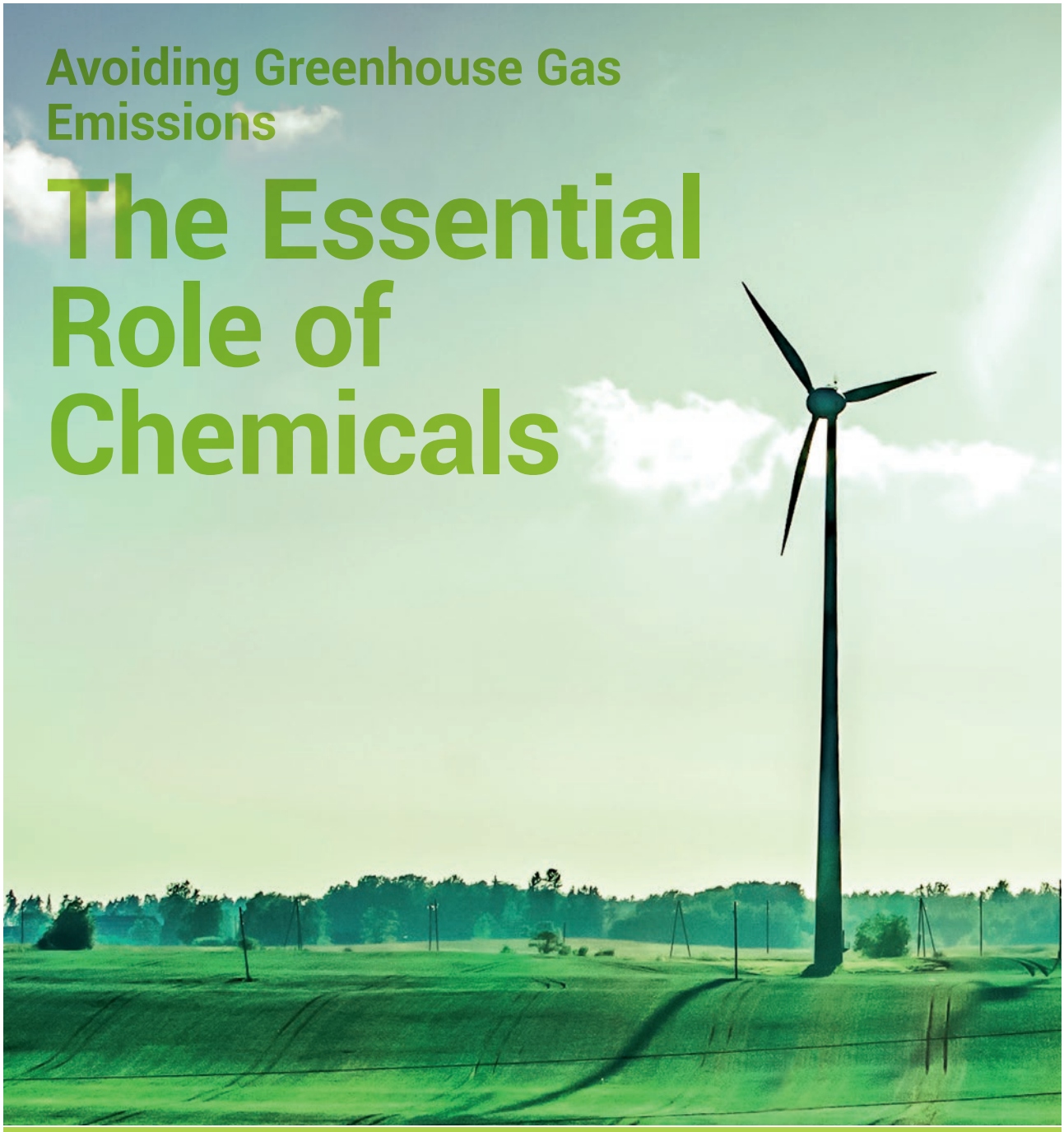
Avoiding Greenhouse Gas Emissions

The Essential Role of Chemicals



Guidelines

Accounting for and Reporting Greenhouse Gas (GHG) Emissions Avoided along the Value Chain based on Comparative Studies

Version 2
October 2013 (updated December 2017)

