Carbon Handprint Guide

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Glossary

Baseline (solution)	A product or combination of products which delivers the same function(s) to a customer or multiple customers as the alternative handprint solution and is/are used for the same purpose(s) as the handprint solution by the customer(s) within a specific time period and region. The carbon handprint solution is compared to the baseline solution with respect to its climate change impact.
Carbon footprint	The sum of GHG emissions and removals in a product system expressed as CO2 eq. and based on an LCA using the single impact category of climate change (ISO 14067: 2018).
Carbon handprint	An indicator of climate change mitigation potential. Describes the GHG emission reduction in a customer's activities that occurs when the customer replaces a baseline solution with a handprint solution.
Communication unit	A clearly understandable, informative and representative unit of reference with which a carbon handprint result can be communicated to the customer or the public.
Critical review	A review of an LCA, footprint or handprint study by an independent third party not involved in the study to ensure consistency between the study and the principles and requirements of LCA (ISO 14044), i.e. to verify the calculation and the results.
Customer	User or applier of the handprint and baseline product. Can be a known or potential customer.
Footprint	An LCA-based metric that describes the potential negative environmental impacts of a product system. Limited to a specific environmental theme or impact category. For example, carbon footprint (climate change impacts) (ISO 14067) or water footprint (water-related impacts) (ISO 14046).
Handprint	An LCA-based metric that describes the potential positive environmental impacts of a customer's (or customers') activities achieved by replacing a baseline solution with a handprint solution.

Handprint contributor	Mechanisms by which a customer's or multiple customers' GHG emissions and carbon footprint can be reduced and, thereby, carbon handprint generated.
Handprint solution	A product with positive environmental impact potential used by a customer (or customers) as an alternative to a baseline solution.
Life cycle assessment, LCA	A methodology to quantify and assess the inputs, outputs and potential environmental impacts of a product system throughout its life cycle (ISO 14040; ISO 14067:2018).
Product	In this Guide, the term product is used broadly meaning, for example, raw materials, components, fuels, technologies, processes, products or services. A product's carbon footprint and carbon handprint can be assessed.
Product system	A model of the life cycle of a product; consists of unit processes and their flows and performs (a) specific function(s) (ISO 14067:2018)
Solution	A product used by a customer.

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1. Introduction

For many companies and organizations the day-to-day challenge of reducing their environmental footprint – using resources more efficiently and minimizing emissions and waste – is already business as usual. Some, though, have gone far beyond this and are developing products, services and technologies that also reduce the environmental impacts of their customers. The need to calculate and communicate these positive environmental benefits is clear, yet there has been a clear lack of effective methods of achieving this.

Environmental impacts are typically assessed by measuring and modelling the negative effects that products, services and companies cause to the environment. In practice, this means evaluating the used resources and energy and the emissions caused. To ensure optimization of overall environmental performance, life cycle thinking based methods are widely implemented. These assessment practices are thoroughly guided by the ISO standards for life cycle assessment (ISO 14040-44: 2006), carbon footprint (ISO 14067: 2018) and water footprint (ISO 14046: 2014). However, life cycle assessment in its current form does not provide for assessing positive environmental impacts. Some industries and individual companies have introduced handprints to communicate the environmental benefits of their actions. Yet these approaches differ in their quantification methods and no systematic grounded approach has been available.

VTT Technical Research Centre of Finland Ltd and LUT University have developed a new approach for quantifying carbon handprint based on standardized methods. The work has been conducted in cooperation with 10 industrial partners representing different business areas and products and has thus benefitted from insider understanding of the varying requirements that arise from diverse operating environments. At the same time, the similarities between different cases have been identified leading to the creation of a decision pathway that helps to define baselines and take the required calculation steps. This step-by-step guide directs you through the process of assessing and communicating the carbon handprint of a product in line with life cycle assessment and carbon footprint methods.

2. **What is** a carbon handprint?

A handprint refers to the beneficial environmental impacts that organizations can achieve and communicate by providing products that reduce the footprints of customers.

