

## CHAPTER 15.

# Product carbon storage

*This chapter provides requirements and recommendations on accounting for the storage of biogenic and TCDR-based carbon that is physically contained in product carbon pools. Product carbon storage is not reported as a removal or emission but instead as a separate and optional category. To account for and report gross CO<sub>2</sub> emissions from biogenic and TCDR-based products associated with removal-and-use pathways, see Chapter 11.*

## 15.1 Overview

Product carbon storage is carbon stored in product carbon pools that is derived from biogenic or technological CO<sub>2</sub> sinks. The product carbon pool refers to the carbon contained in products or materials during the use stage of the product life cycle, including recycling and reuse.<sup>1</sup>

Products that contain biogenic or TCDR-based carbon can keep carbon out of the atmosphere for the duration of the product's lifetime. Therefore, maintaining storage in product carbon pools and preventing its release can help to reduce GHG emissions, depending on the product's durability and end-of-life fate.

The product carbon storage pathway refers to the consecutive and interlinked stages of carbon storage in products, either through biogenic or technological CO<sub>2</sub> removal processes, from raw materials to intermediary and final products during their use stage, including recycling and reuse (Figure 15.1).

Reporting biogenic and/or TCDR-based product carbon storage is optional. Product carbon storage is reported in a separate "Product carbon storage" category, separately from emissions and removals. With product carbon pools, no single entity controls both sink and storage across the product carbon storage pathway, since products are intended to be used by other entities (including end users) across the value chain. Product carbon storage is therefore not accounted as scope 1 by any entity. Product carbon storage corresponds to scope 3, category 11 (Use of sold products) since product carbon storage occurs during the product use stage. However, product carbon storage is not fungible with emissions or removals in scope 3.

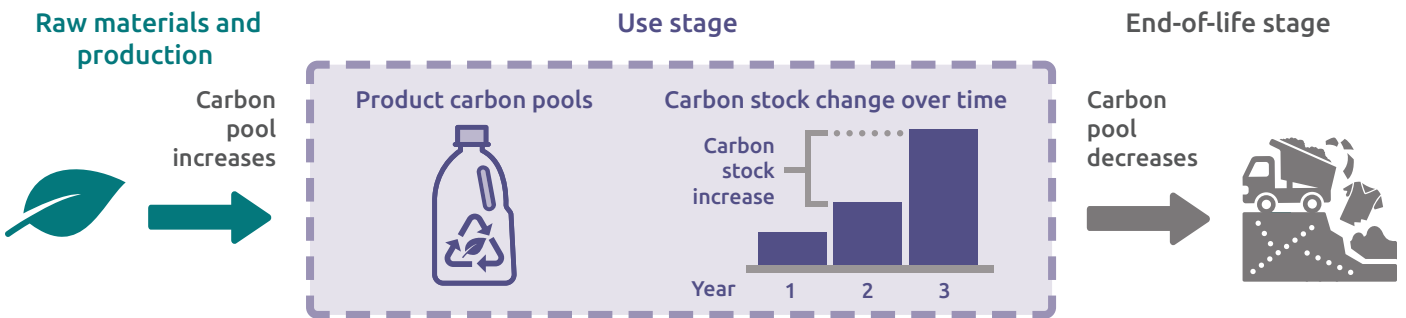
Companies choosing to account for product carbon storage for agricultural or TCDR-based products must meet the following requirements:

- Account for the net product carbon stock change of sold agricultural or TCDR-based products (Requirement 24).



- Ensure that complete product life cycle GHG emissions are accounted for and that no significant land use change emissions are associated with producing the product (Requirement 25.PS).
- Companies **may** separately account for waste carbon stock changes if they seek to account for carbon storage in the end-of-life stage of the product life cycle (Requirement 26). Reporting storage in waste carbon pools is separate and optional.

**Figure 15.1.** Example of a product carbon storage pathway for bio-based plastics



## 15.2 Requirements

### 15.2.1 Accounting requirements

#### REQUIREMENT 24:

#### *Product carbon storage accounting<sup>2</sup>*

If companies choose to account for and report product carbon storage for agricultural or TCDR-based products, they **shall** meet the following requirements:

- **Accounting approach:** Companies **shall** account for the annual net product carbon stock change, using the stock-change accounting approach. The net product carbon stock change **shall** only include biogenic and/or TCDR-based carbon in agricultural or TCDR-based products sold by the reporting company that are in the use stage, which includes recycling and reuse, and that meet Requirement 25.PS.
  - Companies **shall** only report product carbon storage if the total biogenic and/or TCDR-based product carbon stock increases in the reporting year.
- **Data quality:** Companies **shall** account for and report product carbon storage using information regarding the biogenic or TCDR-based carbon content of their sold products, as well as data regarding product lifetime (half-life value), and conversion rates from raw material to intermediate products, final products, and/or recycling and reuse. *See data quality-related product carbon storage recommendations below and Table 15.1 in the Guidance.*
- **Losses of stored carbon:** If the total biogenic and/or TCDR-based product carbon stock decreases in the reporting year (i.e., more carbon leaves the product carbon pool through transfers to the end-of-life stage, where it is combusted or decomposed, than carbon entering the product carbon pool), companies **shall** report negative product carbon storage separately for "biogenic product carbon storage" and "TCDR-based product carbon storage."

## REQUIREMENT 25.PS:

### *Land accounting for agricultural product carbon storage<sup>3</sup>*

When estimating net biogenic product carbon stock changes, companies **shall** only include biogenic carbon from agricultural products that meet the requirement for complete life cycle GHG emissions reporting, including land carbon leakage (where required), and no significant land use change emissions (see Requirement 25).

