

CHAPTER 12.

CO₂ removal accounting

This chapter provides requirements companies must follow to account for and report CO₂ removals in a GHG inventory. Given the unique nature of CO₂ removals and the additional requirements companies must meet, reporting CO₂ removals in a GHG inventory is optional in this Standard.

12.1 Overview

A removal is the transfer of a GHG from the atmosphere to storage within a non-atmospheric pool. A sink is the process, activity, or mechanism by which the transfer occurs. There are two general types of sinks that remove CO₂ from the atmosphere:

- **Biological sink:** A biological process, primarily photosynthesis, that removes CO₂ from the atmosphere.
- **Technological sink:** A mechanical or chemical process that removes CO₂ from the atmosphere or captures biogenic CO₂ from a source and stores such CO₂ or TCDR-based carbon in non-atmospheric carbon pools.

The storage process is specific to the carbon pool(s) in which CO₂ removed from the atmosphere is stored. This *Standard* covers two categories of removals based on the type of storage:

- **Land management CO₂ removals**, stored in land carbon pools (Chapter 13)
- **Removals with geologic storage**, stored in geologic carbon pools (Chapter 14)



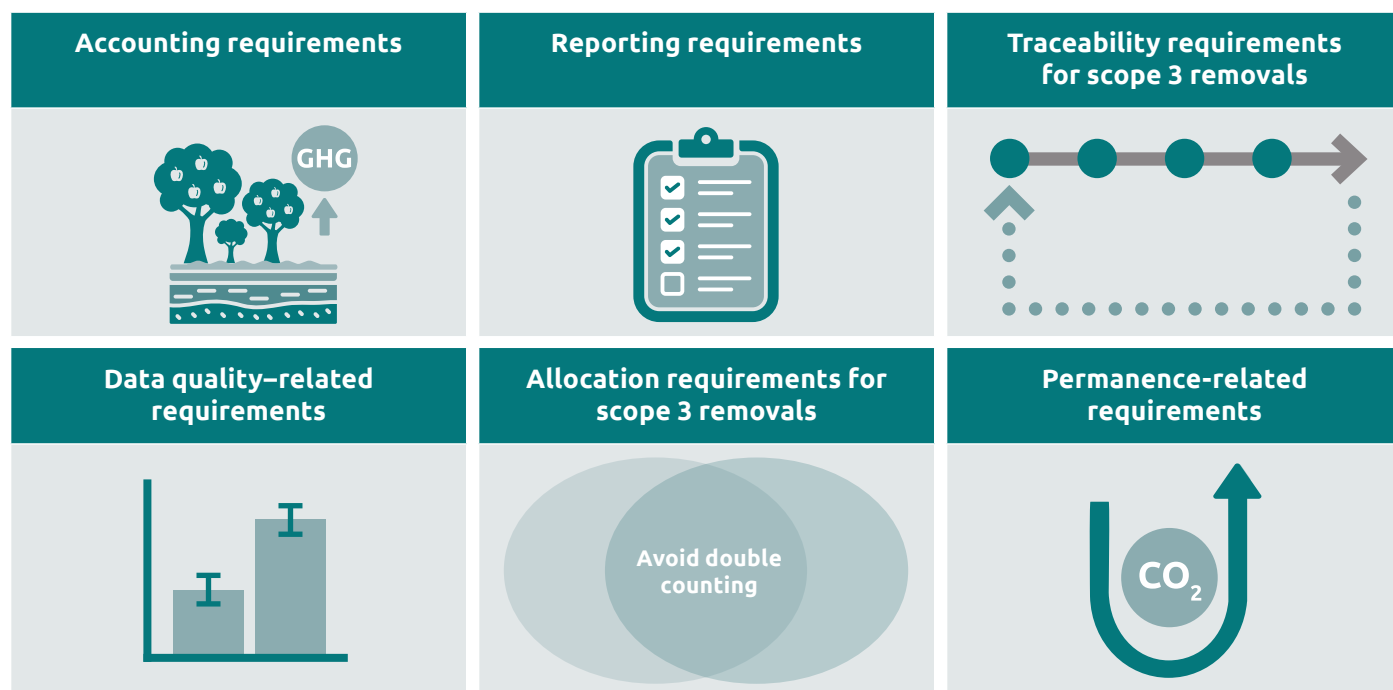
This *Standard* is based on a stock-change accounting approach that quantifies the net CO₂ flux between the atmosphere and non-atmospheric carbon pools. Throughout the text, the term “CO₂ removals” is used to describe *net* CO₂ removals. Gross CO₂ removals only reflect the *transfer* of CO₂ from the atmosphere, whereas net CO₂ removals reflect the transfer of CO₂ from the atmosphere with *continued storage* in non-atmospheric pools. Reporting gross CO₂ removals is optional for additional transparency under the “gross CO₂ fluxes” accounting category.

When CO₂ is removed from the atmosphere and continues to be stored in a non-atmospheric carbon pool, this contributes to reducing cumulative net CO₂ emissions in the atmosphere, which is most correlated with long-term warming.¹ If CO₂ is only temporarily stored, it does not reduce cumulative net CO₂ emissions or atmospheric CO₂ concentrations. Removals reported in a GHG inventory are therefore required to meet the permanence principle (see Table 3.1) and follow permanence-related requirements.

Reporting CO₂ removals is optional. If companies account for and report removals in their GHG inventory, they must meet the following requirements (Figure 12.1):

- Report on all emissions and account for removals based on annual or annualized carbon stock increases (Requirement 19)
- Have traceability throughout the full CO₂ removals pathway (Requirement 20)
- Have sufficient data quality (Requirement 21)
- Ensure the same scope 3 allocation methods are applied for removals to prevent double counting (Requirement 22)
- Meet the permanence principle by ensuring CO₂ removals reported in an inventory are monitored and any losses of stored carbon are accounted for and reported (Requirement 23)

Figure 12.1 Removals requirements



12.2 Requirements

12.2.1 Accounting requirements

REQUIREMENT 19:

Removals accounting

If companies account for and report removals in their GHG inventory, they **shall** meet the following general requirements:

- **Accounting approach:** Companies **shall** account for removals based on annual or annualized net carbon stock changes occurring in the reporting year using stock-change accounting methods.²
- **Life cycle GHG emissions:** Companies **shall** account for all life cycle GHG emissions and other metrics in the value chain of the removal pathway (across scope 1, scope 2, and scope 3).
- **Operational boundary:** Companies **shall** separately account for and report scope 1 and scope 3 removals for each scope 3 category, separate from scope 1 and scope 3 emissions.
- **Scope 3 removals:** Companies **shall** only account for scope 3 removals that are associated with scope 3 categories as defined in the *Scope 3 Standard*. For scope 3 categories associated with products, materials, or services that are purchased, processed, used, or sold by the reporting company, this only includes removals resulting from attributable processes in the life cycle of relevant products, materials, or services.
- **Removals by storage type:** Companies **shall** account for removals with land-based storage separately from removals with geologic storage.
- **Excluded GHG pools and gases:** If companies choose to account for removals with storage in ocean or freshwater carbon pools and/or non-CO₂ GHG removals, companies **shall** report these other categories separately from scope 1 and scope 3 removals in the physical GHG inventory. Product carbon storage is not reported as a removal.

