Carbon origin

Application guideline

Carbon Added Accounting

Make the CO_2e footprint of products and services demonstrably reliable

Connekt

Topsector Logistiek

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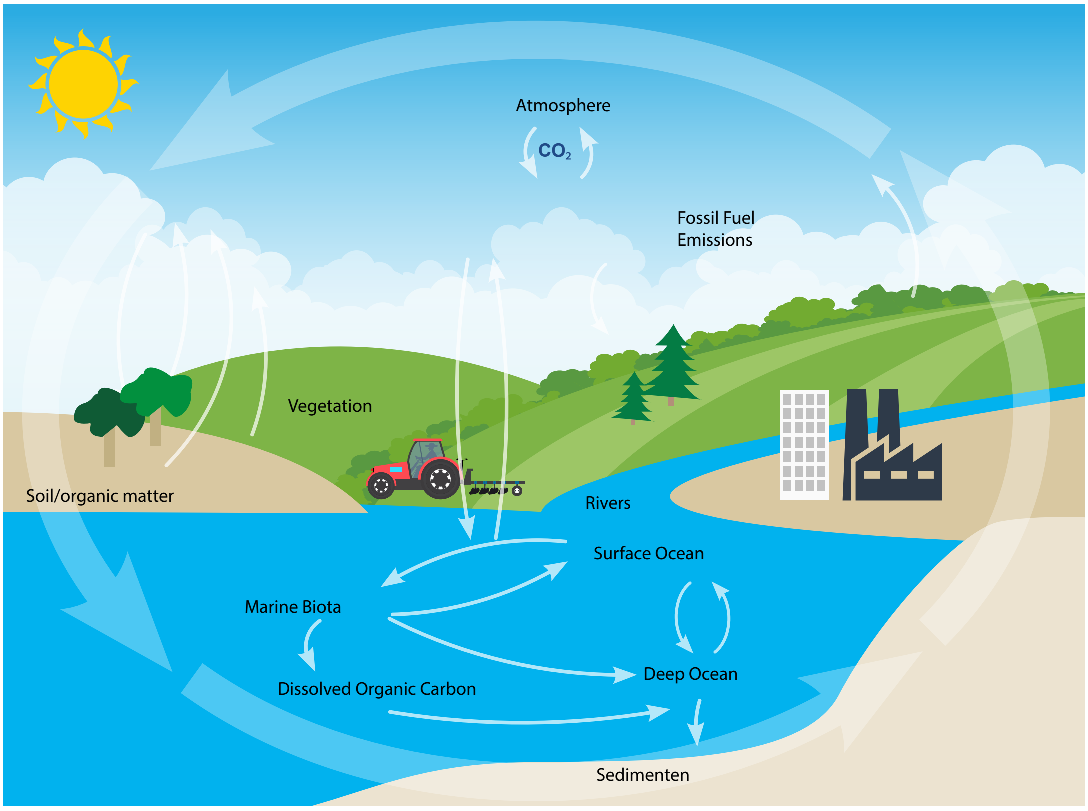
1 Carbon origin

This guideline describes the methodology with regard to the allocation of carbon origin in relation to the Carbon Added Accounting methodology. Although the registration of carbon origin - also known as carbon tracking - does not in itself provide accurate CO_2e values, the registration and allocation of carbon origin can be used to visualise the chain effects of circular measures, such as recycling and the use of (bio-based) substitution raw materials. This is partly in line with government objectives (e.g. the Climate Agreement of the Dutch government). This application guideline describes how carbon origin can be registered, how it can be allocated to end products and how it can be shared in the chain.