A carbon handprint is the reduction of the carbon footprint of a customer or customers.

In contrast to carbon *footprint*, which refers to the negative environmental impact caused by greenhouse gas emissions throughout the life cycle of a product, the term carbon *handprint* refers to the positive environmental impact of a product throughout its life cycle.

With the carbon footprint concept the goal is simple – to get the footprint to close to zero; but with handprints there is essentially no limit to the positive impacts that can be achieved. The purpose of carbon handprint assessment is to calculate the beneficial greenhouse gas impacts of a product when used by a (potential) customer.

The carbon handprint approach is built on the principle that reducing one's own footprint is not a handprint. Instead, the handprint achieved by improving the performance of *another* actor – by reducing *their* carbon footprint. The rules for defining the baseline against which the positive impact can be assessed create another fundamental basis of the handprint approach.

The carbon handprint of a product is achieved by comparing the carbon footprint of the baseline solution with that of the carbon handprint solution when used by a customer.

3. **What generates** a carbon handprint?

A number of different mechanisms can contribute to a carbon handprint, such as more efficient material and energy use, replacing or avoiding unwanted materials, reducing waste, extending service life and reuse – or any combination of these. Carbon capture and storage may also be of growing importance as a carbon handprint contributor.

Less GHG intensive material use

Material use:
Replacing non-renewable / GHG intensive materials / Avoiding material use / Increasing material-use efficiency

Less GHG intensive energy use

Energy use:
Replacing non-renewable / GHG intensive energy and fuels / Avoiding energy / fuel use / Increasing energy efficiency

Increased lifetime and performance

Lifetime and performance:
Lengthening the lifetime of a product / Enabling the performance improvement of a product

Reduced waste and losses

Waste:
Reducing waste and losses / Contributing to recycling, reuse, and remanufacture

Increased carbon capture and storage

Carbon capture and storage:
Contributing to GHG sinks through land-use change / Removal of carbon into biomass / Storing of carbon into products

A carbon handprint can be created either by offering a solution with a lower carbon footprint than the baseline solution (Handprint solution A in Figure 1) or by helping the customer to reduce the footprint of his processes (Handprint solution B in Figure 1), or both. An example could be food packaging that is produced with low carbon emissions and that additionally helps to extend the food's shelf life compared to the baseline packaging, thus preventing food waste.

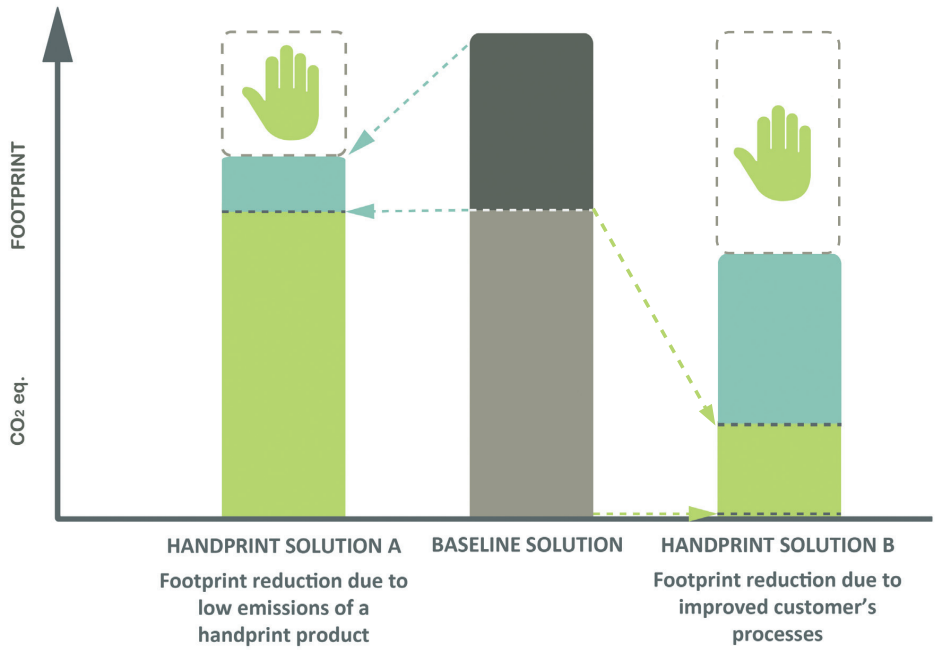

Figure 1. There are various ways to contribute to the carbon handprint.