See Requirement 19.LMR for more details on general removals requirements for land management CO₂ removals.

See Requirement 19.GS for more details on general removals requirements for geologic storage.



REQUIREMENT 20:

Scope 3 removals traceability

If companies account for and report scope 3 removals in their GHG inventory, they **shall** account for and report scope 3 removals only if the reporting company has traceability (following the interim traceability requirement, Requirement 8) throughout the full CO₂ removals and storage pathway, including to the sink (where CO₂ 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.

See Requirement 20.LMR for additional details on traceability for land management CO₂ removals.

See Requirement 20.GS for additional details on traceability for geologic storage.

REQUIREMENT 21:

Data quality for removals

If companies account for and report removals in their GHG inventory, they **shall** meet the following data quality requirements:

- **Data specific to sinks and pools:** Companies **shall** account for and report removals only if 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.²
- **Uncertainty:** Companies **shall** provide quantitative uncertainty estimates for removals, including the removal value, the confidence interval for the estimated removal value based on a specified confidence level, and justification of how the removal value does not overestimate removals.

See Requirement 21.LMR for additional details on data quality for land management CO₂ removals.

See Requirement 21.GS for additional details on data quality for geologic storage.

REQUIREMENT 22:

Scope 3 allocation for removals

If companies account for and report removals in their GHG inventory, they **shall** meet the following allocation requirements:

- **Avoid double counting:** If companies account for and report removals in their GHG inventory, they **shall** not double count scope 3 removals from the same LMU, sourcing region, or technological CO₂ removal operation with other companies at the same or similar tiers of the value chain that source from or sell to that land management system or operation.
- **No over-allocating removals:** The sum of the allocated removals from an LMU, sourcing region, or technological CO₂ removal operation **shall** not exceed 100 percent of the removals occurring in the LMU, sourcing region, or technological CO₂ removal operation in the reporting year.
 - This requirement **may** be achieved by ensuring the same allocation methods are applied in scope 3 accounting across companies, increasing data sharing and transparency across the value chain through third-party registries, obtaining a documented "right to report," establishing regulatory systems to avoid double counting, or a combination of these and other approaches.

For more details, see the "right to report" option in Chapter 13.

REQUIREMENT 23:

Permanence for removals

If companies account for and report removals in their GHG inventory, they **shall** adhere to the permanence principle by meeting the following requirements:

- **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 periodic monitoring plan, to demonstrate that the carbon remains stored or to detect losses of the stored carbon.
- **Losses of stored carbon:** Companies **shall** account for and report net carbon stock losses of previously reported removals in the year the losses occur, as either:
 - **Net CO₂ emissions**, if the carbon pools are within the inventory boundary in the reporting year; or
 - **Reversals**, if the carbon pools are no longer in the inventory boundary in the reporting year.

If companies lose the ability to monitor carbon stocks associated with previously reported removals or if the monitoring plan is not renewed, companies **shall** assume previously reported removals are emitted and report net CO₂ emissions or reversals. Emissions or reversals from losses of stored carbon **shall** be allocated using the same methods as used in previous inventories when the removals were reported.

See Requirement 23.LMR for additional details on permanence for land management CO₂ removals.

See Requirement 23.GS for additional details on permanence for geologic storage.

12.2.2 Reporting requirements

Reporting requirements for removals

If companies account for and report removals in their physical GHG inventory, they **shall** report:

- **Life cycle GHG emissions:** All life cycle GHG emissions and other metrics in the value chain of the removal pathway (across scope 1, scope 2, and scope 3) in the relevant “emissions” accounting category and subcategory.
 - This includes losses of stored carbon of previously reported removals that are still within the inventory boundary.
- **Removals by storage type:** Removals that meet the removals requirements, separately by storage pool.
 - CO₂ removals with storage in land-based carbon pools in the “land management CO₂ removals” accounting subcategory under “removals” in the physical GHG inventory.
 - CO₂ removals with storage in geologic carbon pools in the “removals with geologic storage” accounting subcategory under “removals” in the physical GHG inventory. Companies **should** disaggregate further by sink type into: “captured biogenic CO₂ with geologic storage” and “technological CO₂ removals with geologic storage”.
- **Reversals:** Net losses of stored carbon (occurring in the reporting year) of previously reported scope 1 and/or scope 3 removals (no longer in the inventory boundary), reported in the “reversals” accounting category separately from the physical GHG inventory and disaggregated by “reversals of land management CO₂ removals” and “reversals of CO₂ removals with geologic storage,” and if applicable, information regarding any reserve approach used.

Additionally, they **shall** disclose the following information in their GHG report:

- **Accounting approach:** Whether one year or a longer period was used to calculate the annual or annualized carbon stock change.
 - Monitoring approach and frequency used to estimate CO₂ removals for each relevant activity in scope 1 or scope 3.
- **Traceability:** Systems in place to establish physical traceability.
- **Uncertainty:** The confidence interval associated with reported scope 1 and/or scope 3 removals, based on a specified confidence level, methods used, and justification for how reported removals use conservative assumptions and values.
- **Avoidance of double counting:** How they avoided double counting of removals with other companies at similar tiers of the value chain in scope 3.
- **Monitoring plan:** Systems and procedures for long-term monitoring of carbon pools corresponding to reported scope 1 and/or scope 3 removals, including the length of the monitoring period and monitoring frequency.

See Section 13.2.2 for additional details on reporting requirements for land management CO₂ removals.

See Section 14.2.2 for additional details on reporting requirements for removals with geologic storage.

12.3 Recommendations and options

Accounting for gross CO₂ removals

If net removals are reported under the “removals” accounting category, gross removals **may** be separately reported as well in the “gross CO₂ fluxes” category, as:

- “Gross biogenic land CO₂ removals,” disaggregated by scope 1 and scope 3 gross removals for each scope 3 category
- “Gross technological CO₂ removals,” disaggregated by scope 1 and scope 3 gross removals for each scope 3 category

If gross removals are reported, companies **should** clearly distinguish net removals (reported under the “removals” accounting category) from gross removals (reported under the “gross CO₂ fluxes” category) and ensure that net and gross removals are not aggregated or double counted (see Requirement 31).