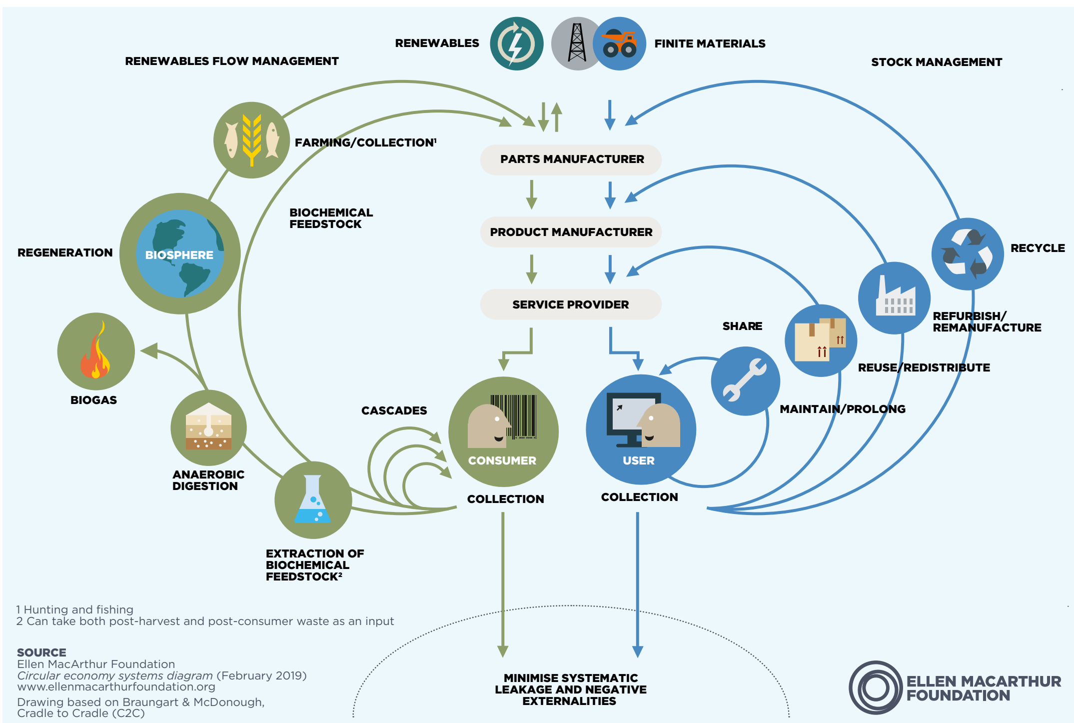


2 The importance of carbon origin

The Dutch government wishes to increase insight into the origin of carbon by setting up a Carbon Tracking system that can be used for and by the industry to primarily map out the indirect (scope 2 and 3) chain effects of CO_2e. The system must focus on the effectiveness and chain effects of sustainable and circular measures with regard to CO_2e, such as replacing fossil raw materials with biomass, recyclate or CO_2e from other processes. This in order to ultimately determine which measures and incentives can be used to reduce indirect emissions.

To achieve a circular economy for carbon, and to show the impact of the materials used throughout the chain, it is desirable to extend CO_2 e-accounting with carbon origin. A circular economy is an economic system in which raw materials are sourced sustainably, fewer raw materials are needed per product and raw materials are reused as much as possible or other useful products are processed (recycling).
For example, construction debris can serve as a foundation under roads, waste paper is raw material for the paper industry and new plastic is made from used plastic bottles. In this way, the linear economy - where raw materials are extracted, used and discarded - is broken. The use of plant and animal material as renewable raw material for products and energy (or a bio-based economy) can also be seen as an important step towards making the circular economy carbon neutral (see: the butterfly model).

The butterfly model



A circular economy is therefore a broader concept than just a closed carbon chain. This Carbon Added Accounting Guideline, however, is limited to the processing of carbon origin in the CO_2e footprint.

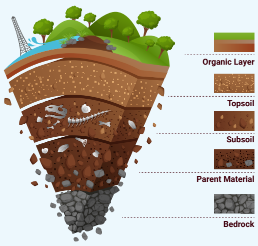
The principle of carbon origin

To gain the above insight, four categories have been defined for carbon origin, namely fossil, biomass, recycled and CO_2e source. The application of these categories allows to deal with differences in carbon origin of all components of the different GHG scopes. By dividing carbon origin by carbon origin categories and sharing this information with the next chain partner, there will be an insight into the reliability of the reported CO_2e output throughout the chain.

Carbon origin categories

The four categories of carbon origin of this guideline are defined as follows.