ICCA INTERNATIONAL COUNCIL OF CHEMICAL ASSOCIATIONS

wbcsd

"The earth we live on is a precious resource for all"

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Foreword

Developments in science and technology have enabled people to live longer, healthier, more agreeable and more prosperous lives. Minimizing environmental impacts whilst furthering these developments is critical to a sustainable future. The chemical industry contributes to almost every modern technology and has long been developing innovative products that improve sustainability. With that in mind, the industry supports the use of life cycle assessment (LCA) methodologies because these enable the assessment of the environmental impact of products and technologies over their complete life cycle, including production, use and end-of-life handling. As such, they are critical to assessing – and ultimately improving – sustainability.

Greenhouse gas (GHG) emissions are one of the many environmental impacts that LCAs can quantify. **By comparing GHG emissions along the life cycle of two alternative products of equal benefit to users, we can understand which technology avoids GHG emissions, improving sustainability.** LCA standards help to improve the quality and reliability of these assessments. The consistent measurement and reporting of LCAs increases credibility and comparability of the results, leading to better decision making by stakeholders along the value chain. Measuring avoided emissions of GHG over the value chain of products in particular, is an area where consistency of approach is essential. But, it has often given rise to debate among stakeholders.

To address these concerns, in early 2012 the International Council of Chemical Associations (ICCA) and the World Business Council of Sustainable Development (WBCSD) Chemical Sector project, "Reaching Full Potential", formed a taskforce to develop practical guidelines to improve consistency in the assessment and reporting of avoided emissions. These guidelines have been updated in 2017. We expect these guidelines to improve reporting consistency across the industry. In the future, we intend to expand them to cover other environmental impacts. We therefore aim to engage all stakeholders in the value chain so as to further improve the guidelines and the quality of our methodology. We believe this is an important step in improving the sustainability of our society.

Related ICCA documents

Available on www.icca-chem.org/energy-climate

- Avoiding Greenhouse Gas Emissions - the Essential Role of Chemicals: 17 Case Studies - Technical Reports
- Avoiding Greenhouse Gas Emissions - the Essential Role of Chemicals: 17 Case Studies - Summaries
- Greenhouse gas emission reductions enabled by products from the chemical industry: Quantifying the global potential

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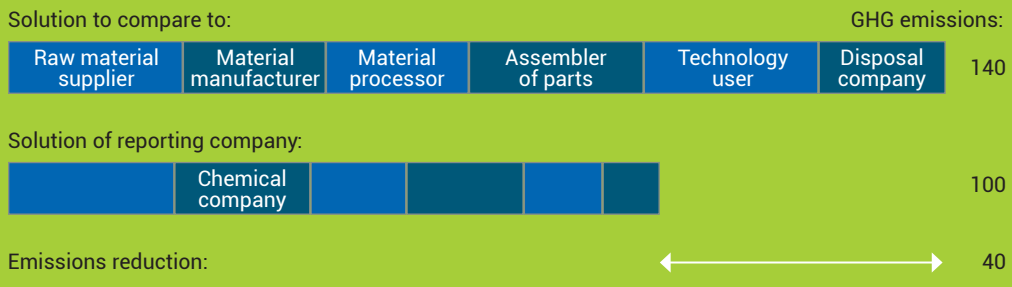
Executive summary

As part of low-carbon technology value chains, many chemical industry products aid the reduction of greenhouse gas (GHG) emissions compared to conventional products or compared to the market average (see Figure 1). Under the terminology of the Greenhouse Gas Protocol international accounting tool, emission reductions of this kind are termed "avoided emissions".

Figure 1. A reduction in GHG emissions is represented by the difference between the life cycle emissions from the solution of the reporting company and the solution to compare to



This document provides guidelines for calculating avoided GHG emissions enabled by chemical products, by comparing two solutions with the same user benefit. It also gives guidance on how to communicate the results. A number of case examples are published on the ICCA website (www.icca-chem.org/energy-climate). These case examples are aimed to provide additional insight for users to understand the guidance and reporting requirements. The intention of these guidelines is to support chemical companies in assessing the GHG emissions avoidance potential of their products. This will support research and development and help the chemical sector communicate credibly to stakeholders the role of chemical products in reducing GHG emissions. The chemical industry hopes that other industries facing similar challenges as the chemical industry may also benefit from these guidelines.