Data quality–related removals recommendations

Data specific to sinks and pools:

- If secondary data (e.g., industry average, regional average, or proxy data) are used to complement calculations using empirical data specific to the sinks and pools where carbon is stored, any secondary data used **should** be technologically, temporally, and geographically representative, as well as based on peer-reviewed scientific literature, government statistics, or reports published by international institutions confirming the estimated value and associated uncertainty over multiple studies.

Uncertainty:

- Companies **should** use sampling approaches that ensure statistically significant estimates of carbon stock changes.
- Companies **should** select conservative values from a confidence interval.
- Companies **should** document all causes of uncertainties that are likely to be addressed through a quantitative uncertainty analysis, such as 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. This includes documenting if some causes of uncertainties have not been included and the steps taken to reduce the uncertainty.

Refer to the Guidance (Chapter 6) for additional information on evaluating data quality and uncertainty.

Accurate estimation of removals in the first year they are reported

In the first year that removals from a given carbon pool (i.e., land or geologic reservoir) are reported in the inventory, companies **should** obtain measurements or calibrate models to ensure that estimates are representative of that carbon pool in the initial year.

Reporting recommendations

Companies **should** report:

- Information on the expected duration of carbon storage (expected length of time the removals are expected to remain stored in carbon pools) for scope 1 and scope 3 removals.
- Total carbon stock or CO₂ stored in carbon pools, separately reported by carbon pool category and separate from the physical GHG inventory, 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).

Options to help manage permanence

Monitoring periods: Companies **may** define a series of consecutive, sequential time intervals for ongoing monitoring to implement Requirement 23:

- This optional approach is a means of implementing the permanence requirements by dividing ongoing monitoring into discrete time periods, specified through monitoring plans that are renewed over time. Monitoring periods **shall** be consecutive and sequential, such that carbon is monitored across all years. For example, a company can implement a series of one-year, five-year, or ten-year monitoring periods that are renewed over time.
- The length of the monitoring period and monitoring frequency within that period **should** be based on the nature of the product (e.g., the rotation period of a crop rotation that produces multiple crops versus one year for an annual crop that is not part of a crop rotation system). *For land management CO₂ removals, see also "Sampling" in Requirement 21.LMR.*
- At the end of a monitoring period, a company **may** renew or implement a new monitoring period to ensure continued ongoing storage monitoring of the carbon pool, or stop monitoring the carbon pool and assume previously reported removals are emitted and report net CO₂ emissions or reversals from the carbon pool.

- Companies **should** align the monitoring period with the reserve accounting policy if the company pursues the reserve approach option (described below).
- Monitoring **should** occur in any year that a target is met to verify target achievement.

Collaborative monitoring approaches: For scope 3 removals accounting, ongoing storage monitoring **may** 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) to facilitate the exchange of monitoring information, standardize data, and increase efficiencies between all relevant companies and partners in the value chain.

Reserve approach: For target setting and tracking, companies **may** use a reserve approach (or “buffer pool”) as a risk management tool to help implement the requirement to account for losses of stored carbon on an annual basis, which **shall** be separately reported from the GHG inventory, when determining progress toward and achievement of removals targets. If used, companies **shall** develop and report a reserve accounting policy that recognizes the following:

- Removals included in the reserve account must meet the removals requirements.
- Removals included in the reserve account cannot be double counted with removals reported in the GHG inventory or with GHG credits.
- The annual contribution to the reserve account and any risk assessment used to inform the share of annual removals are specified.
- Removals in the reserve account can be drawn down in a given reporting year to counterbalance reversals of previously reported removals on an annual basis, including determining target progress/achievement, only if the reserve account remains positive.
- Removals in the reporting company’s reserve account are specific to that company and **may not** be pooled across companies (though such accounts may be managed by a third party).
- Any restrictions on which removals from the reserve account can be used to counterbalance reversals of previously reported removals are specified. Companies **should** include the following restrictions:
 - Time limits (e.g., only counterbalance reversals using removals that occurred within the previous five years of the reversal event)
 - Geographic limits (e.g., only counterbalance reversals using removals that occurred within the same sourcing region as the reversal)
 - Carbon storage limits (e.g., only counterbalance reversals using removals with similar types of carbon storage, such as using recent soil carbon removals to compensate for soil carbon reversals)

See Section 17.4.1 in the *Guidance* for additional details. Target-setting programs **may** provide additional guidance on how to implement a reserve approach.



12.4 Guidance on the requirements and recommendations

12.4.1 Guidance on the removals accounting requirements

Accounting approach

STOCK CHANGE ACCOUNTING FOR NET CO₂ REMOVALS

Reporting CO₂ removals is optional in this *Standard*. If a company chooses to account for and report removals, this *Standard* requires a stock change accounting approach, which quantifies net CO₂ removals based on annual net carbon stock increases within land-based and/or geologic carbon pools (see Section 3.4.4 for further discussion). The net carbon stock change can be estimated using either the Stock-Difference Method or the Gain-Loss Method. For equations and further discussion of the Stock-Difference and Gain-Loss Methods, see Section 9.5.3.1.

Because this *Standard* is based on a stock change accounting approach that quantifies the net CO₂ flux, throughout the text, the terms “CO₂ removals” or “removals” are used to describe net CO₂ removals. Gross CO₂ removals are recommended to be reported for additional transparency under the “gross CO₂ fluxes” accounting category.

FLOW ACCOUNTING FOR GROSS CO₂ REMOVALS

For transparency, this *Standard* also recommends reporting gross CO₂ removals fluxes separately in the “gross CO₂ fluxes” accounting category, based on a flow accounting approach. Gross CO₂ removals subcategories include “gross biogenic land CO₂ removals” and “gross technological CO₂ removals” (Table 12.1).

Flow accounting quantifies annual gross CO₂ removals based on the one-directional, gross CO₂ flux from the atmosphere to land-based or geologic carbon pools (see Table 3.5 for a summary of key differences between stock change and flow accounting approaches). Accounting for and reporting gross CO₂ fluxes can help to ensure complete accounting of net carbon stock changes and provide transparency as to the individual gross CO₂ fluxes that comprise net carbon stock changes. Gross CO₂ removals only reflect the transfer of CO₂ from the atmosphere, not CO₂ transferred from the atmosphere with continued storage.

Accounting for gross CO₂ removals is not subject to the removals accounting requirements set forth in Chapters 12, 13, and 14. However, the use of similar data, methods, and assumptions is recommended where possible. If a company chooses to account for gross CO₂ removals, these gross removals must be separately reported and must not be combined or aggregated with GHG emissions or net CO₂ removals in the physical GHG inventory.