Fossil (F)



Fossil raw materials are hydrocarbon compounds that have arisen from remains of plant and animal life in the Earth's geological past. These include petroleum, natural gas, coal, peat and lignite. These fossil raw materials are used as a source of energy, but also for making various products. Fossil raw materials contain carbon that was captured mainly by plants millions of years ago. At the time, the carbon was not released as CO_2e (after the decay of the plants) because it ended up under layers of soil.

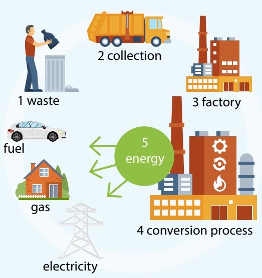
In the long time underground, the material fossilised and was no longer part of the carbon cycle. However, because we now use such raw materials as fuel, the carbon is released into the atmosphere in considerable quantities. In addition to amplifying the greenhouse gas problem, fossil raw materials become scarce due to their consumption and they eventually run out.

Biomass (B)

Biomass is defined by the European Renewable Energy Directive as the biodegradable fraction of products, waste and residues of agriculture (including plant and animal materials), forestry, fisheries and aquaculture and related industries, as well as the biodegradable fraction of industrial and municipal waste. An important difference with fossil raw materials is that biomass and fossil raw materials both have an organic origin, but that fossil raw materials have been transformed over time by geological processes. For this reason, fossil raw materials are not renewable and are not counted as biomass.

**Recycling is not the same as reuse. An important difference with reuse is that a product (or parts thereof) is reused without separating it into raw materials.*

Recycled (R)

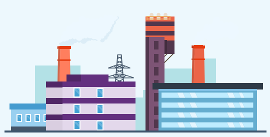


By recycled we mean the reuse of materials as raw materials for new products. Recycling* can occur in various forms such as:

1. Recycling the raw materials for a similar purpose (e.g. paper, plastics or glass). Some raw materials, such as plastics or paper, often deteriorate in quality (also known as downcycling), or

2. Recycling the raw materials for another purpose: such as using petroleum to make plastics first and in the second instance burn them to use as an energy source.

CO_2e source (C)

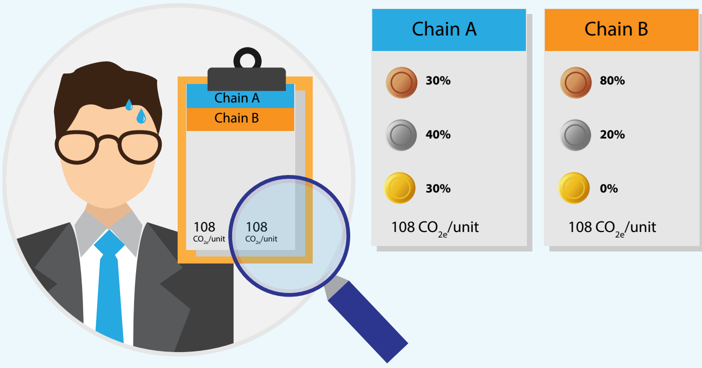


In addition to storing CO_2e, there are alternative ways to capture or reuse CO_2e. Some of these methods are already in use, however the climate benefits are variable. CO_2e that is released from industry or power stations can be used for greenhouse horticulture: CO_2e makes crops grow faster. This use of CO_2e from industry or power plants only helps the climate if it reduces or prevents CO_2e emissions elsewhere.

The CO_2e mainly comes from the chemical industry. One option that is being worked on is to capture CO_2e at a new coal-fired power station and store it in a gas field. When the gas field is full, it can be used as a seasonal buffer for greenhouse horticulture. Other sources being worked on include CO_2e from biogas, CO_2e from the flue gases of waste incineration plants and wood combustion plants and CO_2e from the open air. Important points for attention are, in addition to the CO_2e quality, the capture technique and CO_2e transport.

3 Insight

After calculating the allocation, the data quality of allocation is indicated for each (smallest) part of the allocation. Including allocation categories in the data leads to meaningful analyses.



In this way, the fact that emission values across a chain are composed of data quality will remain visible:

- 30% with carbon origin fossil,
- 40% biomass, and
- 30% recycled.