- This requirement does not apply to biogenic CO<sub>2</sub> or carbon associated with waste materials used as an input to the biogenic product, following the recommendation on allocating upstream GHG emissions from waste in Section 6.3 (i.e., companies do not allocate any upstream GHG emissions to waste materials with no economic value).



## REQUIREMENT 26:

### *Waste carbon storage accounting*

If companies choose to account for carbon storage in waste carbon pools, such information **shall** meet the following requirements:

- **Waste carbon storage requirements:** If companies choose to report on carbon stock changes of the waste carbon pool, companies **shall** follow the same methods, requirements, and criteria as in Requirement 24, but for biogenic and/or TCDR-based carbon in agricultural or TCDR-based products sold by the reporting company in the end-of-life treatment stage, excluding recycling and reuse. Such carbon in waste carbon pools does not need to meet the land requirement for agricultural product carbon storage Requirement 25.PS.
- **Landfill requirements:** When estimating net waste carbon stock change, companies **shall** only include waste carbon from sanitary landfills where adequate measures are taken to avoid soil and groundwater contamination.
- **Life cycle GHG emissions:** All GHG emissions from the end-of-life treatment of sold products (including emissions from landfills) **shall** be accounted for and reported in scope 3, category 12 in the year that the products are sold. There is no time horizon cut-off, consistent with the GHG Protocol *Scope 3 Standard*.

## 15.2.2 Reporting requirements

### *Reporting requirements for product carbon storage<sup>4</sup>*

If companies account for and report product carbon storage for agricultural or TCDR-based products, they **shall** report:

- **“Product carbon storage” separately from the physical GHG inventory:** Biogenic or TCDR-based product carbon stock changes **shall** be reported in the “product carbon storage” accounting category separately

from the physical GHG inventory, corresponding to scope 3, category 11 (Use of sold products). Product carbon storage is not fungible with emissions or removals in scope 3.

- **Product carbon storage by sink type:** Product carbon storage that meets the product carbon storage requirements, separately by sink type.
  - Storage of biogenic CO<sub>2</sub> or carbon in product carbon pools in the “biogenic product carbon storage” accounting subcategory under “product carbon storage,” separately from the physical GHG inventory.
  - Storage of TCDR-based carbon in product carbon pools in the “TCDR-based product carbon storage” accounting subcategory under “product carbon storage,” separately from the physical GHG inventory.

## Specific cases

### *Waste carbon storage:*

If companies choose to account for storage in waste carbon pools, companies **shall** report waste carbon stock changes in the “waste carbon storage” accounting category (corresponding to scope 3, category 12, End-of-life treatment of sold products), separately from the physical GHG inventory and the “product carbon storage” accounting category.

## 15.3 Recommendations

### *Data quality–related product carbon storage recommendations*

**Data specific to sinks and product carbon storage:** To calculate and report on agricultural and TCDR-based product carbon storage in sold products, companies **should** use empirical data specific to the sinks and product carbon pools where carbon is stored. This includes data regarding product lifetime (half-life value) and conversion rates from raw material to intermediate products and/or final products. See Table 15.1 in the *Guidance* for the recommended data quality hierarchy to account for “product carbon storage.”

### *Ongoing product carbon storage monitoring plan recommendation*

Companies **should** implement ongoing storage monitoring of product carbon pools according to monitoring plans designed to obtain information regarding the duration of carbon storage in products sold by the reporting company. For example, a manufacturing company may conduct sampling of their sold products’ use stage 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. Options to help ensure ongoing storage monitoring in dynamic supply chains include:

- Use of digital tracking methods (e.g., through unique identifiers, such as radio frequency identification and near field communication tags)
- Working with supply chain partnerships or engaging in programs to increase the 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



## 15.4 Guidance on the requirements and recommendations

This section provides guidance on how to account for and report on agricultural or TCDR-based product carbon storage and waste carbon storage associated with removal-and-storage pathways. For guidance on how to account for and report gross CO<sub>2</sub> emissions from biogenic and TCDR-based products associated with removal-and-use pathways, see Chapter 11. For broader guidance on entity-level versus product-level accounting, see Section 1.5 and Requirement 3 that set forth the relationship of this *Standard* to the GHG Protocol *Product Standard* (WRI and WBCSD, 2011b).

### 15.4.1 Product carbon storage pathways

Carbon stored within product carbon pools that are part of removal-and-storage pathways can originate from two sources:

- The transfer of biogenic carbon from land-based carbon pools to product carbon pools; and
- Technological CO<sub>2</sub> removal processes, such as direct air capture.

#### Biogenic product carbon storage pathway

A biogenic product carbon storage pathway begins with the transfer of carbon out of land-based carbon pools and into product carbon pools (e.g., during harvest). Biogenic products begin as raw materials, such as agricultural crops, and as they proceed through the value chain (e.g., processing and manufacturing), become semi-finished or intermediate and, ultimately, final products.

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 in biomass carbon pools. In this respect, the carbon from CO<sub>2</sub> originally removed from the atmosphere 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 land-based carbon pools. The difference is that transfers of carbon from land-based carbon pools to biogenic products are always the result of anthropogenic activity.

Figure 11.2 in Chapter 11 illustrates the transfer of biogenic carbon from the atmosphere to land-based carbon pools, then into product carbon pools (and ultimately into waste carbon pools, recycling, or reuse). Figure 11.2 also depicts the associated gross removals and emission fluxes between land-based and product carbon pools

and the atmosphere. Carbon stored in biogenic products is emitted back to the atmosphere after the duration of product storage, as biogenic products and materials that are not recycled or reused enter their end-of-life stage (e.g., GHGs are emitted from biomaterials as they are incinerated or decompose in a landfill). Carbon stocks are encompassed within the dotted lines, while carbon flows (gross emissions, removals, and transfers between carbon pools) are shown as arrows.