Table 12.1 Optional gross CO₂ removals accounting subcategories

Accounting subcategory	Description	Examples
Gross biogenic land CO ₂ removals	Gross CO ₂ removals from atmospheric CO ₂ transferred via biological sinks to land-based carbon pools	Gross CO ₂ removals from photosynthesis in trees in a forest or plants on croplands
Gross technological CO ₂ removals	Gross CO ₂ removals from atmospheric CO ₂ transferred via technological sinks to technological carbon dioxide removal-based product carbon pools or geologic carbon pools	Gross CO ₂ removals from direct air carbon capture facilities

Complete emissions reporting

Companies must follow the requirements and guidance in the *Corporate Standard* and *Scope 3 Standard* to ensure that all relevant GHG emissions in the reporting company's operations and value chain are accounted for, including attributable processes associated with CO₂ removals. For land management CO₂ removals, this includes land emissions and fossil fuel and industrial emissions (see Chapters 7 and 10 for details) associated with the land carbon stock increases reported as land management CO₂ removals. For removals with geologic storage, attributable processes may include GHG emissions from CO₂ removal technologies, transportation of captured CO₂, storage and injection into geologic reservoirs, enhanced oil and gas recovery at the geologic storage reservoir, or other relevant processes and GHG emissions (see Chapter 14 for details).

Operational boundary

Companies must follow the requirements and guidance in the *Corporate Standard* to determine their operational boundary. Section 4.4.2 in this *Guidance* provides guidance on defining the operational boundary to account for scope 1 versus scope 3 removals, including examples in Tables 4.6 and 4.7.

Scope 3 removals

Companies can only account for scope 3 removals that are associated with a scope 3 category, as defined by the descriptions and boundaries for each scope 3 category in Table 5.4 of the *Scope 3 Standard*. The 15 scope 3 categories include:

- | | |
|---|---|
| 1. Purchased goods and services | 9. Downstream transportation and distribution |
| 2. Capital goods | 10. Processing of sold products |
| 3. Fuel- and energy-related activities | 11. Use of sold products |
| 4. Upstream transportation and distribution | 12. End-of-life treatment of sold products |
| 5. Waste generated in operations | 13. Downstream leased assets |
| 6. Business travel | 14. Franchises |
| 7. Employee commuting | 15. Investments |
| 8. Upstream leased assets | |

For example, a food services company that sources grains as an ingredient could account for scope 3 land management CO₂ removals associated with net soil carbon stock increases on the croplands producing the grain it sources, as this activity falls into the company's scope 3, category 1. However, that same food services company cannot account for scope 3 removals associated with direct air capture (DAC) projects with geologic storage, if such removals are not directly related to any scope 3 categories for that company (unless, e.g., that food services company were an investor in the DAC project). A company that purchases electricity or heat from a facility that captures biogenic CO₂ and stores it in geologic reservoirs could account for scope 3 removals with geologic storage in scope 3, category 3, as these removals are associated with the life cycle of energy purchased by the reporting company. However, that same company could not account for scope 3 removals from a soil carbon project it financially supports, unless the lands enrolled in the soil carbon project are related to another scope 3 category for that company. See Table A.2 in the Annex for examples of activities that fall within each scope 3 category.

For product-related scope 3 categories (i.e., scope 3 categories 1, 2, 3, 4, 5, 6, 7, 9, 10, 11, and 12), scope 3 removals must be attributable to processes in the lifecycle of the relevant material or product. Attributable processes are services, materials, and energy flows that become the product, make the product, and carry the product through its life cycle.

Storage pool

Removals are the transfer of a GHG from the atmosphere to storage within a non-atmospheric pool. In this *Standard*, removals accounting is based on the stock change accounting approach, outlined in Section 3.4.4, which focuses on the storage of carbon (removed from the atmosphere) in pools. Under this approach, CO₂ removals are synonymous with enhanced carbon storage in carbon pools (where the carbon is derived from atmospheric CO₂).

Removals result from sinks. A sink is a biological or technological process, activity, or mechanism that removes GHGs from the atmosphere (e.g., photosynthesis in plants or DAC equipment removing atmospheric CO₂). Removals are classified according to both the sink (which transfers CO₂ from the atmosphere to non-atmospheric pools) and the carbon pool where the removal is stored (which keeps CO₂ or carbon out of the atmosphere). Two general types of sinks remove CO₂ from the atmosphere: biological and technological. There are two general types of carbon storage processes recognized in this *Standard*: land-based and geologic storage. Storage processes are specific to the carbon pool(s) in which CO₂ removed from the atmosphere is stored. Table 12.2 provides a summary of the removals accounting subcategories in this *Standard*, by sink and storage types.

Only the CO₂ removed from the atmosphere that is ultimately stored in a carbon pool is accounted for as a removal.³ Similarly, only carbon stored in carbon pools that originated from atmospheric CO₂ in the reporting year (i.e., biogenic carbon or technologically removed carbon) is accounted for as a removal.

Table 12.2 Removals accounting subcategories

Accounting subcategory	Sink	Storage	Examples
Land management CO ₂ removals	Biological sink	Land-based carbon pools	Net carbon stock increases on cropland, including soil carbon stock increases; biochar applied to soils
Captured biogenic CO ₂ with geologic storage	Technological sinks	Geologic carbon pools	Bioenergy carbon capture and geologic storage (BECCS)
Technological CO ₂ removals with geologic storage			Direct air carbon capture and geologic storage (DACCS)

Excluded GHG pools and gases

This *Standard* only provides requirements and recommendations on accounting for CO₂ removals and carbon pools. However, there is potential for the removal of other GHGs from the atmosphere. Box 3.1 briefly highlights the current potential for other non-CO₂ GHG removals. Any non-CO₂ GHG removals must be accounted for and reported separately from removals (i.e., CO₂ removals) in the physical GHG inventory.

Ocean-based and freshwater-based carbon storage is not addressed in this *Standard* and must be accounted for and reported separately from removals reported in the physical GHG inventory (i.e., land management CO₂ removals and removals with geologic storage). Accounting for product-based storage is addressed in Chapter 15 and is accounted for in the "product carbon storage" accounting category, separately from removals and outside the physical GHG inventory.



12.4.2 Traceability for removals accounting

To satisfy Requirement 20, companies accounting for and reporting CO₂ removals must establish traceability throughout the full CO₂ removals pathways to the specific sinks and carbon pools in their operations or value chain where carbon removed from the atmosphere is stored. Traceability refers to the ability of a reporting company to identify and track activities and information about those activities across the company's value chain, both upstream and downstream of its own operations (for further discussion of traceability, see Section 5.4.2).