4. What is a carbon handprint **used for?**

As mentioned above, the goal of carbon handprinting is to assess the positive greenhouse gas impacts that would be achieved when a product is used by a known or potential customer. This can be used for

- Marketing and communications
- Informing and advising decision-makers and other stakeholders
- Identifying opportunities to improve the climate performance of products used by customers.

The intended audience is typically a potential customer (a company (B2B) or consumer (B2C)) but can be any interested party, such as other organizations and industries, political decision makers and communities.

A carbon handprint is not only beneficial for communications; it also enables the identification of potential development needs. The assessment process can even reveal whether no handprint would be created with the current product characteristics when measured with the other parties and options involved in the examined market. This would be valuable information for product developers aiming to meet future sustainability expectations.

5. **Who can calculate** carbon handprints?

Quantification of the carbon handprint is based on a carbon footprint calculation consisting of a life cycle assessment (LCA) that is limited to GHG emissions. Expertise in LCA and a thorough knowledge of the ISO 14067 standard on the carbon footprint of products is therefore a necessity.

Additionally, to understand the operational environment and to set the baseline, experts acquainted with the product, the considered application, and the examined market must be involved in the study.

6. **Step-by-step guide** to carbon handprint calculation

The handprint calculation process consists of four stages and ten steps and is closely based on the LCA method. In the first stage, which is specific to handprint calculation, the conditions of the examined operational environment are identified in order to set a baseline against which a potential handprint can be created. This stage is followed by typical LCA steps and standard footprint calculations. Finally, the communication part is implemented according to the intended audience. As with LCA in general, handprint quantification is essentially an iterative process: the findings of a subsequent step may require the updating of prior steps.