If another chain has a similar emission value with data quality consisting of:

- 80% with carbon fossil, and
- 20% biomass.

This shows the different context to the comparison of the two values. In the latter case, it means that 80% of the 108 kilograms of CO_2e (86.4 kg) is based on fossil raw materials. Although the emission value of chain A is equal to that of chain B, it is considerably 'greener' in origin.

4 Carbon origin for logistics companies

A good solution for dealing with differences in carbon origin is to add carbon origin categories. This is done by dividing the CO_2e output values into the categories fossil, biomass, recycled and CO_2e source. Below, we describe the origins and characteristics of various biofuels (source: Shell):

- **Biofuels:**
  produced from organic material (biomass) such as corn, sugar, vegetable oils or waste materials. Because they emit less CO_2e than conventional fuels, they can be blended with existing fuels as an effective way to reduce CO_2e emissions in the transport sector.

- **Advanced biofuels:**
  processes that produce fuels from waste (animal fat and used cooking oil), inedible crops or wood waste are known as advanced or second-generation biofuels.

- **Bioethanol:**
  produced by fermenting sugar or starch from products such as sugar cane, corn or wheat and mixed with gasoline. When inedible crops are used, the bioethanol is described as second-generation or advanced biofuel.

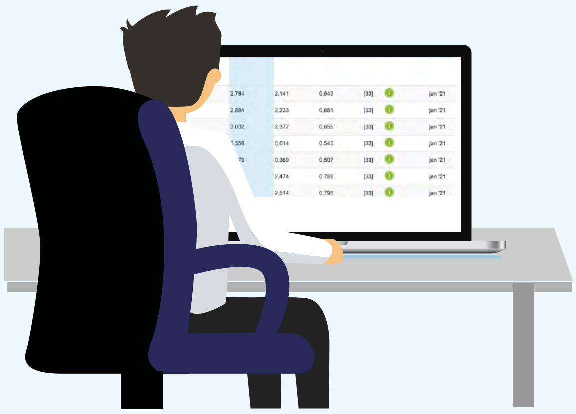
- **Sustainable jet fuel:**
  renewable diesel and sustainable jet fuel. A colourless and odourless fuel, the chemical composition of which is identical to fossil diesel.

- **Hydrogen:**
  this is seen as a key role in the success of the energy transition, preferably green hydrogen, produced with electricity from wind or sun and without CO_2e emissions.

Request

For all components in fuels, it is in principle possible to request the ratio of the carbon origin from the supplier. If no information can be obtained, the least favourable carbon origin category should be chosen, i.e. fossil.

Recording



It is also important to record the carbon origin - or origin percentages - per category, per component in an overview of emission factors.

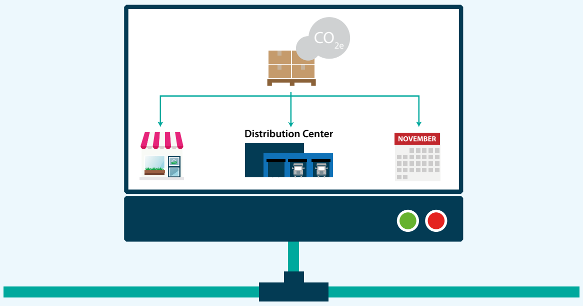
Allocation

Based on this, parallel to the allocation of CO_2e values to transport movements and the allocation of data quality, the carbon origin is allocated to the footprint. Suppose transport movements are realised with a mix of 90% fossil origin and 10% with biomass origin, then the CO_2 key figures are shown as follows.

Key figures	Fossil	Biomass	Recycled	CO_2e source
CO_2e	66,699 kg CO_2e (90.0%)	7,411 kg CO_2e (10.0%)	0 kg CO_2e (0.0%)	0 kg CO_2e (0.0%)
CO_2e/ton	79.07 kg CO_2e/ton (90.0%)	8.79 kg CO_2e/ton (10.0%)	0 kg CO_2e (0.0%)	0 kg CO_2e (0.0%)

The use of biofuels has increased over the last decade, largely due to the introduction of a new energy policy in Europe, the US and Brazil, which demands more renewable, low-carbon fuels for transport. When biofuels are used in transport, they emit CO_2e that is captured by plants or is recycled from materials such as animal fat, used cooking oil or municipal waste.