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 the pools where carbon is stored). See Section 4.4.2 for further guidance on defining scope 1 versus scope 3 removals. Section 14.4.1.4 provides additional guidance on setting the operational boundary and determining ownership and control of geologic storage when accounting for technological CO₂ removals with geologic storage.

For scope 3 removals, companies must establish physical traceability throughout the full CO₂ removals pathways, including to the sink (where CO₂ 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, following the "interim traceability requirement" (Requirement 8). Companies demonstrate physical traceability through traceability systems that apply certain chain of custody models set forth in Requirement 8. 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 to implement such chain of custody models (e.g., through third-party certification programs). Relevant information to implement a chain of custody model may include tracked volumes of products at different points of mixing, allocation approaches used, and reconciliation periods defined for mass balance chain of custody programs.

Establishing traceability to specific sinks and pools in a company's operations and value chain complements Requirements 21 and 23 that pertain to data quality and ongoing storage monitoring in removals accounting. To account for and report removals, companies must use empirical data specific to the sinks and pools where carbon is stored in the company's value chain or operations (Requirements 21, 21.LMR, and 21.GS) and must demonstrate

continued storage of removals through an ongoing storage monitoring framework (Requirements 23, 23.LMR, and 23.GS). Satisfying these removals requirements pertaining to data quality and ongoing storage monitoring is not possible without establishing sufficient traceability.

12.4.3 Data quality for removals

To satisfy Requirement 21, companies are required to account for CO₂ removals using empirical data specific to the sinks and pools where carbon is stored in their operations or value chain and to provide quantitative uncertainty estimates for removals. This requirement ensures CO₂ removals accounting and reporting align with the accounting principles of accuracy and conservativeness (see Table 3.1). The principles of accuracy and conservativeness are interrelated: companies should strive to calculate and report more accurate inventory results, but also use conservative assumptions when improving accuracy is not possible, and the uncertainty of estimates is high.

Using empirical data specific to sinks and pools ensures the accuracy and representativeness of quantified net carbon stock changes, so as not to overestimate removals. Providing quantitative uncertainty estimates for removals (see Requirement 21) ensures that minimum uncertainty standards are met and that conservative assumptions are used transparently, especially in instances when uncertainty is high.

Empirical data

Empirical data is based on observation or experience from instrumental (usually monitoring equipment) or manual methods (e.g., through counts in a survey or census). For removals accounting, empirical data must be specific to the sinks, pools, and activities within a company's operations or value chain where the CO₂ removals occur. For example, to quantify soil carbon stock changes due to agricultural management practices, a company could develop a soil sampling protocol to estimate soil carbon stock changes in the relevant croplands over time or a soil carbon sampling protocol used to calibrate biogeochemical models representative of relevant cropping systems.

Empirical 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 direct measurements to calibrate model-based or remote sensing-based approaches (see Section 6.4.4.3 for general guidance on model calibration). Empirical data does not need to be generated by the reporting company: it may be gathered by the company directly, provided by a third party, or obtained in collaboration with value chain partners.

To support carbon stock change estimates, some average or proxy data that was not gathered from specific activities within a company's operations or value chain, but that is representative of such activities, may be used to support the calculations of net carbon stock change estimates. See Sections 13.4.2 and 14.4.3 for further guidance on the types of parameters that may be based on secondary data when calculating land management CO₂ removals and CO₂ removals with geologic storage, respectively.

See Sections 6.4.2 and 6.4.4 for general guidance on selecting and improving data quality over time.

Uncertainty

Estimates of annual net carbon stock changes are inherently subject to some uncertainty. Therefore, when accounting for removals, quantitative estimates of uncertainty are needed to balance tradeoffs between the GHG accounting principles of accuracy and conservativeness. There are different types of uncertainty, including scenario uncertainty, methodological uncertainty, and parameter uncertainty (see Section 6.4.4.4 for further discussion).

Quantitative uncertainty analysis can be used to evaluate random errors and known or unknown bias associated with methodological uncertainty. Such analysis can also address parameter uncertainty, based on the variability inherent to a system, the sample size of data collection, random errors from measurement techniques or calibration, and random components of uncertainty or bias obtained from expert judgment. Scenario uncertainty and other factors that influence 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 errors associated with the systems for collecting, recording, and analyzing data.⁴ Companies can quantify uncertainty by applying the best practices in Table 12.3.

Table 12.3 Best practices to quantify uncertainty of removal estimates

Best practices	Description
<p>1. Propagate uncertainty from input data (required)</p>	<p>Quantitative uncertainty estimates for input data used to estimate annual net carbon stock changes should follow IPCC national inventory guidance on data collection and uncertainty quantification^a, national guidance for uncertainty reporting^b, or peer-reviewed statistical methods for estimating uncertainty.</p> <p>Where there are no uncertainty estimates for the input data underlying CO₂ 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.</p> <p>Uncertainty in the estimate of the annual net carbon stock change can be represented by a probability density function, which supports reporting on the confidence interval and statistical testing, as described below. A probability density function represents the range and relative likelihood of possible values for the estimated value (e.g., net carbon stock change) based on error propagation of uncertainties in the input data. Creation of a probability density function requires specific information about uncertainty and, therefore, is just one option companies can use to estimate uncertainty.</p>
<p>2. Determine the confidence interval (required)</p>	<p>A confidence interval is the range of possible values that is likely to contain the true value, for a specified confidence level. To determine a confidence interval associated with the CO₂ removals estimate, companies must first specify a confidence level (e.g., a removal estimate of 100 tCO₂e may have a confidence interval of 92 to 108 tCO₂e based on a 95% confidence level). Companies need to specify the confidence interval to estimate uncertainty based on the underlying data, methods, carbon pools, or other relevant factors.</p> <p>The estimated net carbon stock change values at the upper and lower bounds of the confidence interval can also be determined from a probability density function by using the confidence level to determine the relevant percentiles. For example, using a one-sided 95% confidence level, the confidence interval includes values from the 5th to 100th percentiles of the probability density function representing the likelihood of different values for the net carbon stock change. 95% confidence intervals are typically only used under certain conditions, including when all error components are known, random, and well-quantified. For more discussion on estimating types of uncertainty, see Section 6.4.4.4.</p>
<p>3. Test for statistical significance (recommended)</p>	<p>Companies are recommended to only report removals that are statistically significant. The significance level, or alpha, is defined as “one minus the confidence level.” Statistically significant removals are annual net carbon stock change estimates greater than zero for probabilities greater than or equal to the significance level, i.e., the null hypothesis that net carbon stocks did not increase (this is a one-tailed test) is rejected if all values within the confidence interval are positive values (that is, positive values of annual net carbon stock change).</p> <p>For example, removals would be significant if all values within the confidence interval (e.g., 95%) are greater than zero.</p> <p>Where the confidence interval for the net carbon stock changes lies partially or entirely below zero, it cannot be assumed that carbon stocks are increasing and net CO₂ removals occurred (i.e., the null hypothesis that net carbon stocks did not increase cannot be rejected). Therefore, in such cases, the removals estimates are not statistically significant and cannot be reported.</p>

Table 12.3 Best practices to quantify uncertainty of removal estimates (cont.)