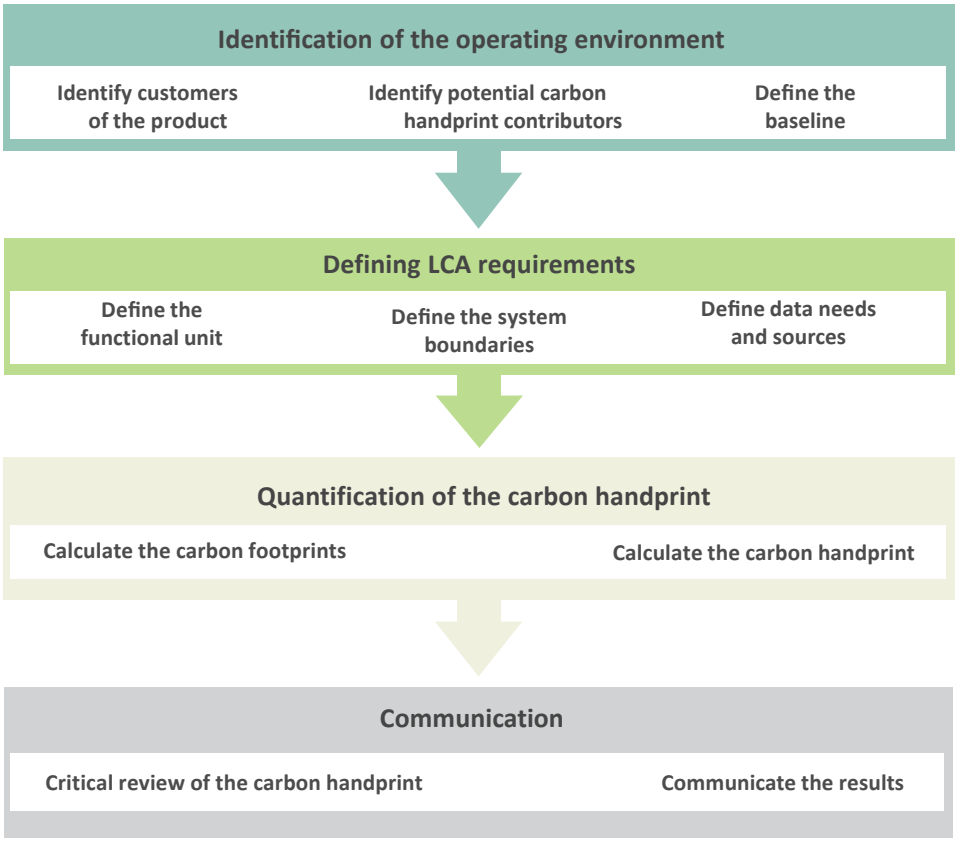

Figure 2. Stages and steps of the carbon handprint approach.

