12.3.

Table 12.3 Approaches to permanence

Approach	Definition
Physical approach to permanence	Removals that permanently remove CO_2 from the atmosphere and store it in non-atmospheric pools for timescales equivalent to the atmospheric lifetime of CO_2 (or other GHG the removal is neutralizing)
Monitoring approach to permanence	Removals that meet all requirements in chapter 6 to implement a storage monitoring framework (i.e., ongoing storage monitoring, traceability, primary data, uncertainty, and reversals accounting), to reflect the company's contribution to the global carbon budget and cumulative emissions which drive long-term temperature change.

Permanent removals balance an emission to the atmosphere by reducing cumulative CO_2 in the atmosphere and improving the global carbon budget. In contrast, temporary carbon storage does not reduce cumulative emissions and improve the global carbon budget due to the eventual release of stored carbon. Therefore, temporary carbon storage should not be mixed in a target boundary with emissions and removals which contribute to limiting cumulative emissions.

Removals with temporary carbon storage (whether stored in land, product, or geologic carbon pools) where the permanence principle is not met should not be included in a corporate-wide net target. Companies, instead, may set separate targets for increasing temporary carbon storage (described in section 12.6). For example, this can be in the form of a separate temporary land carbon storage target or temporary product carbon storage target.

Companies should follow rules set by target setting programs for net targets, which may limit the eligibility of removals used in companies' net targets. For example, programs may limit removals to those that:

- meet requirements beyond those included in chapter 6 (e.g., more specific monitoring, traceability, or data quality requirements),
- meet additionality requirements (removals that result from the company's mitigation efforts, rather than removals that would have occurred otherwise), and/or
- are physically permanent (removals stored for timescales equivalent to the atmospheric lifetime of CO_2 – or other GHG the removal is neutralizing – such as removals with permanent geologic storage).

Companies should specify and report limits on the quantity of removals allowed in net targets. For example, the Science Based Targets initiative's Net-Zero Standard requires that companies reduce emissions in line with 1.5°C pathways and use permanent removals only to neutralize residual emissions.

Net targets by scope

Net targets should be set separately for each scope, rather than setting an overall net target across scopes. A net scope 1 target includes scope 1 emissions and scope 1 removals. A net scope 3 target includes scope 3 emissions and scope 3 removals. Scope 3 removals should not be netted with scope 1 emissions.

Companies may include scope 2 emissions, scope 3 emissions, and scope 3 removals in a single net target boundary since they represent indirect emissions and removals.

Target setting programs could further specify which scopes of removals are eligible to include in a net target, for example, that only scope 1 removals (rather than scope 3 removals) are eligible for use in net targets.

The target boundary for any net target should comprehensively include all emissions within a given scope. For more guidance, refer to the emissions target boundary section in section 12.2 and the removals section above.

12.3.3 Target type

For removal targets, an absolute target is expressed as either a total level of removals or an increase in total removals compared to removals in the base year or period.

For net targets, an absolute target is expressed as either a total level of net emissions or a reduction in total net emissions compared to net emissions in the base year or period. Targets to reach net-zero or net-negative emissions are absolute targets.

In contrast, an intensity target is expressed as a reduction in the ratio of removals or net emissions relative to a business metric, such as output, production, sales or revenue.

Companies should set absolute targets at a minimum. Absolute targets correspond with the need to increase removals and reduce cumulative net emissions to the atmosphere in line with the global carbon budget. Companies may supplement absolute targets with intensity targets.

12.3.4 Target base year or period

Establishing a reference point is necessary to track performance consistently and meaningfully over time. For removal or net targets, performance is measured against a base year or period. Target achievement is determined by the difference between removals (or net emissions) in the target year(s) and removals (or net emissions) in the base year or average annual removals (or net emissions) in the base period.

Accounting requirement

Companies **shall** choose a base year or period and specify their reasons for choosing that particular year or period.

Several considerations can help a company select an appropriate base year or period:[112]

- Verifiable data exist for the base year or period across all sources and activities
- The base year or period is representative of a company's typical emissions profile
- The target has sufficient forward-looking ambition and does not unduly take credit for past progress

Companies should choose the most recent representative year or period for which verifiable data exist.

Companies should set a base period, rather than a single base year, for land sector removals or net emissions, given significant interannual variability that can occur in land-based carbon pools.

To enable consistency and comprehensiveness, companies should aim to use the same base year for all scopes, metrics, and targets. Companies that have previously established a base year for certain scopes and targets may choose a more recent year for any additional targets they establish using this Guidance (e.g., the first year for which companies have complete and reliable data).

Accounting requirement

Companies **shall** also develop a base year recalculation policy (see section 12.8).

12.3.5 Target completion date: short-term or long-term

As with emissions, companies should set a combination of short-term and long-term removal or net targets. See section 12.2.4 for more information.

12.3.6 Target commitment period: single-year or multi-year targets

Companies should set multi-year targets that aim to increase removals (and for net targets, reduce emissions) over multiple consecutive years, rather than setting a single-year target. See section 12.2.5 for more information on types of multi-year targets (annual, average, and cumulative multi-year targets).

Companies should set multi-year targets over multiple consecutive years for several reasons. Setting multi-year targets:

- ensures that companies prioritize mitigation efforts across multiple years, rather than pursuing mitigation efforts in only one year (e.g., 2030) at the expense of mitigation efforts in all other years.
- avoids situation where target year removals unexpectedly fluctuate from previous years, given significant variations in land sector removals that can occur due to weather, natural disturbances, or other factors that can affect removals if only focused on a single year.

[112] SBTi, 2020

- ensures that removals reported in one target year are not negated by subsequent reversals from the same carbon pools in the future years if those subsequent years are not covered by a target.
- avoids situation where a company delays activities that would trigger a reversal until after a single target year is achieved, for example delaying a major harvest event until after a single year target or ending ongoing monitoring of carbon stocks where removals were previously reported.

12.3.7 Target level

The target level is the numerical value of the target, expressed as an absolute level or a percent change relative to the target base year or period, and represents the level of ambition of the removal or net target.

When setting net targets, the target balance of emissions and removals can be positive, zero, or negative. Table 12.4 outlines three types of net targets.

Table 12.4 Types of net targets

Targets to achieve:	Definition
Reduced net emissions	Target level of net emissions where emissions exceed removals within the target boundary, and emissions are reduced from a base year or period
Net-zero emissions	Target level of net emissions where emissions equal removals within the target boundary, and where emissions are reduced in line with 1.5°C pathways and removals are used to neutralize residual emissions
Net-negative emissions	Target level of net emissions where removals exceed emissions within the target boundary, and where emissions are reduced in line with 1.5°C pathways

To inform the numerical value of the target, companies should examine potential removal enhancement opportunities and estimate their effects on total removals. Companies should set an ambitious target that increases removals significantly above the company's business-as-usual removal trajectory (see box 12.2).

Companies should set targets in line with 1.5°C pathways. A goal in line with climate science can drive greater innovation within the company and the value chain and can be seen as most credible by stakeholders.

To limit warming to 1.5°C, global CO_2 emissions across all sectors need to be cut in half by 2030 from 2010 levels and reach net-zero emissions by around 2050. Methane and nitrous oxide emissions also need to be greatly reduced globally to limit warming to 1.5°C.[113] After reaching net-zero emissions globally, the world needs to achieve net-negative emissions globally to limit warming to 1.5°C.[114] Achieving net-zero and net-negative emissions requires CO_2 removal on the scale of 100 billion to 1 trillion tCO_2 over the course of the 21st century.

Given this context, companies should set targets to reach not only net-zero emissions but ultimately net-negative emissions. When setting a net-negative target, a company's target level of removals is not directly tied to a company's level of emissions, but instead removals exceed emissions. Companies should prioritize maximizing both emission reductions and removal enhancements to contribute to global efforts to limit

[113] IPCC, 2018

[114] IPCC, 2018

warming to 1.5°C. The target level of removals for a company to achieve should be driven by the global need to remove billions of tons of CO_2 to avert dangerous levels of climate change.

Companies should inform the target level by using reference levels for land carbon pools. Reference levels project business-as-usual trends and can be used to factor out non-additional and non-anthropogenic impacts on carbon stocks and flows (e.g., natural growth of forests). Doing so can help ensure that progress made in reaching the target represents additional (company-driven) and anthropogenic (human-induced) mitigation action taken to meet GHG targets. Refer to box 12.2 for guidance on using reference levels to inform the target level for land carbon pools.

For more information on net-zero targets, refer to the Science Based Targets initiative's Net-Zero Standard.[115]

12.3.8 Accounting for reversals of previously reported removals

Accounting requirement
Companies with removal targets or net targets **shall** account for reversals of previously reported removals in their target accounting.

Removals only benefit the global carbon budget and reduce long-term warming as long as they are stored in non-atmospheric carbon pools. Any reversals of removals reported in previous GHG inventory years must be accounted for as part of a company's target accounting and determination of whether a target has been met.

Accounting for reversals is required:

- when reversals occur (as detected by ongoing storage monitoring), or
- if ongoing monitoring of the relevant carbon pool(s) ends (in line with the principle of conservativeness, since without ongoing monitoring there is no way to know whether and when reversals occur).

If companies detect losses of stored carbon associated with previously reported removals, the losses are accounted for and reported either as:

- an **emission**, if the relevant carbon pool(s) is included in the reporting company's inventory/target boundary (e.g., lands that are still owned/controlled by the company or in the company's value chain). In this case, the emission is automatically accounted for in the inventory (in the relevant emissions category) and no additional accounting for reversals is needed.
- a **reversal**, if the relevant carbon pool(s) is no longer included in the reporting company's inventory/target boundary (e.g., lands that are no longer owned/controlled by the company or no longer in the company's value chain). In this case, the emission is not captured in the inventory, so additional accounting of reversals (in a separate reversals category) is needed.

In some cases, base year recalculations due to structural changes (e.g., divestments) can make reversals accounting unnecessary, if previously reported emissions and removals in the base year inventory are factored out as part of a base year recalculation. In such cases, reversals accounting is not needed because previously reported removals are no longer part of the base year or base period inventory. See section 12.8 for more information on base year recalculation.

[115] Available at https://sciencebasedtargets.org/net-zero

Accounting for reversals in targets requires accountability for annual emissions. Depending on the company's choice of target commitment period – either single-year or multi-year target (see sections 12.2.5 and 12.3.6) – this can be achieved by:

- setting annual targets over multiple consecutive years (annual multi-year target),
- setting an average multi-year target that reduces annual emissions by an average amount over multiple consecutive years, or
- setting cumulative emissions targets that limit total emissions over multiple consecutive years, or
- setting periodic targets (e.g., every five years) that take prior year reversals into account when determining target achievement.

Companies should set annual targets over multiple consecutive years or cumulative emissions targets that limit emissions over multiple consecutive years to be the most comprehensive.

Accounting requirement

Companies **shall** develop a reversals accounting policy that articulates how reversal events are detected and transparently accounted for and reported where reversals occur.

Equation 12.1 shows how to account for reversals as part of a company's target accounting. Reversals count against a company's progress in reaching GHG emissions targets, whether they are reflected in the GHG inventory automatically as an emission or whether they are separately accounted for as a reversal.

Equation 12.1 Including reversals in target accounting

For emissions targets: Target achieved if:
Emissions in the target year ≤ Target level of emissions

For removal targets: Target achieved if:
(Removals in the target year – Reversals[1]) ≥ Target level of removals

For net land targets: Target achieved if:
(Land emissions[2] in the target year – Land removals[3] in the target year + Land reversals[1]) ≤ Target level of net land emissions

For net non-land targets: Target achieved if:
(Non-land emissions[4] in the target year – Non-land removals[3] in the target year + Non-land reversals[1]) ≤ Target level of net non-land emissions

Notes:

[1] where reversals include reversals in the current target year as well as all reversals that have occurred since the company's previous target year (if the company does not have targets that limit emissions for all years)

[2] where land emissions in target year $_{TY}$ = land use change emissions $_{TY}$ + land management CO_2 emissions $_{TY}$ + land management non-CO_2 emissions $_{TY}$

[3] where removals meet the permanence principle: either permanently remove CO_2 from the atmosphere and store it in non-atmospheric pools for timescales equivalent to the atmospheric lifetime of CO_2 (or other GHG the removal is neutralizing), or meet all requirements in chapter 6 (i.e. ongoing storage monitoring, traceability, primary data, uncertainty, ensure that any reversals of previously reported removals are accounted for)

[4] where non-land emissions in target year $_{TY}$ = all GHG emissions (excluding land use change emissions and land management CO_2 and non-CO_2 emissions) $_{TY}$

Refer to chapter 6 for further requirements and guidance on accounting for reversals.