### Box 15.1 Carbon storage in biochar

Biochar is a material produced by the thermal decomposition of biomass under a limited supply of oxygen. The primary application of biochar is its use as a soil amendment to store carbon and improve soil fertility (International Biochar Initiative 2026). Only by quantifying the life cycle impacts of a biogenic product such as biochar can companies understand the net CO<sub>2</sub> flux (i.e., the net of gross biogenic land CO<sub>2</sub> removals, gross biogenic land CO<sub>2</sub> emissions, and gross biogenic product CO<sub>2</sub> emissions) associated with a biogenic product's life cycle. For biochar to have climate benefits, it should be produced from waste feedstocks (e.g., agricultural residues with no economic value) or biogenic feedstocks with minimal land emissions and other life cycle GHG emissions, including land use change emissions and land carbon leakage.<sup>a</sup>

When the feedstocks to produce biochar leave the land-based carbon pool, it becomes a product and enters the product carbon pool. To optionally account for carbon stored in biochar, companies need to meet the product carbon storage requirements in Chapter 15 and report the relevant net change in product carbon storage in the "product carbon storage" accounting category, separately from emissions and removals.

If biochar is returned to the land-based carbon pool as a soil amendment, the reporting company has the option to continue accounting for any increases of carbon in the biochar product carbon pool as "product carbon storage" or to meet all requirements in Chapters 12 and 13 and report net increases of carbon in soil carbon pools as "land management CO<sub>2</sub> removals."

*Note:* a. See, e.g., Li et al. (2024), Lehmann et al. (2021), and Roberts et al. (2010).

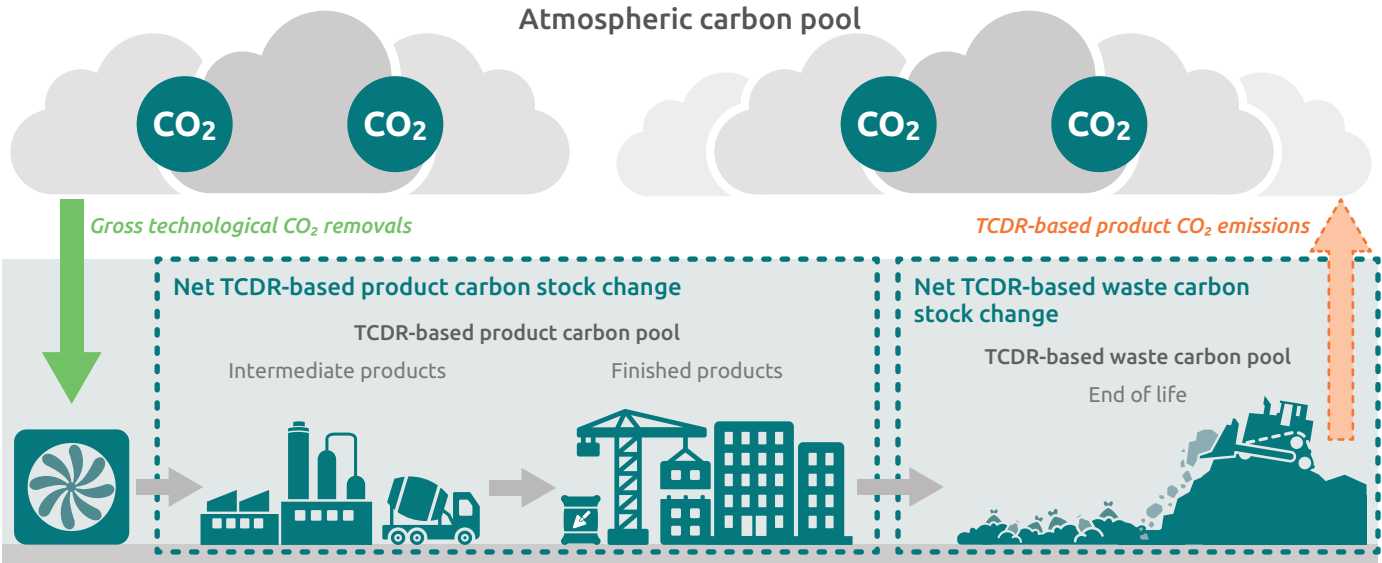
## Technological carbon dioxide removal (TCDR)-based product carbon storage pathway

Products can be made from carbon or CO<sub>2</sub> removed through technological processes, such as CO<sub>2</sub> captured via a direct air capture facility. CO<sub>2</sub> removal technologies can be used to generate TCDR-based materials for products and lead to either short-term carbon cycling through the production of short-lived products (e.g., direct air capture CO<sub>2</sub>-based fuels or packaging materials) or longer-term carbon cycling through the production of long-lived products (e.g., direct air capture CO<sub>2</sub>-cured cement). Carbon stored in TCDR-based products may be emitted back to the atmosphere after the duration of product storage, as TCDR-based products and materials that are not recycled or reused enter their end-of-life stage (e.g., GHG emissions from TCDR-based materials as they decompose in a landfill or are incinerated).