Although these guidelines focus on GHG emissions, the chemical industry supports the multi-criterial approach of Life Cycle Assessment (LCA), to ensure that LCA studies cover all aspects of the environmental impact. The guidelines build on the internationally accepted requirements of the ISO standards on Life Cycle Assessment (LCA). They also aim to be consistent with leading standards and specifications on carbon footprinting of products, including the GHG Protocol Product Life Cycle Accounting and Reporting Standard, PAS 2050 and ISO/TS 14067.

The illustrative case studies assembled by ICCA in line with the present guidance focus on the reduction of GHG emissions only. It is the intention of the ICCA to broaden the approach and include other environmental impacts, like water and land use, in future studies when the respective accounting methodologies become more mature. It is important to note that several of the case studies investigated involve possible trade-offs to other environmental impacts while demonstrating GHG emission reductions. We expect future studies to systematically reflect those trade-offs with authoritative references, reflecting the scientific discussion and methodology.

Main methodological issues addressed in these guidelines

Purpose of the study

The objectives of studies on avoided emissions can be varied, hence different types of comparison can be made. Comparisons can be classified into three different categories:

- Category 1: Product/technology vs non-use of product/technology.
- Category 2: Product/technology comparison across sectors.
- Category 3: Product/technology comparison within the same sector.

Selection of the solution to compare to

In order to calculate avoided emissions, the solution involving the chemical product needs to be compared to a specific reference case or baseline (called the "solution to compare to"), which has to deliver the same function to the user. This solution to compare to can be one specific solution, a few specific solutions or the average market mix.

Assessment

Whenever possible, the full life cycle should be considered when calculating avoided emissions. However, if necessary, identical parts or processes in both life cycles may be omitted.

Uncertainty of future developments

Assumptions about future conditions, such as how electricity used will be generated, can considerably impact the amount of avoided emissions calculated. Thus, for products with a long use stage, the reporting company should undertake a qualitative scenario analysis taking into account alternative future developments.

Attribution of avoided emissions among value chain partners

Life cycle avoided emissions almost always result from efforts of multiple partners along the value chain. Therefore, avoided emissions calculated shall always be first attributed to the complete value chain. Criteria to categorize the significance of the contribution of chemical products to such value chain avoided emissions as "fundamental", "extensive", "substantial", "minor" or "too small to claim" are defined based on the function of the chemical product. Arguments for and against a quantitative attribution of avoided emissions among value chain partners are summarized. To support companies that see a compelling need to attribute part of the avoided emissions to the use of their products, we have developed a decision tree. If quantitative attribution is done, companies should seek consensus with their partners along the value chain.

Guidelines on reporting avoided emissions

To ensure that communication to third parties on avoided emissions is credible the following fundamental reporting guidelines are specified:

- Companies shall report the main results of the study of their own solution (or the solution their product contributes to) and of the comparative solution (the "solution to compare to").
- Avoided emissions shall be presented as the difference between the two emission profiles, and differentiated by life cycle stages.
- Companies shall clearly state that the credit for the avoided emissions belongs to the complete value chain and shall describe and qualify the significance of the contribution of their product in the value chain based on the functionality of their product.
- If trade-offs with other environmental impacts occur, the reporting company shall report on these environmental impact categories in the same way as it reports on GHG emissions or should consider not reporting avoided emissions at all.

The transparency of communication about results of avoided emissions studies is ensured by a number of further reporting requirements. These specify details of the report and include a reporting template.

Key differences between version 1 (2013) and version 2 (2017) of these guidelines

The key differences between version 1 (2013) and this version 2 (2017) of these guidelines are:

- The concept of value chain level (chemical product or end-use level) has been removed.
- The concept of categories of comparison has been introduced.
- The criteria to select the solution to compare to has been made less rigid than in version 1.
- The exclusion of considering solutions being banned or in the process of being banned as solution to compare to has been removed.
- The concept of discount factor has been removed.
- The IPCC version to be used is the most recent one and not anymore the version of 2007.
- The concept of functionality has been added in the attribution approach.
- Several clarifications have been made (e.g. past vs future avoided emissions, decision tree for selection of solution to compare to, data quality, etc.).