12.4 Setting targets for land tracking metrics

Companies should supplement emission reduction targets and removal targets with land tracking targets. As detailed in chapter 7 (section 7.3), actions to reduce direct or statistical land use change emissions and/or increase land-based removals in scope 1 or scope 3 can result in land use changes and increased net emissions outside these scopes.

The set of land tracking metrics included in this Guidance can help ensure that company decisions encourage efficient uses of land and reduce overall pressure on carbon-rich ecosystems, benefiting the global climate. These metrics include:

- Indirect land use change (iLUC) emissions
- Carbon opportunity costs
- Land occupation

Companies with land sector activities in their operations or value chain are required to estimate and report at least one of these land tracking metrics, and should set target(s) against the chosen metric(s) (chapter 7). See box 12.3 for examples of companies setting targets against these metrics.

Companies **shall** report the following information about any land tracking target they set:

- Target boundary
- Target type (absolute or intensity)
- Target base year/period
- Target year(s)
- Whether the target is a single-year or multi-year target
- Target level
- Progress in reaching target

For consistency, target setting for any land tracking metrics should mirror how companies establish their emissions reduction target regarding the target boundary, base year or period, target year(s), and single- versus multi-year targets.

Depending on the land tracking metric, the target type (absolute or intensity) and target level may be different from emissions targets. A different approach is warranted because 1.5°C pathways do not require an elimination of productive land use but, instead, a peaking and reduction (to stop deforestation and allow for some reforestation).

For example, a company that seeks to reduce their scope 1, 2, and 3 emissions by 30% by 2030 and 70% by 2050, relative to a 2019 baseline, might seek to hold their land occupation constant between 2019 and 2030 (in line with the goal to halt deforestation by 2030) and reduce it by 10% by 2050 (in support of global ecosystem restoration goals).

Guidance specific to each land use tracking metric is below. For more information on each metric, see chapters 7 and 17.

12.4.1 Indirect land use change (iLUC) emissions

Indirect land use change emissions are recent carbon stock losses occurring on *other* lands as a result of the demand for a land-based product causing land use change (leakage). Historically iLUC has mostly been used to estimate indirect effects of bioenergy crop expansion on carbon-rich ecosystems.

If iLUC is measured at the level of a jurisdiction where agricultural expansion is no longer occurring (i.e., where net emissions from land-use change are no longer positive), it is theoretically possible to reduce iLUC to zero, although global-level iLUC cannot be zero until global land-use change emissions have been fully eliminated.

To capture both local and global land use dynamics, companies can track an iLUC indicator that averages local and global iLUC emission factors (e.g., 50% local and 50% global), and set a target to reduce that averaged iLUC indicator as close to zero as possible.

12.4.2 Carbon opportunity costs

Carbon opportunity costs (COC) measure the total historical carbon stock losses that have occurred on productive agricultural lands.

Due to the need to halt deforestation and other conversion of native ecosystems — and free up some lands for ecosystem restoration, in order to keep warming below 1.5°C — companies measuring COC should at a minimum set a target to not increase COC over time, and reduce it, if possible.

There is almost always a carbon opportunity cost to using land for agricultural or other land-based (e.g., energy) products. Therefore, the COC cannot be reduced to zero unless the company stops producing or sourcing land-based products. Companies can set absolute and/or intensity reduction targets for the COC metric.

12.4.3 Land occupation

Land occupation measures the area (in hectares) required to produce the land-based products produced (scope 1) or sourced (scope 3) by a company. For forest-based products, land occupation is measured in “clear-cut equivalent” as described in chapters 7 and 17.

As with COC, the need for land to produce agricultural or forest-based products means that this metric can never be reduced to zero. Because of the need to halt deforestation and free up lands for ecosystem restoration, companies should set targets to not increase land occupation over time, and instead reduce it if possible.

For companies projecting significant business growth, an intensity target may be most appropriate, which can be expressed in yield (e.g., food or wood produced per hectare). In general, if yields on lands producing a company’s products grow at an equal or faster rate than the national or global demand for land-based products, then a company would be contributing to increase global productivity and avoid adding to global pressure on natural ecosystems.[116]

For example, if a company estimates that global food demand will grow by 15% between 2020 and 2030, then it should also seek to increase its yields by at least 15%.

Box 12.3 Examples of setting targets for land tracking metrics

Indirect land use change emissions: Several emissions-reduction initiatives now include iLUC tracking, primarily for biofuel feedstocks. For example, the California Air Resources Board (CARB)’s Low Carbon Fuel Standard (LCFS) initiative has a goal to reduce the carbon intensity of California’s transportation fuels by 20% by 2030, and reduce dependence on petroleum. A 2015 report[117] from the LCFS details the calculation of emission factors for each of the 6 main biofuel feedstock types. Any company or commercial entity operating

[116] Searchinger et al., 2021

[117] California Air Resources Board, 2015

in the State of California must report under the LCFS. At present, over 500 organizations are required to track their fuel-related emissions, including iLUC emissions.

Carbon opportunity costs: The Cool Food Pledge is an initiative in which food service companies and other large dining providers have committed to reducing scope 3 agricultural value chain emissions, as well as carbon opportunity costs, by 25 percent between 2015 and 2030—and are tracking progress on an annual basis. The 25 percent reduction target was determined by downscaling a necessary 67 percent emissions reduction from global agriculture and land-use change between 2010 and 2050 to keep global warming below 2°C[118] to a 15-year period using a linear reduction pathway.[119] (To stay within 1.5°C , large-scale reforestation would also need to occur to offset residual agricultural production emissions, but reforestation was assumed to be outside the purview of food service companies). As of 2019, the group had been able to reduce scope 3 emissions by 3% and carbon opportunity costs by 6% relative to the base year.[120]

Land occupation: Mars has set a long-term goal to hold flat the total land area associated with its value chain, even as the business grows. This strategy recognizes that it is important to prevent further expansion of agriculture into forests and other natural ecosystems, and that improving productivity and yields—particularly of smallholders in developing countries—can allow the business to grow while freezing the company's land footprint.[121] This land target accompanies the company's goals to halt deforestation and reduce direct land-use change emissions in high-risk supply chains, as part of its science-based targets to reduce scope 1, scope 2 and scope 3 GHG emissions by 27% by 2025 and by 67% by 2050, from 2015 levels.[122]

12.5 Setting targets or sub-targets for gross emissions and gross removals (subject to open question #1 in chapter 5, box 5.2)

Chapter 4 introduces two accounting frameworks for biogenic and technologically removed CO_2: stock-change accounting and flow accounting. This Guidance accounts for net emissions and net removals using the stock-change accounting approach, with separate reporting of gross emissions and gross removals using flow accounting.

For land-based carbon pools, companies should set targets for net emissions and net removals using the stock-change accounting method (as part of sections 12.2 and 12.3). As a means of meeting those targets, companies should set sub-targets to reduce *Gross biogenic land CO_2 emissions* and increase *Gross biogenic land CO_2 removals*.

For product carbon pools, companies should supplement targets using the stock-change method (as part of sections 12.2 and 12.3) with targets for gross CO_2 fluxes. These include targets to reduce *Gross biogenic product CO_2 emissions* and *Gross TCDR-based product emissions* released at the point of combustion or decomposition. Setting targets for gross biogenic product CO_2 emissions and TCDR-based product CO_2 emissions focuses GHG mitigation efforts at the point when CO_2 is transferred to the atmosphere, as is the approach used in non-land sectors. This approach puts an emphasis on the entities that own or control sources that emit CO_2 directly to the atmosphere.

[118] Searchinger et al., 2019

[119] Science Based Targets Initiative, 2020

[120] Waite and Pozzi, 2021

[121] Mars, 2021a

[122] Mars, 2021b

Reducing both net biogenic CO_2 emissions associated with land carbon stock losses and gross biogenic CO_2 emissions from combustion or decomposition of products contribute to reducing CO_2 emissions to the atmosphere.

To help meet these targets, companies should reduce life cycle emissions associated with biogenic products across the value chain (scopes 1, 2 and 3) and choose materials and fuels with the lowest net life cycle emissions, as well as the lowest impact on the land tracking metrics. Company efforts to reduce net biogenic emissions should be taken in the broader context of reducing emissions from all sources, including fossil fuel combustion, rather than substituting reductions in one sector with increases in another. Such trade-offs can be avoided by setting multiple targets that together cover all of a company's GHG impacts.

12.6 Setting targets for temporary carbon storage

If relevant, companies may set separate targets for increasing temporary carbon storage. This category applies to CO_2 removed from the atmosphere (through biogenic or technological CO_2 removal processes) and stored in land-based carbon pools, product carbon pools, or geologic carbon pools with a temporary storage time or where removal requirements in chapter 6 are not met.

As explained in section 12.3, removals with temporary carbon storage (whether stored in land, product, or geologic carbon pools) where permanence definitions are not met should not be included in a corporate-wide net emissions target, due to lack of equivalence with emissions included in the target boundary. While permanent carbon storage contributes to reducing cumulative CO_2 in the atmosphere, temporary carbon storage does not, since the carbon is stored temporarily and emitted in the future. Therefore, targets for removals with temporary storage or other removals that do not meet the removals requirements in chapter 6 must be separate from removals targets or net targets that include removals.

Temporarily storing removed CO_2 in land carbon pools, product carbon pools, or geologic carbon pools has the benefit of delaying emissions to the atmosphere, which can slow the rate of warming, give society time to deploy permanent climate change mitigation options, and give society and natural ecosystems time to adapt to climate change. However, temporary carbon storage does not reduce long-term warming or contribute to the 1.5°C goal because it does not reduce cumulative emissions or benefit the global carbon budget.

Temporary carbon storage targets can be in the form of a temporary land carbon target (which includes land carbon stock increases and decreases) or a temporary product carbon storage target (which includes product carbon stock increases and decreases).

A temporary product carbon storage target can include product carbon pools such as harvested wood products or direct air capture CO_2-based products. Temporary product storage targets can encourage shifting to producing longer lived products, extending product lifetimes, and promoting reuse, recycling, and circular economy strategies.

Companies should report the following information about temporary carbon storage targets:

- Carbon pool(s) (land, product, or geologic)
- Target boundary
- Target type (absolute or intensity)
- Target base year/period, target year(s), and whether the target is a single-year or multi-year target
- Target level
- Quantity of carbon storage and expected length of storage
- Metrics, methods, data, and assumptions used to quantify temporary carbon storage
- Progress in reaching target

Companies should also set targets for enhancing carbon storage in various carbon pools. Companies should set separate targets by carbon pool (land, product, and geologic carbon pools). Targets by pool can be met through emissions reductions, removals, or a combination, reflected in total carbon storage by pool.

12.7 Setting targets for external compensation or contributions

Companies can supplement GHG targets (in the previous sections) with additional mitigation external to the target boundary. This can be in the form of external compensation targets or contribution targets as described in table 12.5.

Table 12.5 Compensation and contribution targets

Target type	Description
Compensation target	Target for achieving mitigation external to the target boundary through purchasing and retiring GHG credits (also called offsets or carbon credits) to compensate for annual or cumulative unabated emissions in the target boundary, if allowed under the relevant target setting program or target setting policy
Contribution or financing target	Target for contributing to financing GHG mitigation outside the company's target boundary, through financing or purchasing and retiring GHG credits applied against contribution targets (without using GHG credits as offsets or compensation)

Chapter 13 defines quality criteria that credits must meet, including additionality, credible baselines, permanence, avoid leakage, unique issuance and claiming, regular monitoring, independent validation and verification, GHG program governance, and no net harm.

Compensation targets

Compensation refers to compensating for the company's annual or cumulative unabated emissions, while the company is on a pathway to meeting its GHG targets.

A GHG emissions target (section 12.2) should be met entirely from reducing emissions from the sources included in the target boundary (e.g., across scopes 1, 2 and 3). A removals target or net target (section 12.3) should be met by removal enhancements (and if applicable, emission reductions) from within the target boundary (e.g., across scopes 1, 2, and 3).

As a supplement to emission reduction targets and removal or net targets, companies may set separate targets for external compensation to be met through purchasing and retiring credits (generated from projects or activities that reduce emissions or enhance removals from sources/sinks external to the target boundary) or other mitigation actions beyond the company's value chain.

In line with a mitigation hierarchy, companies should prioritize implementing actions to reduce emissions and increase removals within their operations and value chain (scopes 1, 2 and 3) to the maximum extent possible, rather than purchasing credits.