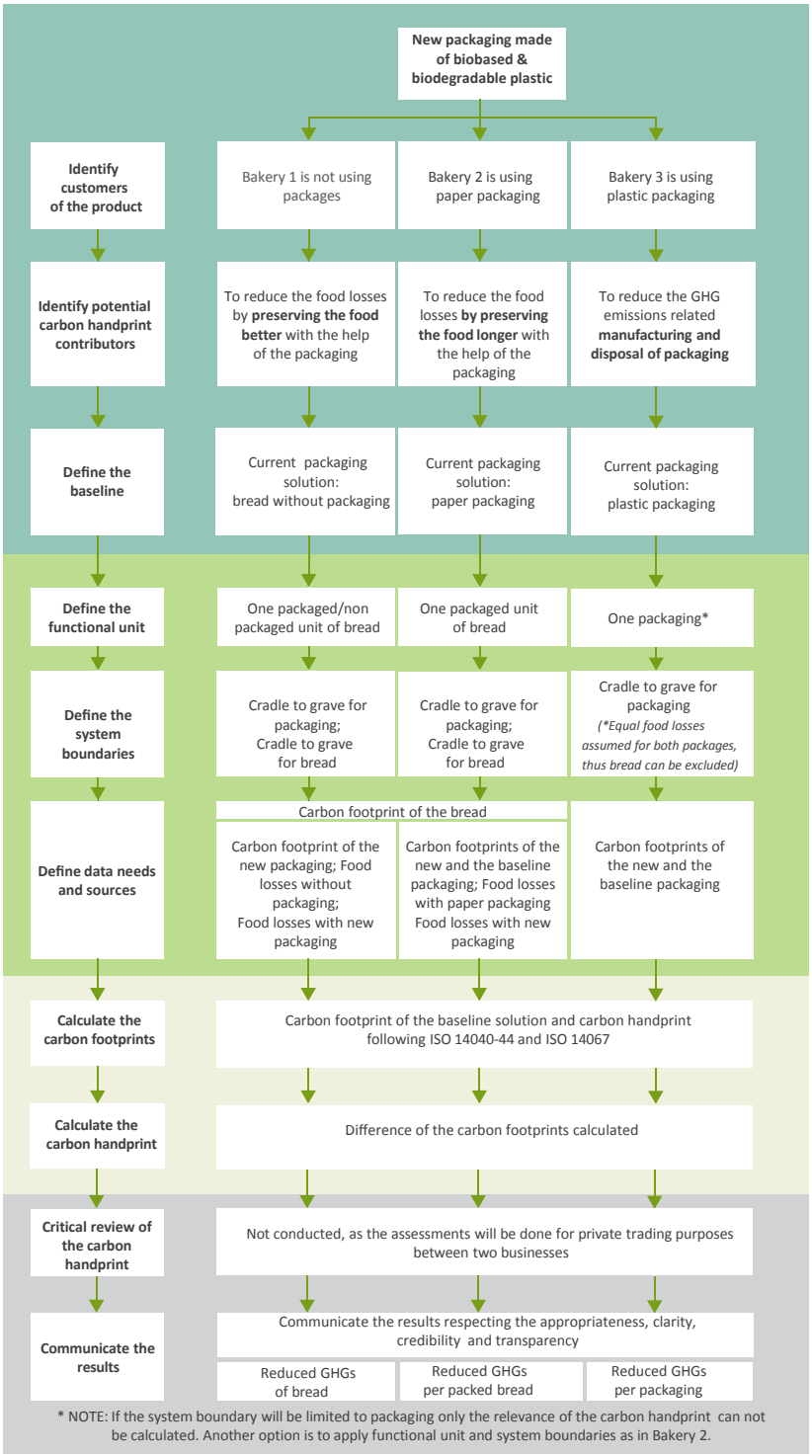

Figure 3. A fictional example of carbon handprint framework for bread packaging used in different bakeries. The template includes the four stages and ten steps.

Stage 1: Identification of the operating environment

Step 1: Identify customers of the product

Carbon handprint is always quantified for a specific situation and a specific type of user. Without a user applying the examined product, no handprint can be created. Therefore, the first step is to identify potential users of the studied product, here referred to as customers. There may be multiple ways of using the product, and its environmental impact will differ depending on the customer and the geographical market. It is therefore necessary to differentiate between customer types. The example carbon handprint framework in Figure 3 can be used as a general template for handprint calculation. It is useful to identify a number of potential customers even though only one would be selected for the handprint study.

Step 2: Identify potential carbon handprint contributors

Contrary to carbon footprint, which represents the absolute sum of GHG emissions and removals in a product system (expressed as CO2 equivalents), carbon handprint refers to a change that will result in a beneficial climate impact. The aim of this step is to identify the hypothetical benefits of the product. How will the product contribute to reducing the customer's carbon footprint? Figure 4 introduces various means by which a carbon footprint can be reduced and may help to identify the potential pros and cons of the product.

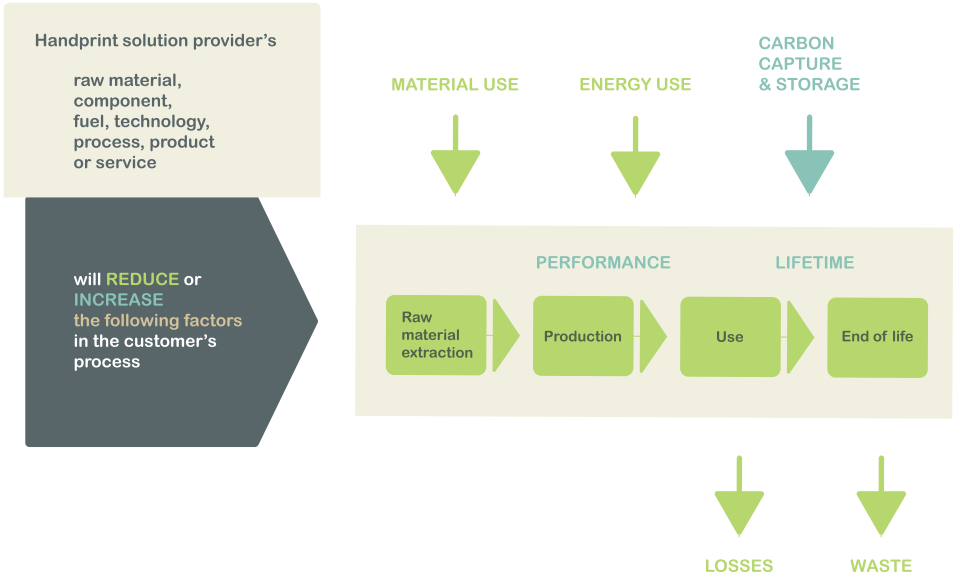

Figure 4. Main carbon handprint contributors.