Best practices	Description
<p>4. Select a conservative value (required)</p>	<p>The confidence interval for the CO₂ 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 CO₂ removals selected from the confidence interval does not overestimate CO₂ removals.</p> <p>To select conservative values, companies should apply approaches that reflect the amount of uncertainty in the estimate of the removal, such as an uncertainty deduction. An uncertainty deduction can be designed to incentivize reducing uncertainty in the estimated removal value over time. At a minimum, companies should determine the mean and the median estimate of annual net carbon stock changes within the confidence interval and select a value within the confidence interval 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 confidence interval, methods, and underlying data.</p>

Notes: a. IPCC 2019a; Volume 1, Chapters 2 and 3; b. See, e.g., Breidt and Ogle (2024).

To satisfy Requirement 21 and the corresponding removals reporting requirements, companies should, to the extent possible, document which causes of uncertainty are addressed through a quantitative uncertainty analysis, which causes of uncertainty have not been included, and the steps taken to reduce uncertainty.

To improve accuracy or ensure conservativeness when estimating CO₂ removals and their uncertainty ranges, companies can, among other options:

- Collect data to estimate uncertainty where currently available datasets do not provide quantitative estimates of uncertainty.
- Increase the sample size or improve the sampling design of data collection protocols.
- Undertake a sensitivity analysis to understand which parameters have the largest influence on modeled results and improve data collection for such parameters.
- Choose values at the lower end of a confidence interval where a given variable or parameter has a positive correlation with CO₂ removal estimates.
- Choose values at the higher end of a confidence interval where a given variable or parameter has a negative correlation with CO₂ removal estimates.
- Choose values by applying a conservative adjustment to the estimated value based on the uncertainty in the analysis (sometimes referred to as an uncertainty deduction). For example, if an estimated value for CO₂ removals was 2.4±0.3 tonnes CO₂, the company could select a conservative estimate for the removal value of 2.1 tonnes CO₂ by applying an uncertainty deduction of 0.3 to the estimated value (based on the standard error or confidence interval). This would result in a conservative estimate of removals and incentivize decreasing the uncertainty in the analysis over time.

12.4.4 Scope 3 allocation for removals

In general, the risk associated with the double counting of scope 3 removals within a specific scope 3 spatial boundary by companies at the same or similar tiers of the value chain is higher than the risk associated with the double counting of scope 3 emissions. This is because reporting removals represents a benefit, while emissions represent a liability.

In scope 3 accounting, different companies can account for the same unit of emissions, removals, and other metrics if those companies are located at different tiers of a value chain. For example, a food processing company that purchases soy and processes it into soybean oil and soy meal, a consumer goods company that purchases soybean oil for use in potato chips, and a retailer that purchases potato chips to sell to customers, could all account for and report scope 3 land management CO₂ removals associated with croplands producing the soy in their value chain. Therefore, double counting can occur between the different scope 3 categories at different tiers of the value chain.

Double counting must not occur within the same scope 3 category for companies at the same tier in the value chain. Using the example above, a food processing company that purchases soy from a farm must account for the removals attributable to the amount of soy that they purchased in the reporting year and ensure there is no double counting of removals with other companies that also purchased soy from that farm.

Similarly, if the soy is processed into oil and meal, a company that purchases soybean oil cannot account for all the removals attributable to the processed soybeans, since a portion of the removals corresponds to the meal. When different types of products or co-products are outputs of a system, allocation is used to estimate the units of emissions, removals, and other metrics that correspond to a specific amount of a specific product or co-product. The system where allocation is performed can have multiple scales or comprise multiple points of aggregation or processing. Allocation for removals from agricultural lands can be applied at the land management unit or at the sourcing region.



Consistent allocation factors must be used for each individual facility or system, so the sum of the allocated removals for each output equals 100 percent of removals from the system. The use of multiple allocation methods for a single system can result in over- or under-counting of total removals from the system. Companies should follow the guidance in Section 6.4.5 to select the most appropriate allocation method. Different mechanisms can be used to register the allocation approach used at a specific land boundary, such as a “right to report” (see Section 13.3 for more details on obtaining the “right to report” for land management CO₂ removals). Regulations or sectoral recommendations developed through inclusive multi-stakeholder processes can support the use of consistent methods across sectors or commodities.

12.4.5 Permanence of removals

This *Standard* sets forth a storage monitoring framework to account for the non-permanence risk associated with CO₂ removals. This section provides general background information on the climate impacts of CO₂ removals and why a storage monitoring framework is needed to implement the permanence principle. Storage monitoring helps to detect any net carbon stock losses from the carbon pools storing the removed CO₂, if they occur. Reporting any losses of stored carbon ensures that the climate impact of carbon losses from previously removed CO₂ is accounted for and reflected in the reporting and helps track progress towards targets.

Climate impacts of CO₂ removals

Global mean warming is approximately proportional to cumulative emissions.⁵ Therefore, the ability to limit overall warming is determined by how much total cumulative emissions to the atmosphere can be reduced (see Box 12.1 for more information).

When CO₂ is removed from the atmosphere and stored permanently (i.e., on a time frame equivalent to the lifespan of CO₂ in the atmosphere) in a carbon pool, the removal contributes to reducing cumulative net CO₂ emissions.⁶ When CO₂ removed from the atmosphere is only temporarily stored in a carbon pool, the temporary removal does not reduce cumulative net CO₂ emissions, since the CO₂ is re-emitted in the future. Therefore, only the following CO₂ removals are fungible with GHG emissions:

- CO₂ removals that result in physically permanent carbon storage; or
- CO₂ removals where the overall carbon stock remains constant or increases, and the carbon stock changes continue to be accounted for over time.⁷

To implement the permanence principle (see Chapter 3) and account for the CO₂ removals described above, this *Standard* sets forth a storage monitoring framework. For further discussion of approaches to permanence in the context of removals target boundaries, see Section 17.4.2.2.

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 12.1). If companies account for temporary carbon storage using dynamic methods, they must report such information separately from the physical GHG inventory (i.e., tonne-year accounting cannot be used to account for and report removals in this *Standard*).