Any use of credits as compensation or neutralization should be consistent with GHG programs. For example, the Science Based Targets initiative's Net-Zero Standard only allows external removals to be used to neutralize a company's residual emissions (i.e., the emissions that remain after companies have achieved their long-term science-based target and thereafter). SBTi also recommends that companies use external mitigation to compensate for emissions while the company is on a path toward net-zero emissions, as a supplement to decarbonizing in line with a 1.5°C pathway.

Compensation for cumulative unabated emissions involves compensating for all historical emissions of the company. Compensation for annual unabated emissions should cover multiple consecutive years (i.e., in the form of a multi-year target, as explained in sections 12.2.5 and 12.3.6), rather than only a single target year.

When accounting for and reporting on compensation targets, companies **shall** specify the types of credits were used. Companies **shall** report progress toward emission reduction targets (section 12.2) and removal or net targets (section 12.3) based on emissions and removals within the inventory boundary, separately from any credits used. Any purchases or sales of credits **shall** be reported separately.

As explained in chapter 13, companies are required to avoid double counting of offset credits by multiple entities. Double counting can be avoided through contracts between buyers and sellers that transfer ownership of credits and by calculating emissions and removals values adjusted for sold credits.

Accounting requirement
If companies sell GHG credits from within their organizational boundary that are used as offsets or compensation, or if such credits are sold in the company's value chain: companies **shall** use emissions and removals values adjusted for sold credits when accounting for progress toward a GHG target to avoid double counting. See chapter 13 for further requirements and guidance for preventing double counting of credits.

Contribution or financing targets

Companies should consider investing in GHG credits to achieve additional GHG mitigation outside the company's GHG target boundary, rather than using credits as compensation. Companies can do so by retiring credits as part of contribution or financing targets.

Credits used toward contribution or financing targets represent contributions a company makes to achieving GHG mitigation outside the company's inventory, without being used as compensation. Under this approach, companies can finance mitigation action or purchase and retire credits in units of t CO_2e (e.g., results-based climate finance). Such retired credits may be referred to as "financed reductions or removals," "financed GHG mitigation," or other claim not related to achievement of the company's GHG target.

Offset credits which are retired and applied against compensation targets require avoidance of double counting between entities.

Credits used against contribution or financing targets do not require avoidance of double counting, since the credits are not counted toward more than one entity's GHG or compensation target. For more information, see chapter 13.

12.8 Base year recalculations to enable consistent performance tracking over time

This section provides guidance on tracking progress over time, including recalculating base year/period emissions for significant changes to enable consistent performance tracking.

Companies should calculate base year or base period emissions, removals, and land tracking metrics by following the requirements and guidance in this Guidance, in addition to the GHG Protocol *Corporate Standard* and *Scope 3 Standard*.

For more information on tracking performance over time, see:

- GHG Protocol *Corporate Standard* (chapter 5: Tracking Emissions Over Time)

- GHG Protocol. *Base year recalculation methodologies for structural changes. Appendix E to the GHG Protocol Corporate Accounting and Reporting Standard, Revised Edition*[123]
- GHG Protocol *Scope 3 Standard* (chapter 9: Setting a GHG Reduction Target and Tracking Emissions Over Time)
- GHG Protocol *Mitigation Goal Standard* [124] (chapters 6-9)

12.8.1 Recalculating base year or base period emissions, removals, and land tracking metrics

Base year or base period recalculation enables meaningful comparisons over time.

Accounting requirement

To enable consistent tracking over time, companies **shall** recalculate base year or base period emissions, removals, and land tracking metrics when significant changes in company structure or inventory methodology occur.

Recalculation is required when the following changes occur and have a significant impact on the inventory:

- Structural changes in the reporting organization, such as mergers, acquisitions, divestments, outsourcing, and insourcing
- Changes in calculation methods, improvements in data accuracy, or discovery of significant errors
- Changes in the categories or activities included in the inventory

12.8.2 Establishing a base year or base period recalculation policy

The need for recalculating base year emissions, removals, and/or land tracking metrics (or average emissions, removals and/or land tracking metrics over the base period) depends upon the significance of the changes. A significance threshold is a qualitative and/or quantitative criterion used to define any significant change to the data, inventory boundaries, methods, or any other relevant factors.

For example, a significant change could be defined as one that alters base year net emissions, or average net emissions in the base period, by at least ten percent of the emissions reduction target (e.g., 5 percent if the emissions reduction target is 50 percent).

Base year recalculation may be required, for instance, in the first year that companies fully integrate their land sector activities into the GHG inventory, leading to inclusion of land based GHG emissions and/or CO_2 removals, which were previously excluded from their inventory and targets.

[123] Available at https://ghgprotocol.org/corporate-standard

[124] The GHG Protocol *Mitigation Goal Standard* is intended primarily for national and subnational government agencies involved in setting and tracking mitigation goals, but companies and other organizations may also find the guidance useful when designing and tracking progress toward targets.

Accounting requirement
Companies **shall** develop a base year or base period recalculation policy, including establishing the significance threshold that triggers base year recalculations.   Companies **shall** apply the recalculation policy in a consistent manner and clearly articulate the basis and context for any recalculations.

12.8.3 Recalculations for changes in calculation methods or improvements in data quality

Companies should seek to improve the quality of the data and calculation methods they use over time to track changes in emissions, removals, and land tracking metrics (see chapter 16). Methods and data to account for land sector emissions and removals are evolving rapidly, and companies are encouraged to continually improve quantification methods and data sources over time.

Improvements in technology, time representativeness, spatial resolution, completeness, and reliability of data and calculation methods can all improve accuracy. However, changes in data or methods can also lead to illusory "trends" in emissions or removals if the new data or method leads to a result that reflects methodological changes rather than changes in a company's GHG inventory.

Companies are required to retroactively recalculate base year or base period emissions, removals, and land tracking metrics when significant changes occur to the data or methods used to calculate them.

For example, this may apply in the case of a company that previously reported *Land use change emissions* using secondary data and the statistical land use change (sLUC) method, then later gains access to primary data from specific land management units the company sources from, and now uses primary data and the direct land use change (dLUC) method to calculate *Land use change emissions*.

If primary data is not available for the historical base year, companies may need to use proxy data or estimates to complement available primary data. Companies should use conservative assumptions and report data and assumptions used.

12.8.4 Recalculations for structural changes in ownership or control

Companies are required to retroactively recalculate base year emissions and removals when significant structural changes occur in the reporting organization, such as mergers, acquisitions, or divestments. Structural changes trigger recalculation because they merely transfer emissions and removals from one company to another without any change in GHGs released to or removed from the atmosphere.

For example, if a company purchases or acquires land which has a significant impact on the inventory, the company is required to recalculate its base year emissions and removals by adding the emissions and removals of the purchased land to the company's base year inventory. Doing so allows the company and its stakeholders to understand that the apparent change in emissions and removals is a result of a structural change rather than a change in practices that affect the climate.

If a structural change leads to a situation where a change in target(s) is necessary to maintain a high level of ambition, companies should set a new target with a higher level of ambition to compensate. Companies should disclose and justify such changes.

12.8.5 Recalculations for outsourcing or insourcing

Scope 3 emissions and removals include outsourced activities. If a company is reporting comprehensively on scope 1, scope 2, and scope 3, a change in ownership or control can have the effect of shifting GHG emitting and removing activities between the scopes.

If a company outsources an in-house activity to a third party, the activity shifts from scope 1 or scope 2 to scope 3. Conversely, a company may shift emissions or removals from scope 3 to scope 1 or scope 2 by performing operations in-house that were previously performed by a third party.

Whether a base year recalculation is triggered by the outsourcing or insourcing of an activity depends on whether:

- the company previously reported emissions and/or removals from the activity;
- the company has a single base year or GHG target for all scopes or separate base years and GHG targets for each scope; and
- the outsourced or insourced activity contributes significantly to the company's emissions, removals, and/or land tracking metric(s).

12.8.6 Recalculations for changes in the activities included in the inventory over time

Companies may add new activities or change the activities included in the inventory over time, affecting estimates of total emissions, removals, and land tracking metric(s).

If the cumulative effect of adding or changing categories or activities is significant, the company should include the new or changed categories or activities in the base year inventory and back cast data for the base year based on available historical activity data (e.g., bill of materials data, spend data, product sales data).

12.9 Accounting for changes in emissions, removals, and land tracking metrics over time

This Guidance primarily uses the inventory method to account for changes in total emissions, removals, and land tracking metrics over time. Changes are calculated by comparing the company's annual inventory (including emissions, removals, and land tracking metrics) relative to a base year or period. The inventory method allows companies to track the total change in emissions, removals, and land tracking metrics within the inventory boundary over time.

The inventory method results in high-level indicators (e.g., % reduction in GHG emissions since a base year) to assess a company's progress over time. Companies may also wish to track changes in emissions, removals, and/or land tracking metrics by project or activity to understand which company actions are most (and least) effective in improving their GHG impacts, and how their actions could be improved.

Companies may also wish to understand the system-wide changes in emissions and removals caused by their actions, in addition to the change in emissions and removals that are tracked within the inventory boundary.

To do this, companies should use the project or intervention accounting method (see chapter 11) to undertake more detailed assessments of changes occurring from discrete mitigation actions, in addition to reporting emissions, removals, and land tracking metrics using the inventory method. Any project-based changes in emissions, removals, and land tracking metrics are reported separately from the scopes. Chapter 11 provides guidance on quantifying impacts of actions on GHG emissions and removals, as well as using intervention methods and inventory methods in combination to inform decision making.

The use of project or intervention methods can ensure that actions aimed at reducing emissions achieve a reduction in global emissions to the atmosphere, and not just a reduction within the inventory boundary.

For example, for companies that source land-based products, the project or intervention method is likely to show that working with existing suppliers to improve their GHG performance has greater net GHG benefits than shifting to new suppliers, relative to a counterfactual baseline scenario. Shifting to better-performing suppliers could result in the company's existing suppliers continuing their higher-GHG practices and selling to new buyers. Therefore, the real-world effect on the climate could be minimal, despite the company's scope 3 inventory showing an improvement.

13

Accounting for Credited Emission Reductions and Removals

Chapter 13: Accounting for Credited Emission Reductions and Removals

Requirements and Guidance

As explained in chapter 12, companies may use credits to achieve additional mitigation external to the reporting company's GHG target. Credits can be used to meet external compensation or contribution targets as a supplement to meeting scope 1, scope 2 and scope 3 GHG targets.

This chapter provides requirements and guidance on accounting for GHG emission reductions or removals that have been credited for the purpose of transferring GHG reduction or removal claims between parties (i.e., companies or other entities). This chapter is applicable if a company engages in purchases or sales of credits or if credits have been generated in the company's value chain.

This chapter applies to GHG credits in the context of voluntary GHG reporting according to the Greenhouse Gas Protocol. Companies should follow national, international, and/or programmatic accounting rules for credits as part of compliance markets, regulations, GHG programs, and the UNFCCC where they apply.

Sections in this chapter

Section	Description
13.1	Introduction to credited GHG emission reductions and removals
13.2	Distinguishing between GHG credits
13.3	Quality criteria for credited GHG reductions or removals
13.4	Accounting for transfers (sales) of credits and avoiding double counting

Checklist of accounting requirements in this chapter

Section	Accounting requirements
13.2	• If applicable, companies **shall** avoid double counting between insets and the scope 3 inventory (e.g., by accounting for the impact of a value chain activity through scope 3 inventory accounting rather than through crediting)
13.3	• Companies **shall** ensure that any credited GHG reductions or removals adhere to the following quality criteria: additionality, credible baselines, permanence, avoid leakage, unique issuance and claiming, regular monitoring, independent validation and verification, GHG program governance, and no net harm.
13.4	• Companies **shall** not double count a ton of GHG reduction or removal that has been credited and sold if the credit is used (or could potentially be used) as an offset or for compensation.

- To avoid double counting of credits used as offsets or compensation, companies **shall** deduct emission reductions or removals associated with the sale of credits used as offsets from the company's GHG target accounting. To do so, companies **shall** separately calculate:
    - **Inventory emissions and removals:** scope 1, 2 and 3 emissions and scope 1 and 3 removals, independent of GHG credit purchases/sales, and
    - **Emissions and removals adjusted for sold credits:** scope 1, 2 and 3 emission values that are adjusted for GHG credits issued or generated within the inventory boundary.
- Companies **shall** use the emissions and removals values adjusted for sold credits when accounting for progress toward a target.

13.1 Introduction to credited GHG emission reductions and removals

Credited GHG reductions or removals are quantified mitigation outcomes of projects or broader interventions which are credited for GHG claims to be transferred between entities. Such interventions and resulting GHG reductions or removals can occur inside or outside of the value chain of the reporting company.