This process of quantifying the carbon handprint is time and resource intensive. It is recommended to do some screening before starting the full process. Often more than one factor will change, making it difficult to estimate the overall effect at a glance. To gain a better understanding of the potential handprint, a preliminary assessment and screening of possible factors contributing to carbon footprint can be carried out. This can be done using rough data and modelling. Alternatively, an expert panel consisting of industrial and sustainability experts can be called together to discuss and evaluate possible carbon footprint reduction pathways. Only a full handprint quantification will show whether the selected product will have a handprint in reality. The hypothesis is important, however, in order to define a properly grounded baseline and product system boundaries, as described in the steps below.

Step 3: Define the baseline

To be able to quantify the amount of reduced GHG emissions, a baseline situation must be determined as a point of comparison. The baseline refers to the alternative or current solution in place that delivers the same functions to the customer as the product we are evaluating, that is, the handprint solution.

Unless the product is new on the market, the baseline and the handprint solution should both:

- Deliver the same function
- Be used for the same purpose
- Be available in the market and used in the defined time period and geographic region
- Be assessed in a consistent manner (in terms of data quality, representativeness, system boundaries, assumptions, etc.)

How the baseline is defined will clearly have a major impact on the handprint result: choosing a “worst possible” baseline with a poor environmental performance will increase the handprint significantly. The baseline definition must, therefore, be well grounded and transparently reported.

Two fundamental questions affect the baseline. The first is whether the product that is presumed to create a handprint is replacing another product or is new to the market. If the product is new, a comparison will need to be made between the current situation with and without the new product. If, instead, the product replaces another product, this leads to the second fundamental question: Is the targeted application company-specific?

If the customer using the product is known, the baseline, i.e. the current product to be replaced, can be precisely identified. However, if the product is released to the market with a range of potential customers and uses in mind, a number of different baselines will need to be considered. If a certain product can be clearly identified as the market leader, this should be used as the baseline. For example, shopping bags made of renewable raw material (potentially creating a handprint) offer a clear replacement for the plastic bags currently used in shops and supermarkets (the baseline). However, sometimes it is not possible to single out one type of product from the market as the obvious replaceable product. For example, the environmental performance of currently used traffic fuels varies considerably. If you introduce a new type of fuel it is essentially impossible to identify an exact fuel type that it will replace. In such cases, the average should be taken from all options and used as the baseline. A third option is to use the available product specifications, standards or BREF specifications as baselines. This would be justified in cases where the business-as-usual technologies are plentiful and data on competitors is hard to attain. The baseline situation may also be a combination of multiple baseline products to be replaced if the handprint solution is a multi-functional product.

The baseline determination procedure:

1. **Is the product new on the market?**
   a. YES → Use the current situation without the new product as the baseline
   b. NO → Go to question 2

2. **Can the customer be specified?**
   a. YES → Use the customer's current product or another option available on the market as the baseline (not the previous generation product of the handprint provider)
   b. NO → Choose one of the following as the baseline:
      i. Market leader or typical product in the identified reference area and time
      ii. Average product in the identified reference area and time
      iii. Product specification or BREF that determines the available options

Stage 2: Defining LCA requirements

This stage is based on the standard LCA procedure and carbon footprinting in accordance with ISO 14040-44 and ISO 14067.

Step 4: Define the functional unit

The functional unit serves as the basis for quantifying the performance of the studied product system. The primary purpose of a functional unit is to provide a reference on which greenhouse gas emissions are related (e.g. 1 kg of product, annual output, 1kg*km, etc.). This reference is necessary to ensure comparability of the handprint solution to the baseline solution. A system may have a number of possible functions. The one selected for a study depends on the customer and what the customer uses the product for. More information about defining the functional unit can be found in ISO 14040-44.

Step 5: Define the system boundaries

The system boundary defines the unit processes to be included in the system. Ideally, the product system should be modelled in such a manner that inputs and outputs at its boundary are elementary flows (drawn from the environment and released into the environment). However, the exclusion of life cycle stages, processes, inputs or outputs within the system under study is permitted if they do not significantly change the overall conclusions of the study. The selection of the system boundary has to be consistent with the goal of the study and equal in baseline and handprint solutions.