Box 12.1 Climate impacts of CO₂ removals

OVERVIEW AND NEED FOR A STORAGE MONITORING FRAMEWORK FOR CO₂ REMOVALS

The human-induced increase in global average temperature is caused by cumulative GHG emissions to the atmosphere. Once CO₂ is emitted to the atmosphere, a portion of that CO₂ leaves the atmosphere through natural processes, such as plant growth or absorption by the oceans. However, a portion stays in the atmosphere for millennia. The resulting accumulation of GHGs causes long-term warming.

Cumulative CO₂ emissions, and therefore long-term temperature change, are largely independent of when emissions occur (i.e., global warming is a time-invariant function of cumulative CO₂ emissions).⁸ In other words, an emission of CO₂ that occurs today or in the future (e.g., 100 years from today) will contribute the same amount of emissions and long-term warming. This fact underpins the idea of net-zero targets and a global “carbon budget,” i.e., 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).⁹

The fact that CO₂ can persist in the atmosphere for thousands of years, and that long-term temperature change is caused by cumulative CO₂ emissions, has important implications for understanding the relevant timescales for the storage of CO₂ removed from the atmosphere needed to reach the Paris climate goals.¹⁰

If the removed carbon is stored in non-atmospheric carbon pools for less than millennial timescales (e.g., carbon is stored for 100 years before being emitted), and there are no additional CO₂ removals to maintain the net carbon stocks in that pool following the carbon stock loss, the removal will not contribute to lowering cumulative CO₂ emissions.

A storage monitoring framework that ensures ongoing monitoring of stored carbon and reporting of emissions or reversals when carbon losses occur is needed to reflect the impact of CO₂ removals on cumulative CO₂ emissions and thus long-term temperature change.

DYNAMIC CARBON ACCOUNTING METHODS FOR TEMPORARY CARBON STORAGE

Temporary carbon storage associated with CO₂ removed from the atmosphere can still have important climate benefits. Temporary carbon storage can help to lower peak warming, but only if fossil fuel CO₂ emissions are also decreased to net zero.¹¹ Temporary carbon storage can “buy time” for the development and deployment of other climate change mitigation options, including options for physically permanent carbon storage. It also gives more time for society and natural ecosystems to adapt to climate change, because both the absolute temperature increase and the rate of temperature change matter. It is therefore important that a GHG inventory provides information on the durability and timing of removals and subsequent emissions or reversals, which can be achieved through a storage monitoring framework of annual net carbon stock changes in an annual GHG inventory.

In contrast, dynamic carbon accounting methods aim to measure the climate impact of removing CO₂ from the atmosphere and temporarily storing that CO₂, or delaying the emission of CO₂, by estimating the impacts on atmospheric radiative forcing within a selected time horizon. Dynamic carbon accounting includes methods such as tonne-year accounting that are sensitive to the selected time horizon.

A 100-year time horizon is generally used to calculate global warming potential (GWP) values that compare non-CO₂ GHG emissions to CO₂ emissions in terms of CO₂ 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 CO₂ emissions and long-term temperature change, then all CO₂ 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 CO₂ emissions. When calculating GWP values, the use of a selected time horizon is necessary to compare the radiative forcing effects of non-CO₂ gases to CO₂. However, to quantify the effect of CO₂ emissions and removals on cumulative CO₂ emissions, it would be inaccurate to apply a limited time horizon or discount CO₂ emissions or removals based on when they occur.

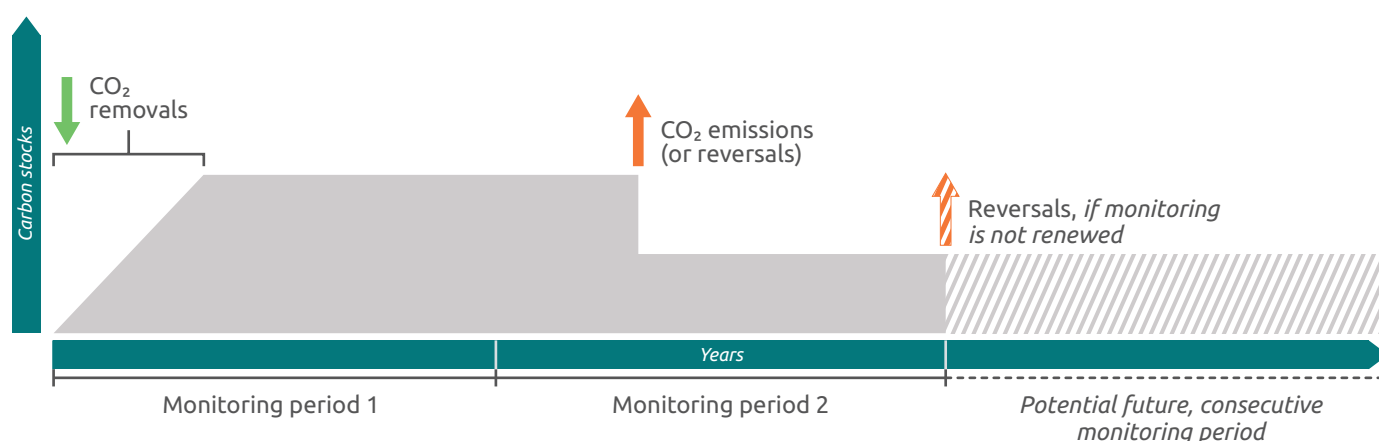
Ongoing storage monitoring

An ongoing storage monitoring framework ensures a complete and closed accounting system, and that mechanisms are in place to:

- Demonstrate that carbon associated with CO₂ removals (i.e., net annual increases in carbon stocks) remains stored in the relevant carbon pools; and
- Account for net carbon stock losses in such carbon pools if they occur and report such losses as emissions or reversals in the year they occur.

Figure 12.2 illustrates the concept of a storage monitoring framework for a carbon pool. In the initial years, a company accounts for net annual increases in the carbon stock as removals and, through ongoing storage monitoring, the company accounts for the carbon stored in the carbon pool over time. In later years, a net decline in the carbon stock is detected. This annual carbon stock decrease is accounted for either as CO₂ emissions or reversals, depending on whether the relevant activity is still within the inventory boundary of the reporting company when the carbon stock losses occur.

Figure 12.2 Representation of a storage monitoring framework



Key:

- CO₂ removals
- CO₂ emissions (or reversals)

Companies can use a variety of data sources to support the 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 or ground-based inventories within relevant spatial boundaries
- Remote sensing of land management practices within relevant spatial boundaries
- Statistical data from 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 changes, or can annualize data from longer monitoring frequencies up to every five years. If using a model-based or remote sensing-based approach to support ongoing storage monitoring, the model should be verified with empirical data at a minimum once every five years. See Chapters 13 and 14 for ongoing storage monitoring guidance by storage type.