Sharing



A logistics service provider who self-allocates CO_2e according to these guidelines, can automatically calculate a key figure (or the emission factor) (emissions per produced unit) and provide carbon origin percentages to then share this with the client.

5 Carbon origin for production companies

Adding carbon origin categories is a solution for manufacturing companies in their efforts how to deal with differences in carbon origin.

Power supplier

Mix	Double green	Wind	Green NL	Green	Essent Retail mix	Essent N.V. mix
Renewable energy sources %	100%	100%	100%	100%	100%	65,1%
Renewable NL						
Wind	100,0%	100,0%	100,0%	9,5%	9,0%	6,9%
Sun	0,0%	0,0%	0,0%	0,0%	0,0%	1,1%
Water	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%
Biomass	0,0%	0,0%	0,0%	0,0%	0,0%	0,2%

			0,0%	90,5%	91,0%	52,7%
			0,0%	0,0%	0,0%	0,0%
			0,0%	0,0%	0,0%	4,2%
			0,0%	0,0%	0,0%	0,0%
Gas	0,0%	0,0%	0,0%	0,0%	0,0%	12,9%
Coal	0,0%	0,0%	0,0%	0,0%	0,0%	11,5%

For all components in scope I (e.g. electricity), II (e.g. gas, diesel) and III (e.g. raw materials, assets) it is in principle possible to request the ratio of the carbon origin from the supplier. If no information can be obtained, the least favourable carbon origin category should be chosen, i.e. fossil.

Recording

Scope	Component	Carbon origin	Emission factor	Data quality	Note	Source emission factor
Scope 1	Gas	Fossil	2.085 (kg CO_2e/Nm^3)	Gold	Natural gas WTW	CO2emissiefactoren.nl
Scope 1	Wood chips (NL)	Biomass	0.062 (kg CO_2e/ kg ds)	Silver	WTW	CO2emissiefactoren.nl
Scope 2	Electricity	Fossil	0.523 (kg CO_2e/kWh)	Gold	Grey power WTW	CO2emissiefactoren.nl
Scope 3	Tap water	N/A	0.298 (kg CO_2e/ m^3)	Gold		Milieubarometer.nl
Scope 3	PCR Inside Layer Fossil	Fossil	1.465 (kg CO_2e/kg)	Bronze		Link to online source
Scope 3	PCR Outside layer	Fossil	1.465 (kg CO_2e/kg)	Bronze		Link to online source
Scope 3	Pallets	Recycled	1.469 kg CO_2e/kg)	Bronze		Link to online source

It is also important to record the carbon origin - or origin percentages - per category, per component in an overview of emission factors.

Allocation

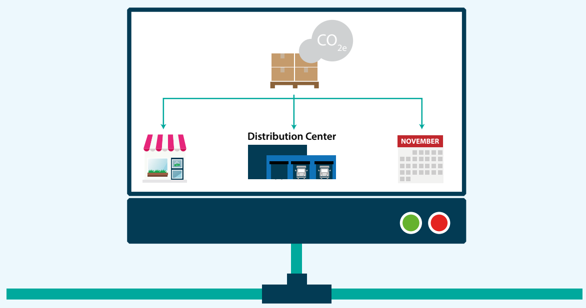
Raw material I	$kgCO_2e$
Fossil	60
Biomass 11	
Recycled	159
CO_2e source	0

Raw material II	$kgCO_2e$
Fossil	11
Biomass 21	
Recycled	0
CO_2e source	0

Raw material III	$kgCO_2e$
Fossil	34
Biomass 0	
Recycled	322
CO_2e source	0

Carbon origin	Total $kgCO_2e$	Fossil $kgCO_2e$	Biomass $kgCO_2e$	Recycled $kgCO_2e$	CO_2e source $kgCO_2e$
Product A	2,118 (100%)	1,605 (75.8%)	32 (1.5%)	481 (22.7%)	0 (0.0%)

A logistics service provider who self-allocates CO_2e according to these guidelines, can automatically calculate a key figure (or the emission factor) (emissions per produced unit) and provide carbon origin percentages to then share this with the client.