The criteria used in establishing the system boundary should be explained. In the handprint approach it is a necessity to include the product use stage (intended customer application) in the system. Furthermore, in most cases the end-of-life stage has an influence on the overall conclusions and needs to be included. Setting the system boundaries is elaborated in ISO 14040-44 and ISO 14067.

Step 6: Define data needs and sources

After setting the system boundaries the data needs are identified and data is collected. In carbon handprinting, there are two types of premises: the actual customer is known, or the customer cannot be determined but potential customers or customer groups can be identified. If the customer can be specified, the most recent primary data should be applied. If not, statistical or average data must be relied upon.

Data on the main carbon handprint contributors must reflect an actual existing operating environment in both the baseline and handprint solution. Furthermore, the data for the baseline solution and handprint solution require the same timeframe. Where the GHG emissions and removals associated with specific unit processes vary over time, data must be collected over an appropriate time period to establish the average GHG emissions and removals associated with the life cycle of the product.

The data used should be representative in terms of geographical, time-related, and technological coverage, as well as being precise and complete, as determined in ISO 14040-44 and ISO 14067. However, whereas in carbon footprint calculations the time horizon is typically applied retrospectively, in the handprint approach potential near-future implications are assessed prospectively.

Stage 3: Quantification of the carbon handprint

Step 7: Calculate the carbon footprints

Using equal functional units, the carbon footprints of the two systems under comparison are calculated following the standardized methodology of ISO 14067 Carbon footprint of products.

Step 8: Calculate the carbon handprint

Whether the studied product will achieve a carbon handprint is revealed by comparing the carbon footprints of the two systems. The carbon handprint is created if the carbon footprint of a customer's product system is smaller when applying the handprint product than it is when using the baseline product, as expressed by the following equation:

$$Carbon\ handprint_{Product} = Carbon\ footprint_{Baseline\ solution} - Carbon\ footprint_{Handprint\ solution}$$

where

$Carbon\ handprint_{Product}$ = *Carbon handprint of a product used by a customer*

$Carbon\ footprint_{Baseline\ solution}$ = *Carbon footprint of the customer's product system using the baseline product*

$Carbon\ footprint_{Handprint\ solution}$ = *Carbon footprint of the customer's product system applying the handprint product*

The carbon handprint is equal to the carbon footprint reduction that the customer attains (Figure 1). The product that enables the footprint reduction and its producer (the carbon handprint solution provider) gets a handprint, see Figure 5.

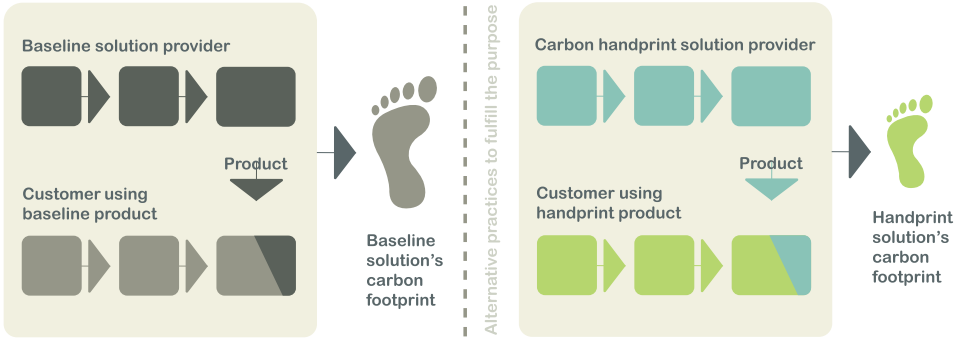

Figure 5. Carbon handprint solution provider receives a handprint equivalent to the achieved carbon footprint reduction.