For some products, removals from the atmosphere can take place during the use stage, such as from enhanced terrestrial weathering over time. For example, crushed basalt rock applied to agricultural soils can absorb CO<sub>2</sub> during its use stage, as base cations released from the basalt rock react with CO<sub>2</sub> in the soil solution to produce bicarbonate ions transferred through downstream water bodies to ocean-based carbon pools.<sup>5</sup>

Figure 15.2 illustrates an example of a TCDR-based product carbon storage pathway. The figure shows direct air capture of CO<sub>2</sub>, transfer of the CO<sub>2</sub> to product carbon pools, and the eventual emission of that CO<sub>2</sub> to the atmosphere from waste carbon pools at the end-of-life stage. The product carbon stock is encompassed within the dotted lines, while CO<sub>2</sub> flows (gross emissions, gross removals, and transfers between carbon pools) are shown as arrows.

**Figure 15.2** Example of carbon stocks and flows across TCDR-based product carbon pools



**Key:**  
 → Gross CO<sub>2</sub> removals    → Transfers between carbon pool  
 [ ] Pool    ↗ Indicates gross CO<sub>2</sub> emissions *may* or *may not* happen

Note: Gross CO<sub>2</sub> fluxes using flow accounting are presented as arrows above the pools; stocks are presented as dotted boxes; net CO<sub>2</sub> fluxes using stock change accounting are presented in teal text at the top of each dotted box.

**Storage of fossil carbon in product carbon pools**

Storage of fossil carbon in products (i.e., where carbon originates from fossil carbon reservoirs or other carbon resources that are part of the long-term carbon cycle) is not part of a removal-and-use or a removal-and-storage pathway. Examples include storage of fossil carbon in fossil fuels or petrochemical products that include fossil carbon (e.g., fossil fuel-based plastics). Storage of fossil carbon in products temporarily prevents the release of CO<sub>2</sub> emissions to the atmosphere and is therefore reflected in a GHG inventory as a non-emission for that relevant time period.

**Captured GHG and storage pathway**

Carbon capture and storage in products can also take place during the production stage of the product life cycle (i.e., as a means to capture CO<sub>2</sub> emissions and store them in a product). For example, CO<sub>2</sub> emissions from cement production (e.g., from fuel combustion and process emissions) can be captured at different stages of production and sequestered into concrete as a final product. Once injected, the CO<sub>2</sub> and the calcium ions in cement form calcium carbonate minerals that can be stored for a long period in the concrete. In this way, and similar to the storage of fossil carbon in products, captured GHGs and their storage in products *prevents* the release of CO<sub>2</sub> emissions to the atmosphere for a period of time and is therefore reflected in a GHG inventory as a non-emission for that period of time.

If companies cannot establish the source of captured CO<sub>2</sub> emissions (i.e., fossil, biogenic, or TCDR-based carbon), companies should conservatively account for the captured CO<sub>2</sub> as fossil CO<sub>2</sub>. If the captured CO<sub>2</sub> is a mixture of biogenic, TCDR-based, and fossil CO<sub>2</sub>, companies should estimate the quantity of product carbon or CO<sub>2</sub> content derived from these different sources and separately account for them according to the guidance provided in this

chapter. Only increases in biogenic product carbon pools or TCDR-based product carbon pools may be accounted for as product carbon storage, following Requirement 24.

## 15.4.2 Product carbon storage accounting

### Stock change accounting and losses of stored carbon

Accounting for and reporting product carbon storage is optional and is only applicable to biogenic and TCDR-based carbon stored in agricultural or TCDR-based product carbon pools. Final accounting and reporting requirements for reporting biogenic product carbon storage in harvested wood products or other forest products may be published in future versions of this *Standard* (see Box 9.1). If companies choose to account for and report product carbon storage, companies must account for the annual net product carbon stock change, using a stock change accounting approach (see Equation 15.1 and Section 3.4.4 for further background information). The net product carbon stock change must only include biogenic and/or TCDR-based carbon in agricultural or TCDR-based products sold by the reporting company that are in the use stage, which includes recycling and reuse, and that meet Requirement 25.PS.

For example, if a company chooses to account for and report product carbon storage in biomaterials (e.g., bioplastics) that it manufactures and sells, the reporting company accounts for the net carbon stock change in sold bioplastics that are in the use stage. Any fossil-based carbon in the bioplastic product carbon pool must be excluded when estimating net biogenic product carbon stock changes.

When estimating net biogenic product carbon stock changes, companies must also only include biogenic carbon from agricultural products for which all life cycle emissions, land use, and land carbon leakage (where required) have been accounted for. As set forth in Requirement 25.PS, companies must also demonstrate that there are no significant land use change emissions attributable to the biogenic materials that are transferred into the product carbon pool. For example, if the bioplastics company in the example above does not have sufficient information to report all life cycle emissions, land use, and land carbon leakage attributable to the bioplastic feedstocks, biogenic carbon from such material inputs is excluded when accounting for the net biogenic product carbon stock change in the bioplastic carbon pool. If there are any significant land use change emissions (see Requirement 25 for the definition of significance as it pertains to this requirement) attributable to the bioplastic feedstock, biogenic carbon from such material inputs is also excluded when accounting for net biogenic product carbon stock change in the bioplastic carbon pool.

If the product carbon stock decreases over the reporting year (i.e., more carbon leaves the product carbon pool through transfers to the end-of-life stage, where it is combusted or decomposed, than carbon entering the product carbon pool), companies must report a negative value for product carbon storage, separately for biogenic and TCDR-based product carbon storage.

For example, for a bioplastics company that chooses to account for and report product carbon storage in the bioplastics they have sold, if the quantity of carbon that leaves the bioplastic product carbon pool (e.g., due to decomposition, combustion, transfers to waste carbon pools, etc.) associated with all previously sold bioplastic products exceeds the quantity of carbon that enters the bioplastic product carbon pool in the reporting year (e.g., due to the manufacture and sale of new bioplastics), the reporting company reports a negative value for biogenic and/or TCDR-based product carbon storage.