Credited GHG reductions and removals are quantified and reported differently from emissions and removals included in the GHG inventory. Credited GHG reductions and removals are quantified using project or intervention accounting methods, which quantify systemwide GHG impacts relative to counterfactual baseline scenarios or performance benchmarks that represent the conditions most likely to occur in the absence of the activity. In contrast, emissions and removals reported in scope 1, scope 2, and scope 3 use an inventory approach to account for emissions and removals occurring in the company's operations or value chain (see figure 13.1).

Chapter 11 introduces the intervention accounting method to evaluate the impacts of a company's actions. Companies should refer to more specific project or intervention accounting standards for detailed methodologies for quantifying GHG impacts from mitigation projects or interventions if used for crediting.[125]

[125] For example, the *GHG Protocol for Project Accounting* (for project-scale actions) and supplementary *Land Use, Land-Use Change, and Forestry Guidance for GHG Project Accounting the GHG Protocol* (available at https://ghgprotocol.org/standards/project-protocol) in combination with program-specific standards or methodologies.

Figure 13.1 Comparison of inventory and project/intervention accounting methods

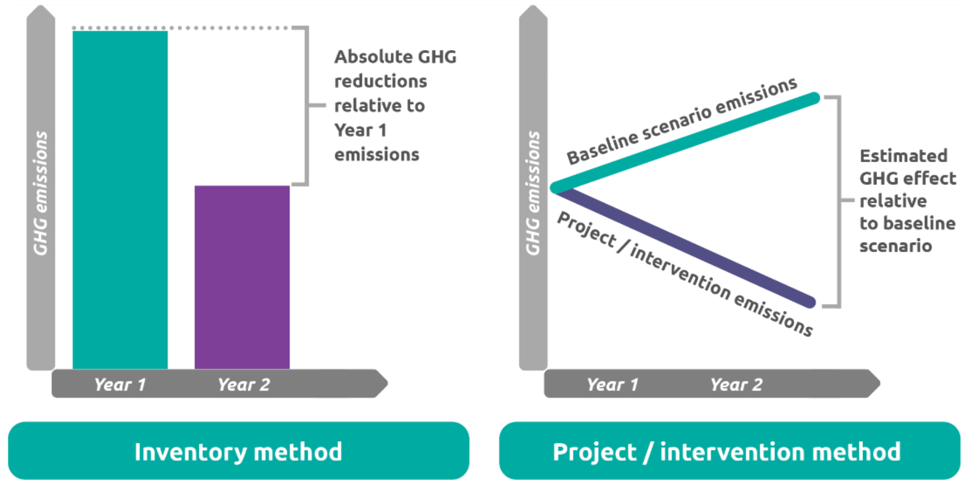


Table 13.1 highlights the differences between accounting for emissions and removals as part of a GHG inventory versus accounting for emission reduction or removal enhancement credits. Each uses a different accounting method, requires different criteria to be followed, and are reported differently in a GHG inventory report.

Table 13.1 Accounting for emissions and removals in the GHG inventory vs accounting for credits

Accounting for:	Description	Accounting method	Quality criteria	Reporting
Emissions and removals in the GHG inventory (scope 1, scope 2, scope 3)	GHG emissions and removals that occur in company operations and value chain	Inventory accounting	• For emissions: n/a • For removals: ongoing storage monitoring, traceability, primary data, uncertainty, reversals accounting (see chapter 6 for more information)	Reported in the scopes (if requirements for reporting removals in chapter 6 are met)
GHG credits (e.g., offsets)	Quantified GHG reduction or removal impacts of projects or interventions, which are credited for GHG claims to be transferred between entities	Project or intervention accounting (relative to counterfactual baseline scenario)	• Additionality • Credible baselines • Monitoring • Permanence • Avoid leakage • Unique issuance and claiming • Independent validation and verification • GHG program governance • No net harm (See section 13.3 for more information)	Reported separately from the scopes

This chapter differentiates credits used against compensation targets (e.g., offsets) from credits used against contribution or financing targets (discussed in section 13.2). Offset credits used against compensation targets quantify the unique GHG reduction or removal claims associated with an activity and must only be counted once. Section 13.4 explains how to account for transfers between entities to avoid double counting of credits used as offsets or against compensation targets.

The need to avoid double counting of GHG credits differs from scope 3 inventory accounting. In scope 3 accounting, companies account for emissions and removals across their full value chain, such that scope 3 emissions and removals from common activities may be counted by multiple companies that are at different stages of the same value chain (see section 5.4.4 for more information). For example, removals generated by increased carbon stocks within a shade-grown coffee plantation (without being credited and sold) could be accounted for within the scope 3 inventories of the coffee manufacturers, distributors, retailers and consumers in the value chain of that coffee plantation. If the removal is instead credited and sold for use as an offset or toward a compensation target, the removal cannot be counted by more than one entity.

13.2 Distinguishing between GHG credits

This section provides information on different types of GHG credits. GHG credits can be distinguished in the following ways:

- Emission reduction vs. removal enhancement credits
- Credits used against compensation targets vs. credits used against contribution or financing targets
- Inset credits vs. offset credits

Emission reduction vs removal enhancement credits

- **Emissions reduction credits** represent a reduction or avoidance of GHG emissions relative to baseline emissions associated with an intervention (e.g., avoided deforestation).
- **Removal enhancement credits** represent an increase in removals relative to baseline removals associated with an intervention (e.g., afforestation, soil carbon sequestration, direct air capture with geologic storage).

In some cases, emission reductions and removal enhancements from a project may be accounted for together against a common baseline. In such cases, separate reporting may not be possible.

If relevant, companies **shall** separately report GHG credits based on whether they are emission reduction credits, removal credits, or a combination.

Credits used against compensation targets vs. contribution or financing targets

As discussed in chapter 12, companies can invest in credits and apply them toward external compensation or contribution targets to achieve additional mitigation outside the target boundary as a supplement to meeting the company's GHG targets:

- **Compensation target:** target for achieving mitigation external to the target boundary through purchasing and retiring credits[126] (also called offsets or carbon credits) to compensate for annual or

[126] In this section, the term 'credits' refers to any type of compensation credit, including 'offset credit' and 'inset credits,' since both follow a project-based crediting approach and are used as compensation.

cumulative unabated emissions in the target boundary, if allowed under the relevant target setting program or target setting policy

- **Contribution or financing target**: target for contributing to financing GHG mitigation outside the company's target boundary, through financing or purchasing and retiring GHG credits applied against contribution targets (without using GHG credits as offsets or against compensation targets)

The distinction depends on how credits are used in relation to the company's targets and whether they can be claimed by any other party (e.g., supplying party, host jurisdiction, or other company or entity).

Credits used against compensation targets require quality criteria to be met (see section 13.3) and require avoidance of double counting between entities (see section 13.4).

Credits used against contribution or financing targets require the same quality criteria to be met (section 13.3) with the exception that they do not require avoidance of double counting, since the credits are not counted toward more than one entity's GHG or compensation target. Under this approach, credits may be referred to as "financed reductions or removals," "financed GHG mitigation," or other claim not related to achievement of the company's GHG target.

Companies **shall** separately report credits based on whether they are used against compensation targets or contribution or financing targets.

Inset credits vs. offset credits

Credits that are retired and applied against compensation targets or used to make offsetting claims are sometimes categorized by their relationship to the corporate value chain:

- **Offset credits** are typically generated from projects or interventions that reduce emissions or increase removals *outside* the corporate value chain.
- The term '**inset credit'** is sometimes used to refer to activities using the same quantification methods as offset credits but that reduce emissions or increase removals *within* the reporting company's value chain.

The requirements and guidance for offset credits in this chapter apply to both inset and offset credits, including quality criteria (section 13.3) and avoidance of double counting (section 13.4).

Accounting requirement
If applicable, companies **shall** avoid double counting between insets and the scope 3 inventory (e.g., by accounting for the impact of a value chain activity through scope 3 inventory accounting rather than through crediting) (see box 13.1).

Box 13.1 Insets and scope 3 accounting

This Guidance explains how to account for scope 3 emissions and removals in the context of a company's GHG inventory. For companies reporting a scope 1, 2, and 3 inventory and also purchasing or retiring inset credits, there is an inherent overlap and double counting between an activity counted as an inset and the same activity accounted for as an improvement in the scope 3 inventory.[127]

Companies should therefore account for scope 3 emissions and removals through an inventory accounting approach – following the other chapters in this Guidance– rather than using a crediting approach. Under the inventory accounting approach, a mitigation action in the value chain is accounted for in the scope 3 inventory either as a reduction in scope 3 emissions or increase in scope 3 removals. To enable actions to be reflected in the scope 3 inventory, companies should collect primary data where possible to enable improvements from actions in the value chain to be reflected in the data and methods used to calculate scope 3 emissions (further described in chapter 16). For examples of actions to reduce scope 3 emissions (and increase scope 3 removals if relevant) in a GHG inventory, see chapter 11 (table 11.1) and the *Scope 3 Standard* (chapter 9).

Within an inventory accounting approach, companies that work with value chain partners to achieve GHG reductions or removals can choose to purchase and retire inset credits from suppliers or other value chain partners, or enter into other contractual agreements to ensure that unique claims to the GHG reductions or removals from activities in the value chain will not be sold/transferred to third parties via credits. Doing so can ensure that the reporting company and value chain partners will account for the benefit in their scope 1, scope 2 and scope 3 inventory and targets (using inventory methods), without risk of double counting. In this case, credits are not deducted or subtracted from the accounting, but used as a contractual mechanism for tracking, verification, and quality control as part of scope 3 inventory accounting, and to ensure the rights to reductions or removals are not transferred to third parties (e.g., as an offset used toward compensation targets). Doing so can also serve as a financing mechanism for the reporting company to help finance emission reductions or removals in the value chain, while accounting for the impacts in an inventory approach. Such credits cannot be used toward compensation targets.

Inset credits cannot therefore be used to adjust scope 3 emissions or removals (e.g., by subtracting credits from reported emissions), but can be used as a tool for ensuring that actions in the value chain are properly accounted for in the scope 3 inventory using an inventory accounting approach.

13.3 Quality criteria for credited GHG reductions or removals

This section provides a list of quality criteria that any credited GHG reductions or removals must meet.

Accounting requirement

Companies **shall** ensure that any credited GHG reductions or removals adhere to the following quality criteria: additionality, credible baselines, monitoring, permanence, avoid leakage, unique issuance and claiming, independent validation and verification, GHG program governance, and no net harm.

[127] Depending on data and methods used, the activity may not be reflected in calculated scope 3 values (e.g., if using secondary data), but the insetting activity occurs within the scope 3 inventory boundary.

Table 13.2 provides definitions for the quality criteria.[128] Companies should also follow applicable GHG program procedures and requirements that provide additional specificity or include additional criteria.

Table 13.2 Quality criteria for credited GHG reductions or removals

Term	Definition
Additionality	The intervention (e.g., project or activity) reduces emissions or increases removals relative to the amount of emissions or removals that would have occurred without the incentives provided by the credit.
Credible baseline	GHG reductions or removals are quantified relative to a realistic, defensible and conservative estimate of GHG reductions or removals occurring in the baseline scenario or performance standard. With respect to removals, a credible baseline may be zero if no removals were likely to occur in the absence of the intervention.
Monitoring	GHG reduction or removal credits are monitored and quantified ex-post based on accurate and precise measurement, sampling and quantification protocols where data are monitored throughout the crediting period.
Permanence	GHG reduction or removal credits ensure the longevity of a carbon pool and the stability of its stocks over time (such as 100 years or other time period defined by the program) and have mechanisms in place to monitor and compensate for any reversals or emissions from the stored carbon.
Avoid leakage	GHG reduction or removal credits mitigate the risk of displacing impacts elsewhere and account for any increase in GHG emissions or decrease in GHG removals outside of the project boundary that result from the intervention. (Chapter 11 provides guidance on addressing leakage and other impacts in GHG inventory accounting.)
Unique issuance and claiming	Processes are in place to ensure that there is an exclusive right to each unit of GHG reduction or removal, where only one reduction or removal unit is issued for each metric ton of carbon dioxide equivalent (tCO_2e) reduced or removed. GHG reduction or removal credits ensure that a single entity claims the right to use or retire that unit. Independent carbon registries linked to voluntary carbon standards can be used to ensure GHG reduction or removal units are issued, reported and retired accordingly. GHG reduction or removal credits from such registries and standards must prevent the following types of **double counting**: • **Double use:** occurs where multiple parties use a single GHG emission reduction or removal unit (e.g., use of a single unit toward more than one entity's mitigation target) • **Double issuance:** occurs where multiple GHG emission reductions or removal units are issued for the same GHG emission reductions or removal

[128] Quality criteria were developed drawing from international best practices from GHG programs and standards such as ICAO's Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) program.