A producer who self-allocated CO_2e according to these guidelines, can automatically calculate a key figure (or the emission factor) (emissions per produced unit) and provide carbon origin percentages. If the buyer multiplies that key figure by the carbon origin percentage and the quantity of products purchased, this gives the total purchased CO_2e for each carbon origin category for that product.

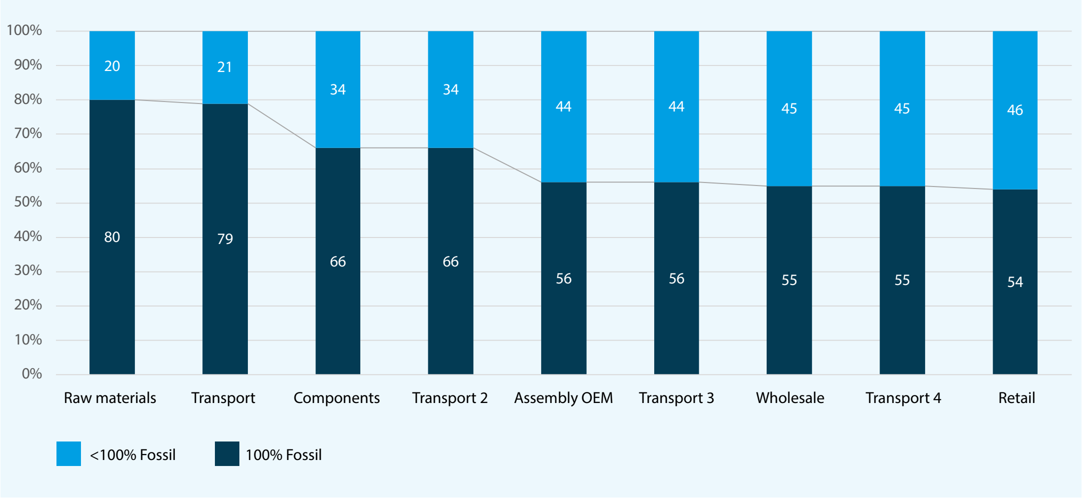
6 Carbon origin in the value chain

In addition to the importance of insight into carbon origin for an individual organisation, insight into carbon origin in chain administrations is even more important. Because each chain party can determine - and often even choose - the carbon origin (percentage) of scope I and II largely accurately, the reliability of the reported carbon origin in the final footprint in chain administrations automatically increases.
See the table below for example of calculations. In practice the carbon origin (percentage) of purchased goods such as raw materials and packaging materials, or scope III, cannot be established accurately.
After all, this requires detailed data from suppliers, sometimes from far abroad, which does not contribute to reliability levels. That is why scope III is often calculated on the basis of the worst carbon origin category i.e. fossil.