Stage 4: Communication

Step 9: Critical review of the carbon handprint

A handprint communication may be intended for business-to-business or business-to-consumer communication. ISO Standard 14040-44 on LCA requires a critical review if the study is intended to be used for a comparative assertion intended to be disclosed to the public. ISO 14026 on Communication of footprint information has requirements on comparative footprints respectively. To be in line with these requirements, a critical review is strongly recommended when the handprint communications are used for business-to-consumer communication and the handprint quantification is based on a comparative footprint relative to another organization's products.

A critical review is a helpful way to verify the calculation process and results and is recommended to be considered in all situations. To keep the procedure leaner, the independent reviewer may also be internal from the organization that conducted the handprint study, for example in the case of business-to-business communications.

Step 10: Communicate the results

A company has its carbon handprint endorsed once a customer is utilizing their product instead of the baseline solution. Thus, among other purposes, the carbon handprint functions as a marketing and communication tool. For a customer, the possibility of reducing their footprint can prove to be a considerable sales argument.

At this point an appropriate communication unit needs to be selected. The basic measure of a carbon handprint is carbon dioxide equivalents. However, an informative and representative reference unit may be something other than the functional unit used in the calculations. For example, in case of calculating the carbon handprint of a fuel, a reasonable functional unit would be based on the fuel properties (e.g. energy content). However, mileage may be a more informative unit of communication for the customers actually using the fuel.

The questions that should be considered when planning and preparing the handprint communication are listed below. They are based on basic principles of environmental communication such as those presented in ISO 14026 and 14063. Information that is necessary to communicate is marked with green color. The list is not exhaustive and cannot be used as only guideline for planning communication, but it provides the basic principles in a nutshell.

Whenever making claims about positive environmental impacts based on handprint assessment, it is important to specify the claim, make it understandable to the target audience and present it together with the information that is needed for correct interpretation of the result. Additional information should be provided to interested parties upon request.

Checklist for planning and preparing the handprint communication

* necessary information in green

Appropriateness

- Is the intended audience familiar with the product and the life cycle in question?
- Is the intended audience familiar with the life cycle assessment method or the carbon footprint concept?
- Is the intended audience familiar with the carbon handprint concept?

Clarity

- What is the quantity and reference unit of the calculated handprint?
- What is the baseline scenario?
- Who is the customer using the product?
- What are the main contributors to the handprint (or mechanisms behind emission reduction)?
- What year does the data and/or most important assumptions apply to?
- In which parts of the life cycle does the handprint (emission reduction) take place?
- What geographical area does the result directly or potentially apply to?
- How significant is the handprint in comparison to the baseline footprint?
- How significant is the quantity of the baseline footprint?

Credibility

- Which methods, guidelines and standards were used for the calculations?
- Who was responsible for conducting the assessment?
- Has the study been critically reviewed?

Transparency

- Is the original study available to the public?
- Do you have a result report which can be made publicly available or shared with interested stakeholders upon request?
- How can/will additional information be provided to interested parties?
- Is a contact point for any further inquiries included?

References

ISO 14026:2017 Environmental labels and declarations. Principles, requirements and guidelines for Communication of footprint information.

ISO 14040:2006 Environmental management. Life cycle assessment. Principles and framework.

ISO 14044:2006 Environmental management. Life cycle assessment. Requirements and guidelines.

ISO 14046:2014 Environmental management. Water footprint. Principles, requirements and guidelines.

ISO 14063:2010 Environmental Management. Environmental Communication. Guidelines and examples.

ISO 14067:2018 Greenhouse gases. Carbon footprint of products. Requirements and guidelines for quantification and communication.

Climate change is one of the critical challenges of our age and carbon footprint calculation has emerged as a standard method of estimating the global warming potential of products. However, shifting the thinking from negative to positive – from causers to reducers of greenhouse gases – is the key to solving this pressing challenge.

The carbon handprint approach offers a new way of quantifying the climate benefits of products. This guidebook presents step-by-step guidance on how to calculate and communicate a product's carbon handprint – the positive climate impact that a product can create.

Carbon handprints can be used by organizations to communicate the climate benefits of their products, services and technologies. Carbon handprints also provide valuable support for product development as well as political and strategic decision making when aiming for climate friendly solutions.

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