	• **Double claiming:** occurs where multiple parties claim the right to a single emission reduction, removal, or mitigation outcome (e.g., by the host country where the emission reduction or removal occurs as well as by a corporate purchaser of carbon credits)
Independent validation and verification	GHG reduction or removal credits are validated and verified in accordance with international best practices, either according to nationally accepted third-party validation and verification procedures or to a reasonable level of assurance by an independent third-party validator and verifier through the GHG program/standard.
GHG program governance	GHG reduction or removal credits are issued by GHG programs with a clearly defined and transparent governance structure, including published rules and procedures, accreditation procedures for third-party auditors, and stakeholder consultation procedures for the development or refinement of program requirements and as part of the project approval process, with established grievance and input mechanisms to address complaints about projects after implementation.
No net harm	Interventions reflected within the GHG reduction or removal credits adhere to social, economic, ecological and environmental safeguards to avoid unintended harm. Projects should comply with applicable legal requirements, be free of human rights violations and be gender sensitive. Some programs require that projects proactively advance social and environmental co-benefits, as well as monitor and report on these benefits. Companies should strive to maximize co-benefits associated with GHG projects to meet a variety of social, economic and environmental objectives (such as health, climate resilience, biodiversity, etc.) and contribute to the United Nations Sustainable Development Goals, and to monitor, report and verify these impacts to the extent possible.

13.4 Accounting for transfers (sales) of credits and avoiding double counting

This section applies to credits if they are applied against compensation targets or used to make offsetting claims, rather than to credits applied against contribution or financing targets.

Avoiding double counting

Credits used as offsets or applied against compensation targets require an exclusive claim for one party (company or other entity) to claim a ton of GHG emission reduction or removal (t CO_2e) from an intervention. Double counting must be avoided, such that no other entity may claim the same ton of emission reduction or removal. Double counting includes double use, double issuance, and double claiming. A GHG credit should only be claimed by the party that retires the credit.

Accounting requirement
Companies **shall** not double count a ton of GHG reduction or removal that has been credited and sold if the credit is used (or could potentially be used) as an offset or for compensation.

This requirement applies to avoidance of double counting between multiple private entities as well as between private entities and governments (e.g., host country's Nationally Determined Contributions), where applicable.

Companies **shall** avoid double counting of credited GHG reductions or removals by multiple entities or in multiple GHG targets, for example, through contracts between buyers and sellers that transfer ownership of credits.

Double counting of credits can occur when a GHG credit is counted towards the target by both the selling and purchasing organizations. For example, company A undertakes an internal reduction project that reduces GHG emissions at sources included in its own target. Company A then sells this project reduction to company B to use towards its target, while still counting it toward its own target.

In this case, a single GHG emission reduction is counted by two different organizations against targets that cover different emissions sources. Trading programs address this by using registries that allocate a serial number to all traded credits and ensuring the serial numbers are retired once they are used. In the absence of registries, the risk of double counting could be addressed by a contract between seller and buyer, coupled with transparent reporting.

Avoiding double counting through adjustments for sold credits

Accounting requirement

To avoid double counting of credits used as offsets or compensation, companies **shall** deduct emission reductions or removals associated with the sale of credits used as offsets from the company's GHG target accounting. To do so, companies **shall** calculate and report:

- **Inventory emissions and removals**: scope 1, 2 and 3 emissions and scope 1 and 3 removals, independent of GHG credit purchases/sales, and
- **Emissions and removals adjusted for sold credits**: scope 1, 2 and 3 emission values and scope 1 and 3 removal values that are adjusted for GHG credits issued or generated within the inventory boundary.

Companies **shall** use the emissions and removals values adjusted for sold credits when accounting for progress toward a target.

Following this approach avoids double counting by deducting emission reductions or removals sold as credits from the company's GHG target accounting.

Reporting adjusted scope 1 emissions and removals enables other companies in the value chain to report their scope 3 emissions and removals while avoiding double counting of unique claims. Adjusted values avoid double counting of emission reductions and removals between buyers and sellers of credits.

Equation 13.1 shows how to calculate emissions and removals adjusted for sold credits to avoid double counting.

Equation 13.1 Calculating emissions and removals adjusted for sold credits

Adjusted scope 1 emissions =
scope 1 emissions + emission reduction credits issued or generated from activities within the scope 1 boundary

Adjusted scope 2 emissions =
scope 2 emissions + emission reduction credits issued or generated from activities within the scope 2 boundary

Adjusted scope 3 emissions =
scope 3 emissions + emission reduction credits issued or generated from activities within the scope 3 boundary

Adjusted scope 1 removals =
scope 1 removals – removal credits issued or generated from activities within the scope 1 boundary

Adjusted scope 3 removals =
scope 3 removals – removal credits issued or generated from activities within the scope 3 boundary

Avoiding double counting of an emission reduction or removal in the supply chain requires that either:

- A supplier provides both inventory emissions and removals and adjusted emissions and removals data to the customer, and the customer uses the inventory data to determine its scope 3 inventory emissions and removals and the adjusted values to determine its scope 3 emissions and removals adjusted for sold credits; or
- The reporting company determines the quantity of emission reductions and removals sold as credits in the supply chain and develops its own calculations of scope 3 inventory emissions and removals and scope 3 emissions and removals adjusted for sold credits.

Table 13.3 provides additional guidance for various scenarios.

Table 13.3 Accounting for various scenarios

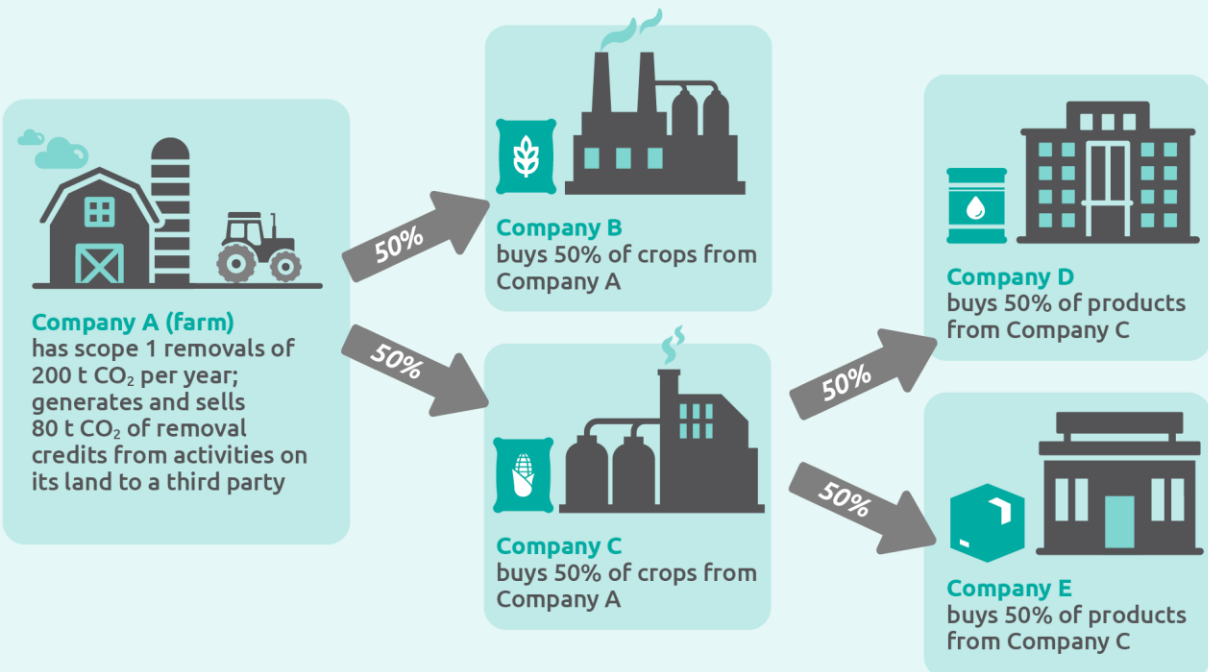
Scenario	Accounting approach
The reporting company generates a removal credit from an activity within its organizational boundary	If a company generates a removal credit from an intervention occurring within its organizational (scope 1) boundary and transfers the credit to another company for use as an offset or compensation claim, the company deducts the removals sold through credits from its scope 1 target accounting to avoid double counting. If the company provides its GHG data to another company (a customer) for purposes of calculating the customer's scope 3 inventory, the company provides two figures to the customer: scope 1 inventory removals and scope 1 removals adjusted for sold credits, such that the customer can calculate both scope 3 inventory removals and scope 3 removals adjusted for sold credits. (The same process applies in cases where the reporting company generates an emission reduction credit, following equation 13.1.)
A company in the reporting company's	The reporting company should determine the quantity of GHG credits that have been sold in the supply chain, for example by asking suppliers to provide

supply chain generates a removal credit and sells or transfers the credits to a third party	information on credits sold or gathering data from registries or other data sources on credits sold with a sourcing region. **If the supplier can provide the necessary data**: The supplier deducts sold removals from the removals data they provide to the reporting company to avoid double counting. The supplier provides two figures to the customer: the supplier's scope 1 inventory removals and scope 1 removals adjusted for sold credits (for the boundary relevant to the customer), such that the customer can calculate both scope 3 inventory removals and scope 3 removals adjusted for sold credits. The supplier should also provide any additional data for the customer to calculate its scope 3 emissions, such as production or sales data needed for allocating emissions and removals. **If the supplier cannot provide the necessary data:** The reporting company should determine the quantity of emission reductions and removals sold as credits in the supply chain from available registries or databases and develop its own calculations of scope 3 inventory emissions and removals and scope 3 emissions and removals adjusted for sold credits.
The reporting company purchases and retires an emission reduction or removal credit from outside its value chain	The reporting company separately reports purchase and retirement of credits outside of the scopes and may report these credits as offsets, provided they are not claimed by another party. The company can apply this offset toward a company's external compensation or contribution target, separate from its GHG emission reduction target (see chapter12).
The reporting company purchases and retires an emission reduction or removal credit from within its value chain	The reporting company can purchase credits or enter into other contractual agreements with suppliers as part of their scope 3 inventory accounting to ensure that unique claims to the GHG reductions or removals from activities in the value chain will not be sold/transferred to third parties via offset or inset credits. Doing so can ensure that the reporting company and value chain partners will account for the benefit in their scope 3 inventory (using inventory accounting methods), without risk of double counting. In this case, credits are not deducted or subtracted from the accounting, but used as a contractual mechanism for tracking, verification, and quality control as part of scope 3 inventory accounting, and to ensure the rights to reductions or removals are not transferred to third parties (e.g., as an offset used toward compensation targets). Doing so can also serve as a financing mechanism for the reporting company to help finance emission reductions or removals in the value chain, while accounting for the impacts in an inventory approach. Inset credits cannot therefore be used to adjust scope 3 emissions or removals (e.g., by subtracting credits from reported emissions), but can be used as a tool for ensuring that actions in the value chain are properly accounted for in the scope 3 inventory using an inventory accounting approach. Such credits cannot be used toward compensation targets.
The reporting company works with a supplier to reduce emissions or increase removals in the value chain (without credits being generated)	The reporting company accounts for the improvement as reduced scope 3 emissions or increased scope 3 removals, for example through reduced emission factors used to calculate the scope 3 inventory.

Boxes 13.2 and 13.3 provide illustrative examples of avoiding double counting in a value chain. In both examples, credits are sold to a third party rather than to other companies in the value chain.

Box 13.2 provides an example of how to avoid double counting of removal credits in a supply chain through calculating removals adjusted for sold credits. Box 13.3 provides an example of how to avoid double counting of emission reduction credits in a supply chain through calculating emissions adjusted for sold credits.