### Reporting product carbon storage

Product carbon storage is not fungible with emissions or removals reported in scope 3. Product carbon storage cannot be aggregated or netted with scope 3, category 11 emissions. Scope 3, category 11 and category 12 emissions are accounted for and reported using flow accounting approaches and have different time boundaries

(see Chapter 5 in the *Scope 3 Standard* for details) than the approaches used to account for product (and waste) carbon storage, which is quantified using net carbon stock changes on an annual basis. Product carbon storage is not fungible with removals, as in most instances, companies are unable to meet the removal requirements in this *Standard* that would be necessary to account for and report removals associated with product carbon storage pathways. For example, the ongoing storage monitoring of product carbon pools during the use stage using empirical data specific to product carbon pools is, in most cases, not feasible.

## Data quality

Table 15.1 provides a hierarchy of data sources to prioritize when calculating product carbon storage. Higher-ranked data sources in Table 15.1 are generally considered to be more accurate (provided that adequate data and infrastructure are in place to develop, evaluate, and apply the data). Companies that report product carbon storage should use the most accurate and relevant data according to data availability and the hierarchy provided in Table 15.1.

Companies should prioritize using empirical data specific to their operations, products, and value chain. Data on product carbon stock changes can be collected by direct measurement of the carbon stocks within the company's operations or value chain, information received from suppliers or consumers, model-based approaches using primary data inputs, official statistics, or peer-reviewed published literature data that are specific to the reporting company's value chain, product type, and region. Such data should be recent (e.g., not older than 10 years).

Companies may use data from lower-ranked sources in Table 15.1 when higher-quality data are not available. Companies reporting product carbon stock changes should strive to use the most accurate and relevant data possible. For example, companies should not use global average default data (e.g., on half-lives or decay rates) when sourcing region-specific and product type-specific published data are available. Companies should additionally strive to improve the data availability and quality of their product storage calculations over time (e.g., through customer surveys and studies of end-of-life fates within specific markets).



**Table 15.1** Recommended data quality hierarchy for accounting for product carbon storage

Data type (Hierarchy: high to low)	Description	Data sources	Recommendations	Example
<b>Company-, product-, and value chain-specific data</b> (highest quality)	For a specific type of product/product carbon pool: <ul style="list-style-type: none"> <li>• Data from primary analysis in a specific market; or</li> <li>• Sourcing region-specific supply chain data, conversion rates, and half-life data that are measured and validated</li> </ul>	In-house and/or third-party surveys or analyses of product life cycles in the reporting company’s supply chain and/or consumer behavior	Companies should: <ul style="list-style-type: none"> <li>• Use the highest possible level of data quality within a recent (e.g., 10-year) time window.</li> <li>• Use data that are as granular as possible based on the region, product type, and end-of-life and processing value chains</li> <li>• Provide assurance of their product storage calculations to ensure the reported values are conservative</li> </ul>	Company- and product-specific service or half-life values for specific regions/markets
<b>Subnational-level statistical data</b>	Subnational statistics or market analysis in relevant markets	Official subnational data platforms and peer-reviewed published literature	NA	Official state- or region-specific data or peer-reviewed published literature on product use and storage pathways
<b>National-level statistical data</b>	National statistics in relevant markets	Official national data platforms and peer-reviewed published literature	NA	IPCC Tier 3, IPCC Tier 2, or similar data
<b>Regional (e.g., European Union) or global-average statistical data</b>	Global or macroregional (e.g., EU) published statistics	Official data platforms and peer-reviewed published literature	NA	IPCC Tier 1 data
<b>Design data</b> (lowest quality)	Data from the design and/or production stage of a product that specify the expected product lifetime, carbon content, and carbon storage	Conservative estimated lifetime of product based on product design and type (e.g., guarantee or warranty information).	Companies should: <ul style="list-style-type: none"> <li>• Use design data only when no other higher-quality data types are available</li> <li>• Use higher-quality data as soon as they become available</li> </ul>	Half-life of products based on internal studies, expected lifetime of products, etc.

## Downstream traceability for product carbon storage monitoring

As companies seek to improve data quality when accounting for and monitoring product carbon storage, they are encouraged to collect more data specific to their relevant product life cycles and supply chains. This can be achieved by improving traceability to downstream end users. Downstream traceability depends on whether products sold by the reporting company are final products or intermediate products. The eventual end use and end-of-life treatment 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. In such instances, companies should work to improve traceability and data collection before choosing to report product carbon storage, while following the hierarchy provided in Table 15.1.

### 15.4.3 Accounting for and reporting storage in waste carbon pools

Accounting for and reporting waste carbon storage associated with removal-and-storage pathways is optional and is only applicable to agricultural and TCDR-based products when sold products are transferred to waste carbon pools, where adequate measures are taken to avoid soil and groundwater contamination (e.g., in sanitary landfills). For example, the carbon contained in biogenic or TCDR-based materials that are not recycled following demolition of a building and instead are disposed of in sanitary landfills could be accounted for in the waste carbon pool.

This *Guidance* recognizes that carbon stored in landfills exists, but includes carbon storage in waste carbon pools as an optional category reported separately. This is to avoid perverse incentives that could change company behavior to increase waste carbon storage by diverting more products into landfills or that motivate targets to increase carbon stored in landfills.