1.

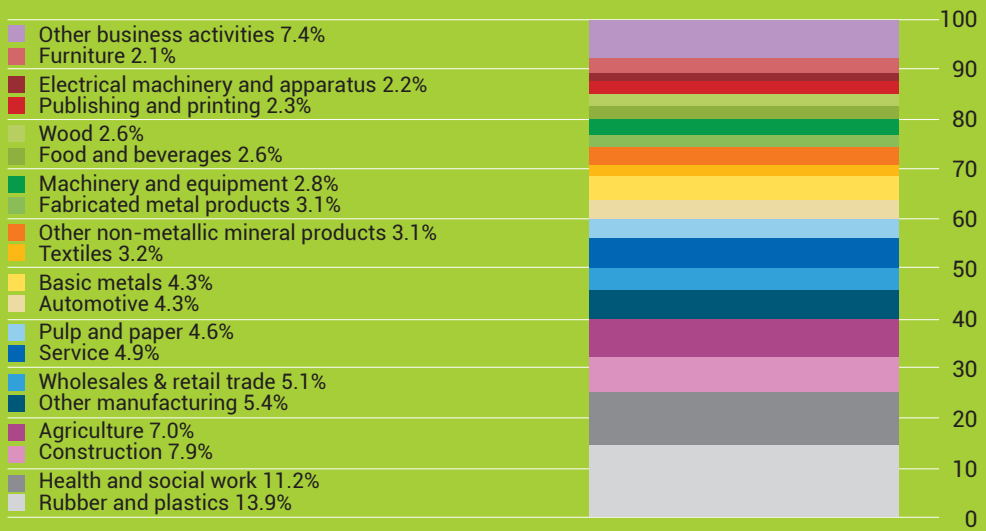
Introduction

1.1 Purpose of the guidelines

Today's world faces the challenge of climate change. The chemical industry is contributing to the reduction of greenhouse gas (GHG) emissions by pursuing two complementary actions:

1. Reducing emissions in its own manufacturing facilities and supply chains, and
2. Developing innovative products or applications that reduce emissions when used by other industries and consumers.

Figure 2. Customers of the EU chemical industry
(percentage of output consumed by customer sector)

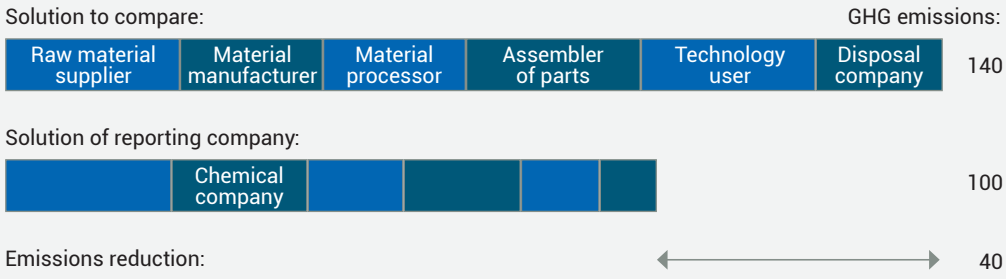


Sources: European Commission, Eurostat data (Input-Output 2000) and Cefic Analysis

Chemicals are part of the life cycle of most everyday goods, as shown in Figure 2. This unique position offers the chemical industry opportunities to reduce GHG emissions throughout society.

Many innovative chemical industry products enable GHG emission reductions downstream in the value chain, for example during the processing and manufacturing of downstream products, during use by the consumer or during end-of-life treatment (see Figure 3). The chemical industry contributes to GHG emission reductions throughout society, in collaboration with its value chain partners. Chemical companies seek to identify opportunities for further emission reductions and to communicate these opportunities to their customers and policy-makers.

Figure 3. A reduction in GHG emissions is the difference between the life cycle emissions from the solution of the reporting company and the solution it is compared to



To support these efforts, reliable and credible figures on GHG emission reductions enabled by chemical products are essential. As part of a value chain, chemical products assist emission reductions but are not solely responsible for them. That is why many leading chemical companies called for sector guidelines on calculating emission reductions enabled by chemical products.