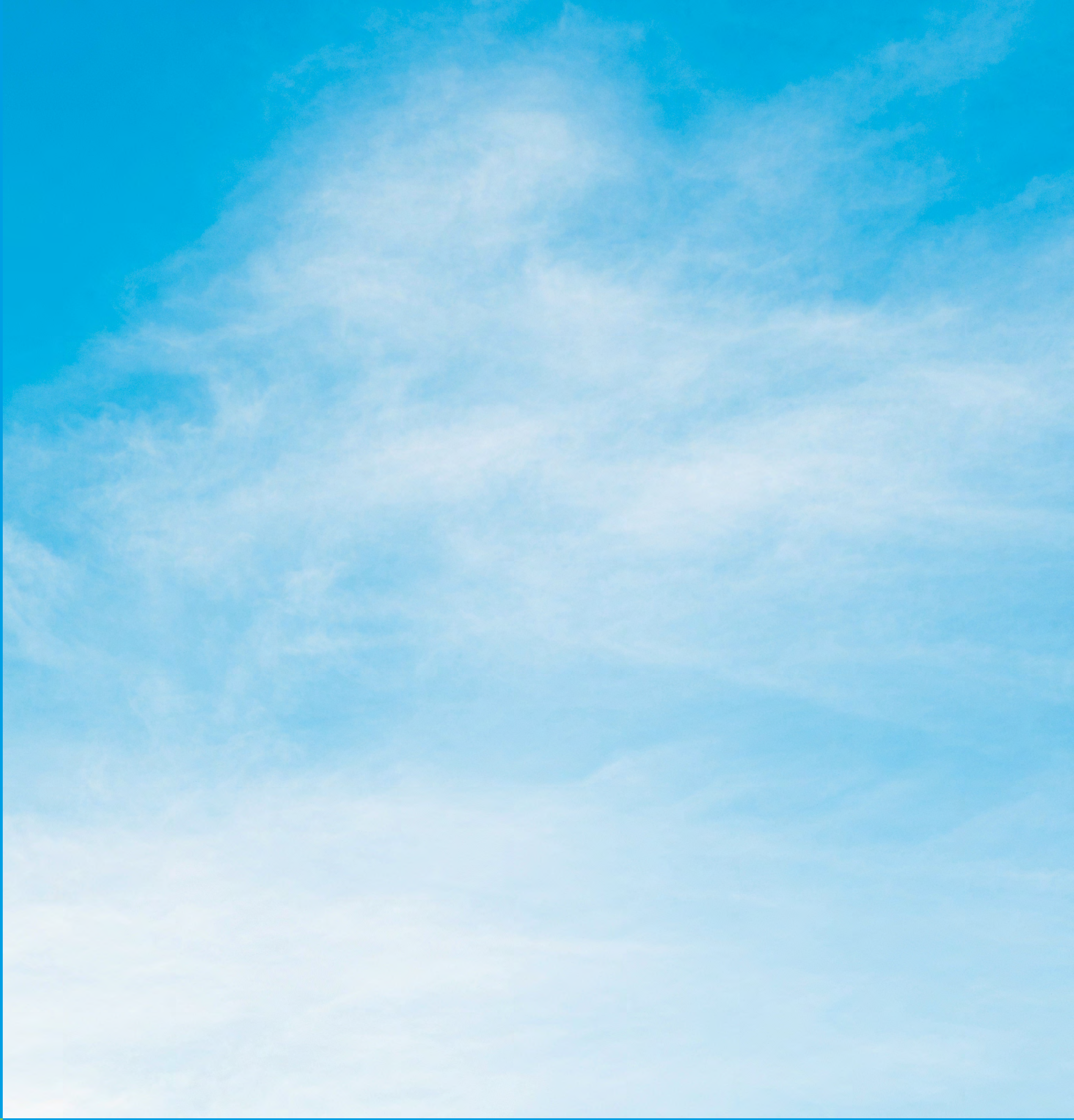
In the calculation example below, it is assumed that scope I and II in all cases have a more favourable carbon origin (expressed as <100% F) than completely fossil and that the scope III input for the first step in the chain (raw materials, for example, through agricultural processes or extraction) is carbon origin: completely fossil (expressed as =100% F).

CO_2e value (kg)	Raw materials	Transport 1	Components	Transport 2	Assembly/ OEM	Transport 3	Whole sale	Transport 4	Retail
Scope I (<100% F)	10	1	10	1	10	1	1	1	1
Scope II (<100% F)	10	0	10	0	10	0	1	0	1
Scope III (=100% F)	80	100	101	121	122	142	143	145	146
Total CO_2e footprint	**100**	**101**	**121**	**122**	**142**	**143**	**145**	**146**	**148**

In the graph below, the aforementioned CO_2e values are expressed in percentage terms in the categories 100% fossil and <100% fossil. If each chain partner passes on its added CO_2e to the next step in the chain on the basis of Carbon Added Accounting, then the share of 100% fossil origin in this calculation example will rise from 80% to 54% by merely sharing carbon added, including carbon origin, with the next chain partner. In short, the more chain partners add their scope I and II to the CO_2e output data based on such data sources, the more favourable the carbon origin of the CO_2e footprint ultimately reported to the consumer.



Providing the carbon origin (percentage) along with the CO_2e values at each step of a value chain, will lead to insight into the final CO_2e footprint for end-users indicating the carbon origin (percentage) per category.



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