Storage of carbon in waste carbon pools by definition occurs downstream in the value chain, when the carbon in sold products is transferred to waste carbon pools (e.g., landfills) at the end of the products' life cycle. Accounting for storage in waste carbon pools follows the approach for product carbon storage. To account for storage in waste carbon pools, companies are required to:

- Account for the annual net waste carbon stock change, using the stock change accounting approach, based on inputs to the waste carbon pool from biogenic or TCDR-based carbon sold or otherwise disposed of by the reporting company. If the total biogenic and/or TCDR-based waste carbon stock increases in the reporting year, companies may report storage in waste carbon pools.
- Account for and report waste carbon storage using information regarding the biogenic or TCDR-based carbon content of their waste carbon pools, as well as data regarding the decomposition rate and sequestration of carbon in waste carbon pools. Companies should follow the same data hierarchy in Table 15.1 for product carbon storage calculations, adapted to biogenic and/or TCDR-based carbon in products or materials sold or otherwise disposed of by the reporting company during their end-of-life treatment stage, excluding recycling and reuse.
- Account for and separately report losses of the stored carbon if the total biogenic and/or TCDR-based waste carbon stock decreases in the reporting year (e.g., more carbon leaves the waste carbon pool than carbon entering the waste carbon pool).
- Account for and report all GHG emissions from the end-of-life treatment of products or materials sold or otherwise disposed of by the reporting company (including emissions from landfills in scope 3, category 12) in the year that the products are sold. For scope 3, category 12, some emissions are expected to occur in future

years that are due to the activities of the company in the reporting year. Consistent with the *Scope 3 Standard*, companies should account for and report all GHG emissions from the end-of-life treatment of sold products that are expected to occur in the reporting year, as well as in the future, without any time boundary.

- Only account for storage in waste carbon pools where adequate measures are taken to avoid soil and groundwater contamination.

Note that accounting for and reporting waste carbon storage is distinct from accounting for emissions associated with food loss and waste, or emissions associated with biogenic wastes. Companies are required to account for emissions and other metrics associated with losses and the waste of agricultural products (e.g., food loss and waste) that occurred *prior* (i.e., upstream in the value chain) to purchase by the reporting company, in scope 3, category 1 (see Requirement 3). Similarly, companies are required to account for emissions associated with the use (e.g., GHG emissions associated with the transporting and processing of agricultural residues to be used as a bioenergy feedstock) or disposal (e.g., CH<sub>4</sub> emissions from the decomposition of municipal solid waste in a landfill) of biogenic waste materials generated by the reporting company (see Section 11.4.5).

## Reporting waste carbon storage

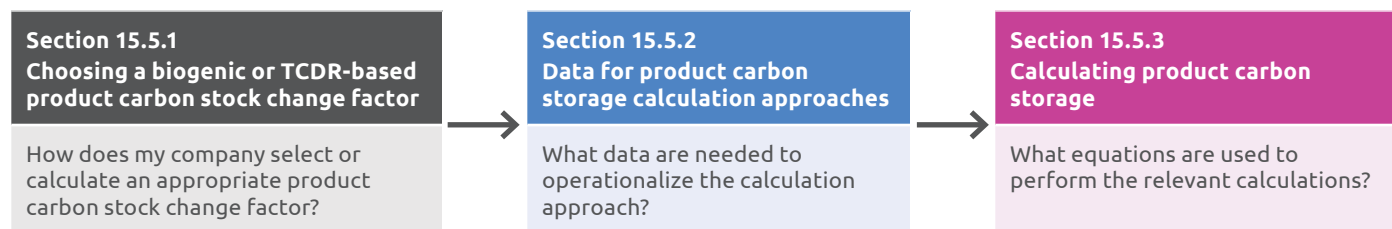
Companies that optionally account for and report biogenic carbon stock increases in their waste carbon pools do so under scope 3, category 12 as “biogenic waste carbon storage” and TCDR-based carbon stock increases in their waste carbon pools as “TCDR-based waste carbon storage,” separately from the physical GHG inventory.

Waste carbon storage is not fungible with emissions, removals, or product carbon storage reported in scope 3. Waste carbon storage cannot be aggregated or netted with scope 3, category 12 emissions. Scope 3, category 11 and category 12 emissions are accounted for and reported using flow accounting approaches and have a different time boundary (see Chapter 5 in the *Scope 3 Standard* for details) than that used to account for waste carbon storage, which is quantified using net carbon stock changes on an annual basis. Waste carbon storage is not fungible with removals, as in most instances, companies are unable to meet the removal requirements in this *Standard* for removals that would be necessary to account for and report removals associated with waste carbon storage pathways. Waste carbon storage is reported separately from product carbon storage to differentiate carbon storage in a product’s use stage (which companies may seek to incentivize) from storage in a product’s end-of-life stage (which should not be incentivized).

## 15.5 Calculating product carbon storage

This section provides guidance on calculating product carbon storage. The calculation guidance in this section can also be adapted and used to account for and report on waste carbon storage following the guidance in Section 15.4.3. Figure 15.3 provides an overview of the calculation guidance in Section 15.5.

**Figure 15.3** Overview of Section 15.5



### 15.5.1 Choosing a biogenic or TCDR-based product carbon storage change factor

Instead of selecting and applying an average product carbon stock change factor, companies need to calculate the net product carbon stock changes relevant to their value chain using information that is specific to their relevant activities, product types, and markets where products are sold. When accounting for and reporting product carbon storage for agricultural or TCDR-based products, companies need information about the quantity of a product entering the use stage (i.e., the quantity of a product that is sold), the fraction of total product carbon of biogenic or TCDR-based origin, and the decay rates of the products (see Section 15.5.2). These data are then applied to the relevant equations in Section 15.5.3.

### 15.5.2 Data for calculating product carbon storage

Table 15.2 provides a general overview of the types of data needed to estimate biogenic product or TCDR-based product carbon storage. See Table 15.1 for the recommended data quality hierarchy for calculating product carbon storage.