This document provides guidelines on how to calculate emission reductions in value chains, by comparing two solutions with the same user benefit. In line with terminology chosen by the Greenhouse Gas Protocol, the difference in emissions between two alternative solutions is termed “avoided emissions” in this document. The guidelines will help the chemical sector to communicate credibly to stakeholders the role of chemical products in reducing GHG emissions. The chemical industry hopes that other industries facing similar challenges may also benefit from these guidelines.

1.2 How the guidelines were developed

The guidelines were developed by the chemical sector task force of the World Business Council for Sustainable Development (WBCSD) and the International Council of Chemical Associations (ICCA) between July 2012 and June 2013. The task force drew upon existing Life Cycle Assessment (LCA) studies, company presentations, and expertise from participating chemical companies. The guidelines were revised and updated in 2017. This document builds on internationally accepted standards and guidelines on LCA and carbon footprinting (see Section 1.4) and is therefore not a stand-alone document.
Use of the terms "shall", "should" and "may" conforms to ISO/IEC directives (2011).
For definitions of the terms see Annex C.

1.3 Who should use the guidelines

The guidelines have been developed for all chemical companies worldwide and for interested stakeholders. Companies that seek to measure, manage and communicate the avoided GHG emissions of their chemical products are encouraged to use this guidance document. Widespread use of these guidelines will increase the consistent calculation and communication of avoided emissions and make companies' findings more credible.

Results of avoided GHG emissions studies interest a wider audience, including chemical industry value chain partners and other stakeholders. This document could serve as a starting-point for conversations with value chain partners on how overall sustainability of product systems can be improved and communicated.

1.4 Relationship to existing standards and guidelines

This document builds on internationally accepted requirements and guidelines found in the ISO 14040 (2006) and ISO 14044 (2006) on LCA and is inspired by the Guideline for Calculating the Avoided CO_2 emission (2012) of the Japan Chemical Industry Association (JCIA). In addition, these guidelines aim to be consistent with leading standards and specifications on product carbon footprinting, including the GHG Protocol Product Life Cycle Accounting and Reporting Standard (2011), PAS 2050 (2011), and ISO/TS 14067 (2013). The guidelines provide a step-by-step procedure to estimate the differences in GHG emissions between solutions. They focus on common challenges of LCA practitioners (people and organisations carrying out studies) in the chemical industry. In particular, they take into account the upstream position of chemical products in the value chain and provide a way to reliably quantify the effect a chemical product can have on environmental impacts of downstream activities. Accordingly, the guidelines go beyond existing standards. Table 1 gives an overview of the extra guidelines provided in this document compared to ISO 14040 (2006) and ISO 14044 (2006).

Table 1. Extra guidelines on accounting and reporting avoided emissions compared to ISO 14040 (2006) and ISO 14044 (2006)

ISO 14040 / ISO 14044	Guidelines in this document
Goal and Scope definition	Purpose of study (Section 3.1) Solution to compare to (Section 3.2) Functional unit (Section 3.3) Boundary setting (Section 3.4.1)
Life cycle inventory (LCI)	Data quality (3.4.2) Methods/formulas used (Section 3.4.3)
Life cycle impact assessment (LCIA)	Assessment (Section 3.4.4)
Interpretation	Key parameters (Section 3.4.5) Integrating uncertainties and scenarios of future developments (Section 3.4.6)
-	Attribution of avoided emissions to value chain partners (Section 4)
Reporting	Reporting guidelines (Section 5)

If a full LCA[1] is not possible initially, companies may start with an analysis restricted to GHG as a first step. In this case, the reporting company shall check if tradeoffs exist by doing a screening LCA[1]. If trade-offs are identified in the screening LCA, the reporting company shall report on these environmental impact categories in the same way as it reports on GHG emissions or should consider not reporting avoided emissions at all. If the analysis does not comply with ISO requirements, this shall be stated and the reasons shall be explained. In all aspects not specified in these guidelines, for example data quality requirements, companies shall follow the relevant ISO and GHG protocol standards.Though this guidance is made for GHG emissions, the key principles apply to any impact category.