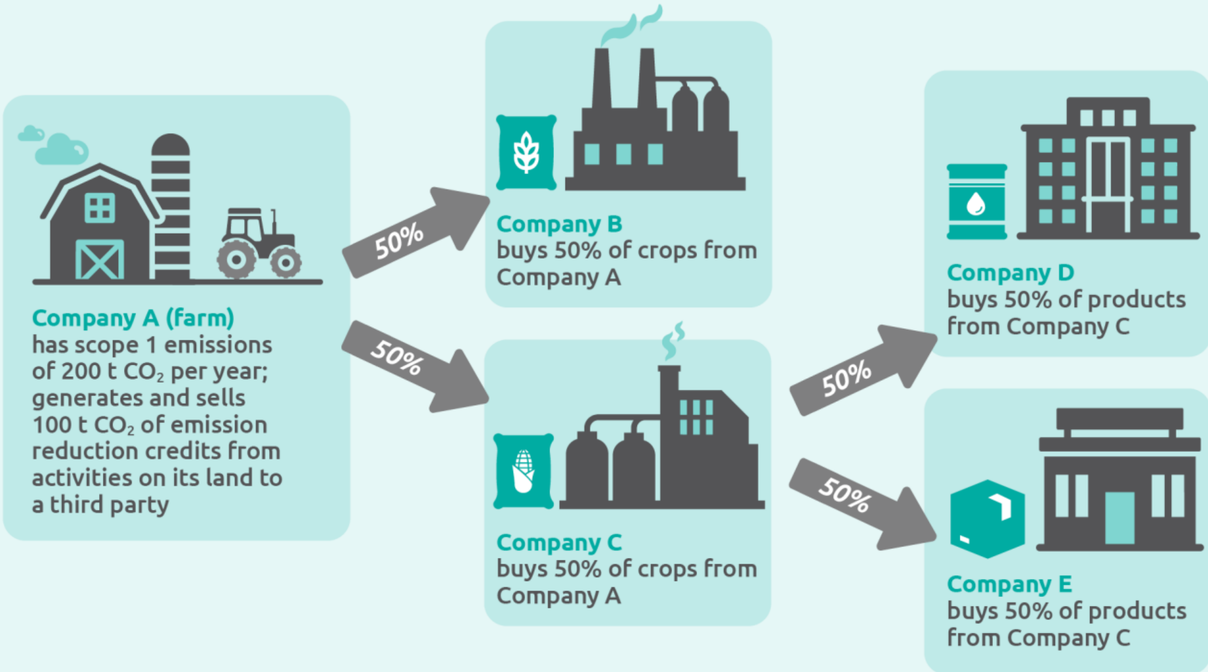
Box 13.2 Example of how to avoid double counting of *removal credits* in the supply chain



Accounting for removals sold as credits in the supply chain

Company	*Scope 1 land removals (inventory)*	*Scope 1 land removals (adjusted for sold credits)*	*Scope 3 land removals (inventory)*	*Scope 3 land removals (adjusted for sold credits)*
A	200	120 (200 - 80 = 120)	0	0
B	0	0	100 (200 x 50% = 100)	60 (120 x 50% = 60)
C	0	0	100 (200 x 50% = 100)	60 (120 x 50% = 60)
D	0	0	50 (200 x 50% x 50% = 50)	30 (120 x 50% x 50% = 30)
E	0	0	50 (200 x 50% x 50% = 50)	30 (120 x 50% x 50% = 30)

Box 13.3 Example of how to avoid double counting of *emission reduction credits* in the supply chain



Accounting for emission reductions sold as credits in the supply chain

Company	*Scope 1 land emissions (inventory)*	*Scope 1 land emissions (adjusted for sold credits)*	*Scope 3 land emissions (inventory)*	*Scope 3 land emissions (adjusted for sold credits)*
A	200	300 (200 + 100 = 300)	0	0
B	0	0	100 (200 x 50% = 100)	150 (300 x 50% = 150)
C	0	0	100 (200 x 50% = 100)	150 (300 x 50% = 150)
D	0	0	50 (200 x 50% x 50% = 50)	75 (300 x 50% x 50% = 75)
E	0	0	50 (200 x 50% x 50% = 50)	75 (300 x 50% x 50% = 75)

14

Reporting

Chapter 14: Reporting

Requirements and Guidance

A credible GHG emissions report presents information based on the principles of relevance, accuracy, completeness, consistency, and transparency. This chapter provides a list of reporting requirements which must be met for a GHG inventory report to be in conformance with the Greenhouse Gas Protocol Land Sector and Removals Guidance*. It also provides a list of optional reporting information that should be reported where relevant.*

Sections in this chapter

Section	Description
14.1	Reporting requirements
14.2	Optional reporting information

14.1 Reporting requirements

Companies **shall** publicly report the information listed in table 14.1. Reporting removals is optional, but if removals are reported, then all reporting requirements in table 14.1 must be followed.

For public reporting, companies may produce a single report that contains all the required reporting information in this section (as well as all relevant optional reporting information in section 14.2). Alternatively, companies may produce a summary of the public report and a full public report that contains all the required information, with a link or reference in the summary report to the publicly available full report where all the information is available.

Table 14.1 Reporting requirements in this Guidance

Topic	Reporting Requirements
Inventory Boundary (Chapter 5)	• An outline of the organizational boundaries chosen, including the chosen consolidation approach • Scopes, scope 3 categories, gases, sources, and sinks included in the GHG inventory • Any scopes, scope 3 categories, accounting categories, gases, sources or sinks excluded from the GHG inventory, with justification for their exclusion • The reporting period covered
Greenhouse Gas Emissions (Cross-cutting)	• Scope 1 emissions, disaggregated by land emissions (*Land use change emissions*, *Land management net CO_2 emissions*, and *Land management non-CO_2 emissions*) and non-land emissions (including stationary combustion, mobile combustion, fugitive, and process emissions), with biogenic CO_2 emissions separately reported from non-biogenic emissions • Scope 2 emissions, disaggregated by land emissions (*Land use change emissions*, *Land management net CO_2 emissions*, and *Land management non-CO_2 emissions*) and non-land emissions (including stationary combustion, mobile combustion,

	fugitive, and process emissions), with biogenic CO_2 emissions separately reported from non-biogenic emissions
	• Scope 3 emissions, disaggregated by scope 3 category, and disaggregated by land emissions (*Land use change emissions*, *Land management net CO_2 emissions*, and *Land management non-CO_2 emissions*) and non-land emissions (including stationary combustion, mobile combustion, fugitive, and process emissions), with biogenic CO_2 emissions separately reported from non-biogenic emissions
	• Scope 1 and scope 2 emissions data separately by individual GHG (CO_2, CH_4, N_2O, HFCs, PFCs, SF_6, NF_3) in metric tonnes and in tonnes of CO_2 equivalent.
	• For each scope 3 category, total emissions of GHGs (CO_2, CH_4, N_2O, HFCs, PFCs, SF_6, NF_3), reported in metric tonnes of CO_2 equivalent
	• Net emissions of biogenic or TCDR CO_2 stored in geologic carbon pools, if removals from geologic carbon pools are reported, by scope and scope 3 category
	• Net emissions of biogenic or TCDR CO_2 stored in product carbon pools, if removals from product carbon pools are reported, by scope 3 category
	• The following gross emissions, separately reported from and not aggregated with net emissions categories:
	  ○ *Gross biogenic product CO_2 emissions* (e.g., from combustion), disaggregated by scope and scope 3 category to differentiate direct and indirect emissions
	  ○ *Gross TCDR-based product CO_2 emissions*, if applicable, disaggregated by scope and scope 3 category to differentiate direct and indirect emissions
	  ○ *Gross CO_2 emissions from geologic storage*, if applicable, disaggregated by scope and scope 3 category to differentiate direct and indirect emissions
	• For each scope, scope 3 category, and gross emissions category: a description of the methodologies, allocation methods, and assumptions used to calculate emissions, a description of the types and sources of data (activity data, emission factors and GWP values) used to calculate emissions, and a description of the data quality of reported emissions data
	• For each scope 3 category, the percentage of emissions calculated using data obtained from suppliers or other value chain partners
	• If companies use the recycled content allocation method for post-consumer waste that is recycled or reused, evidence that the waste is post-consumer and that the waste has been reused or recycled

Removals (if reported) (Chapter 6)	Reporting CO_2 removals in a GHG inventory is optional. Removals may only be reported if the requirements for reporting removals in chapter 6 are met. If companies include scope 1 removals in the GHG inventory, companies **shall** report: • Scope 1 removals, separately from emissions, and disaggregated by *Land management net removals* and *Net removals with geologic storage*, with separate reporting of biogenic removals and technological removals, if relevant • Methods, data sources, and assumptions used to calculate scope 1 removals • Systems and procedures for long-term monitoring of carbon pools owned/controlled by the reporting company corresponding to reported scope 1 removals • Information on traceability systems in place to meet physical traceability requirements

	• A description of the types and sources of data, including activity data and emission factors, used to calculate scope 1 removals, and a description of the data quality of reported removals data • The uncertainty range associated with reported scope 1 removals, with justification for how reported removals use conservative assumptions and values. • Reversals of previously reported scope 1 removals (occurring in the reporting year), reported separately, and disaggregated by reversals from land-based storage and reversals from geologic storage If companies include scope 3 removals in the GHG inventory, companies **shall** report: • Scope 3 removals, separately from emissions, and disaggregated by *Land management net removals*, *Net removals with geologic storage*, and *Net removals with product storage (subject to open question #2, chapter 6, box 6.3)*, with separate reporting of biogenic removals and technological removals, if relevant • Methods, data sources, and assumptions used to calculate scope 3 removals • Systems and procedures for long-term monitoring of carbon pools owned/controlled by the relevant entities in the value chain corresponding to reported scope 3 removals • Information on traceability systems in place to meet physical traceability requirements • A description of the types and sources of data, including activity data and emission factors, used to calculate scope 3 removals, and a description of the data quality of reported removals data • The uncertainty range associated with reported scope 3 removals, with justification for how reported removals use conservative assumptions and values. • Reversals of previously reported scope 3 removals (occurring in the reporting year), by scope 3 category, reported separately, and disaggregated by reversals from land-based storage, reversals from geologic storage, and reversals from product storage (*subject to open question #2, chapter 6, box 6.3*)
Land Use Change and Land Tracking (Chapter 7)	• Scope 1 land tracking metric(s) (*Indirect land use change emissions*, *Carbon opportunity costs*, and/or *Land occupation*) • Scope 2 land tracking metric(s) (*Indirect land use change emissions*, *Carbon opportunity costs*, and/or *Land occupation*) • Scope 3 land tracking metric(s) (*Indirect land use change emissions*, *Carbon opportunity costs*, and/or *Land occupation*) • Whether direct land use change (dLUC) or statistical land use change (sLUC) was used to account for scope 1, scope 2, and scope 3 *Land use change emissions*, with justification for the approach used • Whether the shared responsibility approach or product expansion approach was used to calculate sLUC emissions, with justification for the approach used • The land use change assessment period and approach used to distribute emissions across the assessment period (linear discounting approach or equal discounting approach), with justification for the approach used • Data sources, methods, and assumptions used to quantify *Land use change emissions* • Data sources, methods, and assumptions used to quantify selected land tracking metric(s) • Allocation method(s) used for *Land use change emissions*

	• If companies use certification or chain-of-custody programs, the type of certification programs or chain-of-custody models used
Land Management (Chapter 8)	• Approach(es) used to account for anthropogenic emissions and removals due to land management, with justification • If companies choose to separate managed from unmanaged, a description of the definitions and criteria used to distinguish managed and unmanaged lands • Which land uses and carbon pools are included in their analysis of net carbon stock changes, including where they assume no carbon stock changes for a particular carbon pool and land use • Data sources, quantification methods, and assumptions used • Spatial scale and level of traceability of data used, by product type (e.g., harvested area, land management unit, sourcing region, jurisdiction, global) and the attributable managed lands included in the spatial boundary used to evaluate net carbon stock changes • Monitoring approach and frequency used to estimate *Land management net* CO_2 *emissions or removals* for each relevant land use and/or activity in scope 1 or scope 3 • Primary data sampling method(s) used, if applicable • Uncertainties of the results, quantitatively (with methodology) or qualitatively (description) • Allocation method(s) used for land management emissions and removals
Product Carbon Pools (Chapter 9) *(subject to open question #2, chapter 6, box 6.3)*	• *Net removals with product storage*, if separately reported from the scopes *(subject to open question #2, chapter 6, box 6.3)* • *Net removals with product storage*, separately reported by scope 3, category 11 (Use of sold products) from scope 3, category 12 (End-of-life treatment of sold products) *(subject to open question #2, chapter 6, box 6.3)*, with separate reporting of biogenic removals and technological removals, if applicable • Methods, data sources, and assumptions used to calculate *Net* CO_2 *emissions from product storage* or *Net removals with product storage*, if applicable • Methods, data sources, and assumptions used to calculate *Gross biogenic product* CO_2 *emissions* and *Gross TCDR-based product* CO_2 *emissions*, if applicable • If applicable, the uncertainty range associated with reported *Net removals with product storage*, based on a specified confidence level, and justification for how the estimated removals use conservative assumptions and values
Geologic Carbon Pools (Chapter 10)	• Any CO_2 or other carbon losses from the geologic reservoir • Net amount of CO_2 (in metric tons) at each custody transfer, where the net amount is the difference between CO_2 inputs and outputs, corrected by any changes in composition of the CO_2 stream, if applicable • The monitoring plan for ongoing storage monitoring of the geologic reservoir, including methods, data, and assumptions • If applicable, description of contractual arrangements that specify which single entity accounts for removals as scope 1, including information on allocation of CO_2 related risks and obligations and avoidance of double counting of scope 1 removals between all entities in the geologic removal and storage value chain • Methods, data sources, and assumptions used to calculate *Net* CO_2 *emissions from geologic storage* or *Net removals with geologic storage*, if applicable