Losses of stored carbon

To ensure a complete GHG accounting system that captures the full climate impact of CO₂ removals, companies must account for losses of stored carbon. As set forth in Requirement 23, companies must account for and report net carbon stock losses of previously reported removals in the year the losses occur, as either:

1. **Net CO₂ emissions**, if the carbon pools are part of the inventory boundary in the reporting year; or
2. **Reversals**, if the carbon pools are no longer in the inventory boundary in the reporting year.

A reversal is an emission from a carbon pool that stores carbon associated with a removal that was previously reported by the reporting company, and that is no longer within the inventory boundary. If companies lose the ability to monitor carbon stocks associated with previously reported removals or if the monitoring plan is not renewed, companies must assume previously reported removals are emitted and report reversals. All net carbon stock decreases associated with carbon pools *within* the inventory boundary must be reported as land emissions.

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 CO₂ removals, companies may work with supply chain partners or other relevant stakeholders to ensure ongoing monitoring can occur. Otherwise, any removals previously inventoried by the reporting company must be accounted for as reversals by the reporting company. Meanwhile, the new owner of the relevant carbon pools would account for any net carbon stock losses in those carbon pools as scope 1 land management net biogenic CO₂ 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 to 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.

Take, for example, a company that reports 50 t CO₂ scope 3 soil carbon removals (e.g., net soil carbon stock increase) from producers they source from, and then changes suppliers but continues to monitor the relevant agricultural land. If they later detect a net carbon stock loss of 75 t CO₂ emissions from those agricultural lands associated with their previously reported removals, they only need to report 50 t CO₂ 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, the company is required to account for emissions equal to all CO₂ 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 reporting company stopped monitoring the agricultural lands associated with their previously reported scope 3 soil carbon removals, they would need to report 50 t CO₂ 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:

- 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
- 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:

- Annual net carbon stock decreases occur in land-based or geologic carbon pools associated with previously reported scope 3 removals, as detected by ongoing storage monitoring; or
- 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 17 for further guidance on accounting for and reporting reversals in the context of target setting and tracking progress.



Case study: Pernod Ricard—Removals requirements

Pernod Ricard is one of the largest alcoholic beverage companies in the world, known for selling quality wine and spirits. The company has implemented the *Land Sector and Removals Standard* in their GHG accounting approach, and it has set out to align its emissions and removals targets with the Paris Agreement of limiting global warming to 1.5°C by identifying hotspots to target improved agricultural practices that reduce emissions and boost removals in its scope 1.

To include removals in its GHG inventory, Pernod Ricard accounts for and reports all life cycle GHG emissions, including emissions related to operations of its own vineyards, meeting the general removals accounting requirement (Requirement 19).

Pernod Ricard partnered with Carbone 4, a climate consulting firm, to assess soil carbon stock changes in its vineyards, which were identified as a good demonstrator for improvement towards its corporate targets. Since Pernod Ricard owns the vineyards, the biogenic sink processes (vine photosynthesis) and carbon storage pool (vineyard soil) fell within the company's scope 1, ensuring **traceability throughout the full CO₂ removals pathway** (Requirement 20). Soil carbon stock changes in over 40 land parcels needed to be assessed for this project. Carbone 4 implemented a model-based approach that is calibrated with empirical data from the tool Simeos AMG, an IPCC-classified Tier 2 model. Vineyard parcels have been grouped into three stratified land units based on climate and soil characteristics and agricultural practices. To ensure a representative sampling approach, Pernod Ricard used a third-party service provider who aligns with the ISO 18400 standard for soil sampling. The following data points were collected from each land unit: soil (N and C stock, alluvium %, clay %, gravel %), climate (evapotranspiration, average temperatures, rainfall), and agricultural parameters (quantity and types of fertilizers, vine-pruning methods). By using this empirical data, specific to the sinks and pools studied, this approach met the first data quality requirement for land management removals (Requirement 21.LMR). Scope 3 allocation for removals is not relevant since the vineyards are in Pernod Ricard's scope 1 (Requirement 22).

Pernod Ricard also planned for annual **monitoring** of land management practices, such as quantities of fertilizers applied, vine pruning methods, and types of cover crops. They plan to **sample soil carbon stocks** on a **five-year basis**, hence meeting the second data quality Requirement 21.LMR and the ongoing storage monitoring requirement (Requirement 23), through a representative sampling strategy that considers both climate–soil characteristics and agricultural practices. These future data will update the model (Simeos AMG) inputs and ensure any potential **carbon stock losses** are accounted for (Requirement 23).

Implementing the *Standard* with Carbone 4 provided several insights and informed subsequent steps for Pernod Ricard to improve their GHG accounting. The outlined approach was successful for scope 1 and can serve as a basis for conducting a similar analysis for scope 3, where Pernod Ricard plans to improve interactions with suppliers by seeking partnerships that improve traceability and transparency within their supply chain.

12.5 Calculating removals

Accounting for and reporting removals in this *Standard* is optional. If a company chooses to account for and report removals, removals are calculated using a stock change accounting approach, and companies must satisfy the other requirements set forth in Section 12.2 of the *Standard*. Calculation guidance for land carbon stock changes used to account for land management CO₂ removals is provided in Section 9.5.3, with additional guidance in Chapter 13. Calculation guidance for geologic carbon stock changes used to account for removals with geologic storage is provided in Section 14.5.4.

Gross CO₂ removals are an optional accounting subcategory that may be reported for additional transparency under the gross CO₂ fluxes accounting category. Sections 13.5.4 and 14.5.5 provide calculation guidance to optionally account for and report gross biogenic land CO₂ removals and gross technological CO₂ removals, respectively.

Endnotes

- 1 Matthews et al. 2009.
- 2 This text includes elements that may change to align with the resolution on forest carbon accounting in future versions of this *Standard*. See Box 9.1.
- 3 Losses that occur in the process of capturing and storing CO₂ 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 CO₂ emissions at direct air capture facilities).
- 4 IPCC 2006; Volume 1, Chapter 3.
- 5 Nzotungicimpaye et al. 2024.
- 6 Brunner et al. 2024.
- 7 When accounted for as an aggregate carbon pool with ongoing storage monitoring, CO₂ removals that are not permanently stored can still contribute to reducing cumulative net CO₂ emissions, if the carbon stock remains stable or increases across all individual pools. For example, if the annual net land carbon stock change increases in cropland soils (i.e., the inputs of biogenic carbon to the soil are greater than the carbon stock losses from decomposition or other soil carbon emissions), there is a reduction in atmospheric CO₂ in that year.
- 8 Allen et al. 2009.
- 9 Allen et al. 2022.
- 10 Brunner et al. 2024; Hausfather 2024.
- 11 Matthews et al. 2022.

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