**Table 15.2** Data for calculating and reporting product carbon storage

Data	Description
<b>Biogenic or TCDR-based carbon content of sold products</b>	<p>Carbon content data provide information regarding the mass of biogenic or TCDR-based carbon contained in the product carbon pool(s). For example, for bio-based packaging material or bioplastics, this would include the fraction of total C in the material derived from agricultural products. To calculate and report on biogenic and TCDR-based product carbon storage, companies should use product life cycle data specific to the biogenic or TCDR-based products sold by the reporting company. Where storage in the use stage may include different intermediate biogenic and TCDR-based products with different carbon contents, companies should follow the data hierarchy provided in Table 15.1 for each intermediate product.</p> <p>The biogenic or TCDR-based carbon content of the product can be calculated based on direct measurement of the biogenic and TCDR-based inputs to the product (primary data), or based on data collected from peer-reviewed literature and databases specific to the reporting company’s value chain, product type and category, and region.</p>
<b>Product decay rates or half-life values for sold biogenic and/or TCDR-based products</b>	<p>Product decay rates or half-life values provide information regarding the expected duration of carbon storage in the product carbon pools. For example, for bioplastics, this would represent the expected half-life of the product (i.e., the number of years it takes to lose one-half of the material from the use stage of the product). Data on annual changes in product carbon stocks are essential to provide accurate estimates of product carbon storage, their losses, and the associated uncertainty. The product decay rates or half-life should reflect the average product service life (storage duration) and any end-of-life fate that includes recycling or reuse for the product type and value chain in which the product carbon storage occurs. It must exclude end-of-life treatment where carbon is transferred to waste carbon pools (e.g., the product decay rate or half-life value must exclude any carbon storage within landfills).</p>

### 15.5.3 Calculating product carbon storage

When calculating product carbon storage, companies apply Equation 15.1 to estimate the annual net change in product carbon stock for agricultural and TCDR-based product carbon pools.

**Equation 15.1 Annual net product carbon stock change**

$$\Delta C_{P_k} = C_{P_{k,y+1}} - C_{P_{k,y}}$$

Description	Unit	Source
$\Delta C_{P_k}$ Annual net product carbon stock change for product type $k$ , sold by the reporting company during the reporting year	tonnes C (year) <sup>-1</sup>	Calculated
$C_{P_{k,y+1}}$ Product carbon stock for product type $k$ at the end of the reporting year $y+1$	tonnes C	Equation 15.2, 15.5
$C_{P_{k,y}}$ Product carbon stock for product type $k$ at the beginning of the reporting year $y$	tonnes C	User input
$k$ Product or material type		User input
$y$ Reporting year		User input

Source: Equation adapted from IPCC (2019a), Volume 4: Agriculture, Forestry and Other Land Use; Chapter 12: Harvested Wood Products; Equation 12.2.

### Calculating biogenic product carbon stock

The annual net biogenic product carbon stock change in the reporting year represents the annual losses from, and annual gains to, the aggregate biogenic product carbon pool associated with all biogenic products of a particular product type sold by the reporting company (i.e., carbon added to the product carbon pool associated with all relevant products sold by the reporting company, whether they were sold in the reporting year or in past years).

Using Equation 15.2, companies estimate annual net biogenic product carbon stocks at the end of the reporting year based on the decay of previously sold biogenic products of a particular product type and the new inputs of biogenic carbon to the aggregate biogenic product carbon pool from products of a particular product type sold by the company in the reporting year. Depending on data availability, companies can convert between decay constants and half-lives for a given product type and its particular value chain using Equation 15.3.

The biogenic product carbon stock for a given biogenic product type at the beginning of the year should be estimated based on the calculated biogenic product carbon stock at the end of the previous year, and where product carbon stock estimates over time are quantified relative to a defined base year or base period. Companies should estimate the base year biogenic product carbon stock for each biogenic product type using historical data representing the mass of biogenic carbon in sold products and the emissions from those carbon pools in the inventory base year or period. Where no biogenic product storage was previously reported by a company, omitting calculations from years prior to the base year or base period will not lead to any overestimation of the product carbon storage impact of activities in a company’s value chain; however, data from the base year or base period are necessary.

Where data on the biogenic product carbon stock in the base year or base period are not readily available, companies can approximate the base-year biogenic product carbon stock using a five-year reference period representative of historic production in the base year or period and a decay constant, following Equation 15.4.

**Equation 15.2 Calculating biogenic product carbon stocks**

$$C_{BP_{k,y+1}} = (C_{BP_{k,y}} \times e^{-DC_k}) + \left( M_{k,y} \times f_{B_{k,y}} \times \frac{1 - e^{-DC_k}}{DC_k} \right)$$

Description	Unit	Source
$C_{BP_{k,y+1}}$ Biogenic product carbon stock for product type $k$ at the end of the reporting year $y+1$	tonnes biogenic C	Calculated
$C_{BP_{k,y}}$ Biogenic product carbon stock for product type $k$ at the beginning of the reporting year $y$	tonnes biogenic C	User input
$DC_k$ Decay constant for product type $k$ , specific to the particular value chain	year <sup>-1</sup>	User input or Equation 15.3
$M_{k,y}$ Mass of product type $k$ , sold in reporting year $y$	tonnes product (year) <sup>-1</sup>	User input
$f_{B_{k,y}}$ Fraction of total product carbon of biogenic origin in product type $k$ , sold in reporting year $y$	tonnes biogenic C (tonnes product) <sup>-1</sup>	User input or default value
$e$ 2.718 (mathematical constant)		Constant
$k$ Product or material type		User input
$y$ Reporting year		User input

Source: Equation adapted from IPCC (2019a), Volume 4: Agriculture, Forestry and Other Land Use; Chapter 12: Harvested Wood Products; Equation 12.2.