	• Methods, data sources, and assumptions used to calculate *Gross CO_2 emissions from geologic storage* • If applicable, the uncertainty range associated with reported *Net removals with geologic storage*, based on a specified confidence level, and justification for how the estimated removals use conservative assumptions and values
Impact of Actions (Chapter 11)	• For any actions implemented by the reporting company expected to have a potentially significant negative impact (i.e., that increase GHG emissions and/or decrease removals) outside the scope 1, 2 and 3 boundary: the estimated impacts on GHG emissions and removals resulting from the actions using intervention accounting methods (including land tracking metric[s] in chapter 7), reported separately from the scopes • Methods, assumptions, assessment boundary, time period, and data sources used to calculate impacts

Target Setting and Tracking Progress
 	
(Chapter 12)
	Information about base year/period:
	
	• Selected base year or period and the rationale for choosing the base year or period
	• Emissions profile over time (for all scopes and scope 3 categories) that is consistent with the base year emissions recalculations policy
	• Base year recalculation policy, including the significance threshold that triggers base year recalculations
	• Any recalculations of base year/period levels, including the rationale for recalculation and which assumptions and values were changed with a comparison of updated values with original values
	• Appropriate context for any significant emissions changes that triggered base year emissions recalculation (acquisitions/divestitures, outsourcing/insourcing, changes in reporting boundaries or calculation methodologies, etc.)
	
	Companies with GHG targets **shall** report the following information, by target type as relevant:
	
	• Information about GHG emissions targets
	    ○ Target boundary
	    ○ Target type
	    ○ Target base year/period, with justification
	    ○ Target year(s) and whether the target is a single-year or multi-year target
	    ○ Target level
	    ○ Progress in reaching target
	• Information about removal targets
	    ○ Whether scope 1 and/or scope 3 removals are included in the target boundary
	    ○ Types of removals included in the target boundary (removals with land-based, geologic, or product storage *(subject to open question #2, chapter 6, box 6.3)*; and biogenic or technological removals), including eligibility requirements
	    ○ Target type
	    ○ Target base year/period, with justification
	    ○ Target year(s) and whether the target is a single-year or multi-year target
	    ○ Approach for accounting for reversals of previously reported removals
	    ○ Target level

- Progress in reaching target
- Information about net targets that include emissions and removals
    - Target boundary, including which greenhouse gases and scopes of emissions are included (scope 1, scope 2, scope 3, and which scope 3 categories), which scopes of removals are included (scope 1 and/or scope 3), and what types of removals are included (removals with land-based, geologic, or product storage *(subject to open question #2, chapter 6, box 6.3)*; and biogenic or technological removals), with justification for their inclusion, and eligibility requirements and limits on the quantity or type of removals allowed in the net targets
    - Target type
    - Target base year/period, with justification
    - Target year(s) and whether the target is a single-year or multi-year target
    - Approach for accounting for reversals of previously reported removals
    - Target level
    - Progress in reaching target
- Information about land tracking targets
    - Selected land tracking metric(s)
    - Target boundary
    - Target type (absolute or intensity)
    - Target base year/period, with justification
    - Target year(s) and whether the target is a single-year or multi-year target
    - Target level
    - Progress in reaching target
- Information about targets for gross emissions and gross removals
    - Target metric(s) (*Gross biogenic product CO_2 emissions* (e.g., from combustion), *Gross biogenic land CO_2 emissions*, *Gross biogenic land CO_2 removals*, *Gross technological CO_2 removals*, *Gross TCDR-based product CO_2 emissions*, or *Gross CO_2 emissions from geologic storage*)
    - Target boundary
    - Target type
    - Target base year/period, with justification
    - Target year(s) and whether the target is a single-year or multi-year target
    - Target level
    - Progress in reaching target
- Information about temporary carbon storage targets
    - Carbon pool(s) (land, product, or geologic)
    - Target boundary
    - Target type
    - Target base year/period, with justification
    - Target year(s) and whether the target is a single-year or multi-year target
    - Target level
    - Quantity of carbon storage and expected length of storage
    - Methods, data, and assumptions used to quantify temporary carbon storage
    - Progress in reaching target
- Information about external compensation or contribution targets
    - Target boundary
    - Target base year/period, target year(s), and whether the target is a single-year or multi-year target
    - Target level

	○ Types of financing or credits used ○ Methods, data, and assumptions used ○ Progress in reaching compensation or contribution target, separately from emissions and removals within the inventory boundary ○ See required reporting under chapter 13
Credits (If applicable) (Chapter 13)	• Scope 1 emissions, independent of any transactions • Scope 2 emissions, independent of any transactions • Scope 3 emissions, independent of any transactions • Scope 1 removals, independent of any transactions, if applicable • Scope 3 removals, independent of any transactions, if applicable • Scope 1 emissions adjusted for sold credits, if applicable • Scope 2 emissions adjusted for sold credits, if applicable • Scope 3 emissions adjusted for sold credits, if applicable • Scope 1 removals adjusted for sold credits, if applicable • Scope 3 removals adjusted for sold credits, if applicable • Emission reductions or removals from sources or sinks inside the inventory boundary that have been sold/transferred as offsets to a third party, if applicable • GHG credits or other instruments purchased and retired, if applicable, reported separately from the scopes • Credits used against compensation targets, if applicable, separately from credits used against contribution/financing targets, if applicable • Credits separately reported by emission reduction credits, removal credits, or a combination, if relevant • Offset/credit quality criteria followed, GHG crediting program and protocols/methodologies used, scale (jurisdictional or project), and other information as relevant • Vintages and serial numbers of credits purchased/sold/retired • Non-permanence risks associated with removals and mechanisms followed to address permanence • Type of credited removal activity(ies), if applicable • Social and environmental co-benefits of credits, if relevant
Assurance (Chapter 15)	• Whether third-party assurance was performed • The relevant competencies of the assurance provider(s) • The opinion issued by the assurance provider

14.2 Optional reporting information

Companies **should** report the information in table 14.2 if relevant and applicable to the reporting company.

Table 14.2 Optional reporting information in this Guidance

Chapter/topic	Optional reporting information
Greenhouse Gas Emissions (Cross-cutting)	• Non-land emissions, separately reported by stationary combustion, mobile combustion, process, and fugitive emissions, by scope and scope 3 category • Land use change emissions and land management emissions, separately reported by product category

	• The following gross emissions, separately reported from and not aggregated with net emissions categories: ○ *Gross biogenic land CO_2 emissions* (e.g., from fires, other disturbances, and soil respiration), disaggregated by scope and scope 3 category to differentiate direct and indirect emissions • If relevant, CO_2 emissions from ocean-based or freshwater-based carbon pools, separately reported • Emissions data further subdivided where this adds relevance and transparency (e.g., by business unit, facility, country, source type, activity type, etc.) • Emissions data further disaggregated within scope 3 categories where this adds relevance and transparency (e.g., reporting by different types of purchased materials within category 1, or different types of sold products within category 11) • Emissions from scope 3 activities not included in the list of scope 3 categories (e.g., transportation of attendees to conferences/events), reported separately (e.g., in an "other" scope 3 category) • Scope 3 emissions of GHGs reported in metric tons of each individual gas • Emissions of any GHGs other than CO_2, CH_4, N_2O, HFCs, PFCs, SF_6, NF_3 whose 100-year GWP values have been identified by the IPCC to the extent they are emitted in the company's operations or value chain (e.g., CFCs, HCFCs, NO_X, etc.) and a list of any additional GHGs included in the inventory • Historic scope 3 emissions that have previously occurred, reported separately from future scope 3 emissions expected to occur as a result of the reporting company's activities in the reporting year (e.g., from Waste generated in operations, Use of sold products, End-of-life treatment of sold products) • Qualitative information about emission sources not quantified • Quantitative assessments of data quality • Information on uncertainty of emissions reported in the GHG inventory (e.g., information on the causes and magnitude of uncertainties in emission estimates) and an outline of policies in place to improve inventory quality

Removals
(Chapter 6)
	• *Land management net removals*, separately reported by product category
	• *Net removals with product storage*, separately reported by product category *(subject to open question #2, chapter 6, box 6.3)*
	• The following gross removals, separately reported from and not aggregated with net removal categories:
	  ○ *Gross biogenic land CO_2 removals*, disaggregated by scope and scope 3 category to differentiate direct and indirect emissions
	  ○ *Gross technological CO_2 removals*, disaggregated by scope and scope 3 category to differentiate direct and indirect emissions
	• For scope 1 removals, information on the expected duration of carbon storage (expected length of time the removals are expected to remain stored in carbon pools)
	• For scope 3 removals, information on the expected duration of carbon storage (expected length of time the removals are expected to remain stored in carbon pools)
	• Total carbon stock or CO_2 stored in carbon pools, separately by carbon pool category and separately from the scopes, in the reporting year, in the base year/period, and in all years between the base year/period and the reporting year

	for which carbon stocks are measured (to provide additional transparency over time on reported net changes in carbon stocks) • If relevant, non-CO_2 GHG removals, reported separately • If relevant, CO_2 removals stored in ocean-based or freshwater-based carbon pools, separately reported
GHG Impact of Actions (Chapter 11)	• If companies implement actions that are expected to have a potentially significant positive impact (i.e., that decrease GHG emissions and/or increase removals) outside the scope 1, 2 and 3 boundary: the estimated impacts on GHG emissions and removals resulting from the action using intervention accounting methods (including land tracking metric[s] in chapter 7), reported separately from the scopes • Methods, assumptions, assessment boundary, time period, and data sources used to calculate impacts
Additional information (Cross-cutting)	• Relevant performance indicators and intensity ratios • Information on the company's GHG management and reduction activities, including reduction targets, supplier engagement strategies, product GHG reduction initiatives, etc. • Information on supplier/partner engagement and performance • Information on product performance • A description of performance measured against internal and external benchmarks • Information on any contractual provisions addressing GHG-related risks or obligations • Information on the causes of emissions changes that did not trigger a base year emissions recalculation • GHG emissions data for all years between the base year and the reporting year (including details of and reasons for recalculations, if appropriate) • Additional explanations to provide context to the data

15

Assurance

Chapter 15: Assurance

Guidance

Assurance is recommended for all companies and may be required by GHG programs. Assurance provides a level of confidence that the GHG inventory is complete, accurate, consistent, transparent, relevant, and without material misstatements. The assurance process also checks that removals reported in the GHG inventory follow the principles of conservativeness and permanence defined in chapter 3. The outcome is invaluable to reporting companies and its stakeholders so they can make decisions based on the inventory results.

Companies should use the guidance provided in this chapter, along with chapter 10 of the Corporate Standard and chapter 10 of the Scope 3 Standard. Together, they inform the selection and implementation of an appropriate assurance or verification standard (e.g., ISO 14064-3).

Sections in this chapter

Section	Description
15.1	Benefits of assurance
15.2	Competencies of assurers
15.3	Assurance process

15.1 Benefits of assurance

The process of assuring the land and removals aspect of an inventory can be complex in comparison with other sectors. The land sector presents data and traceability challenges, higher levels of uncertainty, and the need to ensure permanence and conservative estimates for removals. There are many interacting issues and uncertainties that may rely upon estimating past and future events, when expanding the requirements and guidance in the *Corporate Standard* and *Scope 3 Standard*.

The complexity, physical uncertainty and rapidly developing technical knowledge and land management options heightens the need for collaborative decision-making across value-chains that assurance supports.