**Equation 15.3 Product decay constant and its relation to product half-life**

$$DC_k = \frac{\ln(2)}{HL_k}$$

Description	Unit	Source
$DC_k$ Decay constant for product type $k$ , specific to its particular value chain	year <sup>-1</sup>	Calculated
$HL_k$ Average half-life for product type $k$ , specific to its particular value chain	year	User input
$\ln(2)$ 0.693 (mathematical constant)		Constant
$k$ Product or material type		User input

Source: Equation adapted from IPCC (2019a), Volume 4: Agriculture, Forestry and Other Land Use; Chapter 12: Harvested Wood Products; Equation 12.2.

**Equation 15.4 Biogenic product carbon stock estimation based on historical data**

$$C_{BP_{k,yr_b}} = \frac{\left[ \frac{\sum_{yr=1}^5 (M_{k,yr} \times f_{B_{k,yr}})}{5} \right]}{DC_k}$$

Description	Unit	Source
$C_{BP_{k,yr_b}}$ Biogenic product carbon stock for product type $k$ , at the beginning of the base year	tonnes biogenic C	Calculated
$M_{k,yr}$ Mass of product type $k$ , sold in year $yr$ of the 5-year reference period	tonnes product (year) <sup>-1</sup>	User input
$f_{B_{k,yr}}$ Fraction of total product carbon of biogenic origin, in product type $k$ , sold in year $yr$ of the 5-year reference period	tonnes biogenic C (tonnes product) <sup>-1</sup>	User input or default value
$DC_k$ Decay constant for product type $k$ , specific to its particular value chain	year <sup>-1</sup>	User input or Equation 15.3
$k$ Product or material type		User input
$yr$ Year in the 5-year reference period		User input
$yr_b$ Base year, i.e., year 1 ( $yr = 1$ ) in the 5-year reference period		

Source: Equation adapted from IPCC (2019a), Volume 4: Agriculture, Forestry and Other Land Use; Chapter 12: Harvested Wood Products; Equation 12.4.

### Calculating TCDR-based product carbon stock

The annual net TCDR-based product carbon stock change in the reporting year represents the annual losses from and annual gains to the aggregate TCDR-based product carbon pool associated with all TCDR-based products of a particular product type sold (in the reporting year or in past years) by the reporting company. Annual net TCDR-based product carbon stocks at the end of the reporting year are estimated based on the decay of previously sold TCDR-based products of a particular product type and the new inputs of TCDR-based carbon to the aggregate TCDR-based product carbon pool from products of a particular product type sold by the company in the reporting year, using Equation 15.5.

The TCDR-based carbon stock for a given TCDR-based product type at the beginning of the year should be estimated based on the calculated TCDR-based product carbon stock at the end of the previous year, and where product carbon stock estimates over time are quantified relative to a defined base year or base period. Companies should estimate the base year TCDR-based product carbon stocks using historical data representing the mass of carbon derived from technological CO<sub>2</sub> removal processes in the first year that TCDR-based products were sold.

**Equation 15.5 Calculating TCDR-based product carbon stock**

$$C_{TP_{k,y+1}} = (C_{TP_{k,y}} \times e^{-DC_k}) + \left( M_{k,y} \times f_{T_{k,y}} \times \frac{1 - e^{-DC_k}}{DC_k} \right)$$

Description		Unit	Source
$C_{TP_{k,y+1}}$	TCDR-based product carbon stock for product type $k$ at the end of the reporting year $y+1$	tonnes TCDR-based C	Calculated
$C_{TP_{k,y}}$	TCDR-based product carbon stock for product type $k$ at the beginning of the reporting year $y$	tonnes TCDR-based C	User input
$DC_k$	Decay constant for product type $k$ , specific to its particular value chain	year <sup>-1</sup>	User input or Equation 15.3
$M_{k,y}$	Mass of product type $k$ sold in reporting year $y$	tonnes product per year	User input
$f_{T_{k,y}}$	Fraction of total product carbon originating from TCDR processes in product type $k$ , sold in reporting year $y$	tonnes TCDR-based C (tonne product) <sup>-1</sup>	User input or default value
$e$	2.718 (mathematical constant)		Constant
$k$	Product or material type		User input
$y$	Reporting year		User input

Source: Equation adapted from IPCC (2019a), Volume 4: Agriculture, Forestry and Other Land Use; Chapter 12: Harvested Wood Products; Equation 12.2.

**Endnotes**

- 1 This *Standard* recognizes that carbon stored in landfills exists, but includes it as an optional category of the waste carbon pool outside of the inventory, due to incentives related to landfilling (i.e., there is a consensus that companies should not be encouraged to change their behavior to put more materials into landfills or to set targets to increase carbon stored in landfills).
- 2 This requirement is currently only applicable to product carbon storage in agricultural products and TCDR-based products. Product carbon storage requirements for forest product carbon storage are still pending to ensure alignment with the resolution on forest carbon accounting in future versions of this *Standard*.
- 3 This requirement is currently only applicable to agricultural product carbon storage. Land requirements for forest product carbon storage are still pending to ensure alignment with the resolution on forest carbon accounting in future versions of this *Standard*.
- 4 This requirement is currently only applicable to product carbon storage in agricultural products and TCDR-based products. Reporting requirements for forest product carbon storage are still pending to ensure alignment with the resolution on forest carbon accounting in future versions of this *Standard*.
- 5 Detailed guidance on accounting for removals due to enhanced rock weathering is not provided in this version of the *Guidance* due to the need for additional research and methodology development at the time of publication. See, e.g., Beerling et al. (2025).

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