Third party assurance to this Guidance offers tangible benefits to the company and its stakeholders, such as:

- Increased confidence in data and conformity to accounting standards which helps de-risk external or internal reporting of complex information and management plans (e.g., farm data collection, product re-design strategies or soil monitoring processes).
- Meets the needs of GHG reporting and target-setting programs by verifying that reduction and removal estimates and monitoring and reporting processes are adequate.
- Supports more effective collaboration and consistency within supply chains and across sectors by ensuring common and independent interpretation of standards.
- Provides feedback and recommendations linked to possible weaknesses in observed internal accounting, modelling or reporting practices (e.g., data collection, calculation, and internal reporting systems).
- Provides increased transparency in supply chains which can highlight risks or opportunities in supply chain relationships and contracts for ongoing removals and storage.

- A third-party verifier offers privacy and builds trust when dealing with commercially sensitive information within supply chains (e.g., to support supplier data privacy when reporting to downstream partners).
- Improved efficiency in subsequent inventory update processes and ongoing monitoring of carbon pools.
- Third party verifiers have broad experience of interpreting standards and applying them independently and consistently in different circumstances.

15.2 Competencies of assurers

Table 15.1 includes a list of competencies that may be required for the assurance of GHG inventories with the *Land Sector and Removals Guidance.*

Table 15.1 Assurer competencies, in addition to those defined in the selected assurance or verification standard

Competency type	Inventory-specific assurance knowledge
Expertise and experience with verification of data and models	• Verification of historical, existing, data records relating to land-use and removal GHG inventories • Verification that models and assumptions fairly reflect the inventory • Verification that data management or monitoring systems address the needs of the inventory scope
Expertise and experience with removals-based accounting	• Biogenic removals • Technological removals • Removals with land-based storage • Removals with product storage • Removals with geologic storage
Expertise and experience with carbon-accounting standards and frameworks	• Corporate greenhouse gas accounting standards (e.g., GHG Protocol *Corporate Standard*, GHG Protocol *Scope 3 Standard*) • Product life cycle accounting standards (e.g., GHG Protocol *Product Standard*) • Voluntary Carbon Markets • Corporate target setting frameworks (e.g., SBTi, Net-zero)
Site visits	• Land-based removals and storage – agriculture • Land-based removals and storage – forestry • Technological removals and storage – industrial facilities • Technological removals and storage – geologic reservoirs
Related land-based sustainability issues, regulations, and certification programs	• Local pollution • Watershed dynamics • Legal requirements • Land rights/ownership • Biodiversity impacts • Certification programs (e.g., AFI, RSB, FSC, SFI)

Temporal issues with carbon storage	• Land-based issues of permanence • Carbon storage in products • Current and future carbon storage and monitoring technology
Contracts	• Ownership claims and allocation of accounted removals • Liability for ongoing storage monitoring • Ownership claims of carbon storage (land or technological)

15.3 Assurance process

Table 15.2 provides a general overview of the steps involved in the assurance process for GHG inventories that include land sector activities or and removals.

Table 15.2 General overview of the assurance process

Assurance process	Assurance activities required
1. Planning and scoping	• Planning and scoping considers the level of assurance, determination of risks, site visits and competency requirements and according to reporting and disclosure aims • Determine the level of assurance and the intended use of the GHG inventory, where reasonable assurance is recommended for target setting and monitoring • Identify the relationships between parties in the assurance process • Identify sink and storage processes (removals) within scope 1 and scope 3 • Verify the geographical scope of sink and storage processes included in the inventory
2. Perform the assurance processes	• The assurance process includes gathering evidence, performing analytics, evaluating the inventory methods and data quality, etc. • Verification of historical data and the suitable use of data, calculations and assumptions regarding planned storage and any other expectations about the future • Recording of verification findings
3. Evaluate verification results and report conclusions	• Evaluation of verification findings should follow the process determined by the assurer and the selected verification standard. • Verification reporting should follow the process determined by the assurer and the selected verification standard. • Assurers should provide an assurance statement

15.3.1 Planning and scoping

The planning and scoping phase of the assurance process considers the level of assurance, determination of risks according to the company's reporting and disclosure aims, relationship of parties in the assurance process, identification of the scope and geography of sources, sinks and storage processes, need to perform site visits and competency requirements for assurers. The detailed process, need for site visits and level of assurance opinion may vary according to the purpose of the inventory and scope of information being reviewed.

Level of assurance

The assurance process may apply varying degrees of rigor to provide a reasonable or limited assurance opinion, as shown in table 15.3. As the *Scope 3 Standard* states in section 10.4, it is not possible to provide absolute assurance.

Table 15.3 Limited and reasonable assurance opinions

Assurance opinion	Nature of opinion	Example wording of opinion
Limited assurance	Negative opinion	"Based on our review, we are not aware of any material modifications that should be made to the company's assertion that their greenhouse gas inventory is in conformance with the *Land Sector and Removal Guidance*."
Reasonable assurance	Positive opinion	"In our opinion the reporting company's assertion of their greenhouse gas inventory is fairly stated, in all material respects, and is in conformance with the *Land Sector and Removal Guidance*."

The company and assurance provider should determine the level of assurance to be applied during the planning and scoping phase of assurance. Assurance levels are classified as either limited or reasonable (see table 15.3) and must be appropriate to the purpose of the inventory, initial misstatement risk assessment and requirements of any associate program. For example, it is not appropriate to provide only a limited level of assurance if a program includes removals in the context of a net GHG target. In such cases, reasonable assurance is recommended.

Determining assurance risk factors

Some factors which may determine the complexity of assurance and risk of misstatement are listed in table 15.4. Examples of misstatements include the following:

- Omission of information
- Incorrect data
- Misapplication of methodology required by the inventory standard or this guidance

Table 15.4 Assurance risk factors

Types of complexity and risk factor	Examples
Extent and complexity of historical data	• Range of different historical land use and management issues (e.g., number of countries) • Historical land ownership
Extent and complexity of current or past land use	• Current and historical land use patterns and applicable boundaries • Contractual arrangements and claims to upstream removals

Storage technology uncertainties	• Carbon removal, capture, and storage operations (e.g., energy use, equipment performance, calibration records) • Current and future storage operations (e.g., structural design, equipment performance, calibration records)
Assumptions and modelling	• Assumptions and modelling regarding sold products • Assumptions about future land use and ownership • Assumptions, modelling and/or contractual arrangements for future storage (land and technological)

There is potential for existing certification schemes or government regulations to already include verification of some relevant information. For example, supply chain traceability, land ownership or existing land management practices which relate to removals. The use of food production sustainability certification programs or related government regulations may therefore support the assurance process, by providing pre-verified, re-usable information.

The following list of principles can be applied when assessing the reporting company's and value chain partners' conformity with regulations, or information provided by certification programs:

- Existence of qualitative or quantitative data on historical land use change and whether there is enforcement of a date from which no (further) land use change is allowed.
- Collection of qualitative or quantitative data on forest and soil management activities.
- Approach of the certification program to third party verification and whether key requirements regarding GHG data are voluntary or mandatory.
- Approach to supply chain traceability or chain-of-custody models if applicable (e.g., identify preserved, segregated, mass balance, or book and claim supply chain models).
- Basis for calculation methodology (if any) and consistency with greenhouse gas accounting principles.

Relationships of parties in the assurance process

There are many roles, or parties, that may be involved in implementing this guidance – either within the reporting company or among its suppliers and customers, such as:

- Land managers with access to land management operations, ownership and contract information.
- Sustainability and energy management teams compiling and managing reporting data.
- Supply chain managers know suppliers and the specific relationships through which key data will be available.
- Legal representatives managing supplier contracts, which are particularly important when allocating removals and dealing with monitoring processes with long-term lifespans.
- Communication and marketing teams who need to translate complex inventories into straightforward, accurate external messages.
- Service providers (such as those implementing carbon removal or land management activities) whose operations and/or contracts may be subject to the assurance process (e.g., to verify suitable allocation of removals).
- Senior management responsible for company targets and sustainability investments.
- External stakeholders affected by land management choices (other land managers in a shared watershed, NGOs monitoring biodiversity etc.).

A useful output of determining these relationships may be a clear understanding of the structure of the organization creating the inventory. This information will be necessary for the next scoping stage.

Identifying scope and geography of sources, sinks and storage processes

Once the structure of the inventory's organization and its value chain relationships are understood, it is necessary to identify which sources, sinks and carbon pools are within the reporting company's scope 1 or scope 3 and where, physically, they are.

Subsequently, verify that all sinks and storage processes comprising removals have been included in the inventory and correctly defined as scope 1 or scope 3. The geographical location is important information to ensure suitable monitoring programs exist and any assumptions or modelling are appropriate.

15.3.2 Performing the assurance processes

Assurance against the *Land Sector and Removals Guidance* has requirements for both backward- and forward-looking content in a GHG inventory. Assurance of GHG inventories associated with the land sector and CO_2 removals include the verification of historical data to ensure that models of future expectations are correct and use appropriate methodologies.[1] For example, future expectations associated with ongoing monitoring of land-based, product or geologic carbon storage, or cradle-to-grave product life cycle assessment (LCA). Assurance therefore follows the scope of ISO 14064 standards[2].

The assurance process should assess:

- Historical data describing the inventory year
- Records pertaining to historical land use or ownership
- Conformity of methods used by any modelling of past or future emissions or removals
- Changes to any previous inventory being compared against

Chapter 10 of the *Scope 3 Standard* lists a range of key assurance concepts to consider when conducting the assurance process that also apply to the use of the *Land Sector and Removals Guidance*. GHG inventories with land sector impacts and CO_2 removals raise additional challenges to the assurance process which are outlined in table 15.5.

Table 15.5 Assurance challenges for GHG inventories with land sector impacts and CO_2 removals

Assurance challenge	Description
Ongoing storage monitoring of carbon pools	Defining and applying criteria to validate the adequacy of the reporting company's ongoing storage monitoring and reporting systems for removals is a distinct activity not covered by this Guidance. It is instead sufficient to verify that carbon associated with previously reported removals is stored in carbon pools in the reporting year (i.e., by verifying annual carbon stock changes in relevant carbon pool) and that there is evidence the monitoring program is operating as intended.
Types of removal and storage	Assurers should possess sufficient knowledge of the biological, chemical, and business processes involved in generating and maintaining biogenic and technological removal and storage.

[1] Adapted from ISO 14064-3:2019

[2] See for example clauses 3.6, 6 and 7 in ISO 14064-3

Modelling	The verification process is extended to include the conformity of the approach taken to the prediction, uncertainty measurement and reporting of modelled future carbon stock changes.
Materiality	There should be an equal weight given to the materiality of removal magnitude covering both the removal itself and the risk of reversal. That is, the materiality of a removal should also take account of the reversal risk. For example, a large removal with low risk of reversal (e.g., physical storage of CO_2 as calcium carbonate in a geologic reservoir) is less material as a potential inventory misstatement than a large removal with a high level of reversal risk (e.g., new forest growth).
Land ownership	Land ownership at the time of the inventory, in the past, and expected ownership in the future offers challenges of transparency, legal documentation, multiple jurisdictions, and varying levels of control for the reporting company. Complexities arising from varying levels of control apply separately to land owned by the reporting company versus that owned by those in the value chain, who may also be supplying other companies. Attribution of removals or land use change may not be obvious. Indirect effects of land use or land use change by or upon the reporting company's value chain may also be important. The use of GIS tools and existing land-based certifications may support decision making.

In addition, it is often necessary to verify the appropriateness and quality of assumptions about the future (e.g., ongoing storage monitoring requirements for CO_2 removals etc.). These assumptions may include estimating the soil carbon impacts of land management changes, predicted long-term geologic carbon storage dynamics and end-of-life treatment of sold biogenic or technologically removed CO_2-based products.

The performance of review and corrective action processes that address data collection and ongoing storage monitoring for removals should also be verified in the context of the current inventory. These review and corrective action processes will be needed when the current inventory is compared against measurements made during previous or subsequent inventory assessments to ensure consistency, drive improved data quality, and verify continued integrity of removals.

If the guidance is applied to an inventory that is associated with a GHG program (e.g., Science Based Targets Initiative), the requirements and expectations of the GHG program should be taken into account during the assurance process.

15.3.3 Evaluating verification results and report conclusions

Assurers present their conclusions about the inventory results through an assurance statement. The assurance statement should indicate the following:

- the level of assurance
- how the level implemented by the assurer informed the assurance process
- the implications of the assurance statement for the use of the inventory results.

The statement may indicate separately the approach taken to data quality and the assurance of primary and secondary data.

GREENHOUSE GAS PROTOCOL

The Greenhouse Gas Protocol provides the foundation for sustainable climate strategies and more efficient, resilient and profitable organizations. GHG Protocol standards are the most widely used accounting tools to measure, manage and report greenhouse gas emissions.

DRAFT FOR PILOT TESTING AND REVIEW (SEPTEMBER 2022)