The chemical industry supports the multicriterial approach on which LCAs are based, as this ensures that studies show all aspects of the environmental impact (ICCA, 2013). To compare their products with alternative solutions, companies should perform a multicriterial LCA and check for possible trade-offs with other environmental impacts resulting from increased use of their low-carbon solutions (comparative assertion according to ISO 14040 (2006) and ISO 14044 (2006)).

1.5 Limitations of the guidelines

These guidelines should be regarded as a first global effort to develop consistent guidelines to account for and report avoided emissions. The guidelines note that chemical industry products are delivered to end-users through value chains and try to address value chain reporting issues, thereby avoiding multiple counting of avoided emissions. Fair reporting can only be achieved through coordination with value chain partners. We strongly welcome feedback on this document from value chain partners. It will help us update these guidelines to take into account the experience of companies and other organizations.

[1] In general, a screening LCA takes all relevant impact categories into account, but uses more data from databases (secondary data) than life cycle specific data collected by the reporting company (primary data), compared to an ISO compatible LCA study.

2.

Principles

This document adopts the five accounting principles of the GHG Protocol standards: relevance, completeness, consistency, transparency and accuracy. We have added a sixth principle, feasibility. The principles will guide users implementing the guidelines, especially when making choices that are not specified in this document.

Relevance

- Ensure the GHG inventories appropriately reflect the GHG emissions of the product and serve the decision-making needs of users – both internal and external to the company.

Completeness

- Account for and report on all GHG emission sources and activities within the chosen inventory boundary.
- Disclose and justify any specific exclusions.

Consistency

- Use consistent methodologies to allow for meaningful comparisons of emissions over time.
- Transparently document any changes to the data, inventory boundary, methods, or any other relevant factors in the time series.

Transparency

- Address all relevant issues in a factual and coherent manner, based on a clear audit trail.
- Disclose any relevant assumptions and make appropriate references to the accounting and calculation methodologies and data sources used.

Accuracy

- Ensure that the quantification of GHG emissions is systematically neither over nor under actual emissions, as far as can be judged, and that uncertainties are reduced as far as practicable.
- Achieve sufficient accuracy to enable users to make decisions with reasonable assurance as to the integrity of the reported information.

Feasibility

- Ensure that the chosen approach can be executed within a reasonable timeframe and at reasonable effort / cost.

3.

Guidelines on accounting avoided emissions

3.1 Purpose of study

In defining the purpose of the study, the following items shall be clearly stated:

- The name and description of the organization(s) commissioning the study and the organization(s) performing it ("the practitioner(s)").
- The objectives of the study.
- What chemical product the study focuses on (e.g. resin hardener for a wind turbine blade, engineering plastic for a fuel tank, or Expanded Polystyrene (EPS) for wall insulation).

Products or technologies can be compared using different reference products or reference technologies, respectively.
It is not limited to the chemical sector only but valid for other sectors as well.
Comparisons can be classified in three categories (Table 2):

- **Category 1, where the reference product is the non-use of a product or technology.**
- **Category 2, where the reference product or technology is from another sector (for a chemical product the reference product is a non-chemical product or technology).**
- **Category 3, that compares products or technologies within the same sector (for chemical industry the reference product is another chemical product).**

Chemical products are often intermediate products that are integrated in technologies/products that are manufactured downstream in the value chain. Chemical products may influence the performance of these technologies/products in such a way that GHG emissions are avoided. In order to assess the contribution of chemical products to the emissions avoided by the use of these low-carbon technologies/products, the comparison needs to be carried out between technologies/products. In this case the low-carbon technology/product is compared to a reference technology/product (called "the solution to compare to") and can be categorized in category 1, 2 or 3 based on selected reference technology/product. For example, a comparative study on wind electricity versus natural gas power generation will fall into category 2, whereas a comparison between carbon fiber blades for windmills versus glass fiber based wind blades will be classified as "category 3".

The type of comparison should be reported.

Table 2. Different categories of comparison

Category 1 Product/technology vs. non-use of product/technology	Chemical product* vs. non-use of product/technology	e.g. • Insulation vs. no insulation. • Packaging of food vs. no packaging. • Wind electricity vs. no-electricity for rural homes in developing countries. • Fuel additives for vehicle efficiency vs. non-use of fuel additives.
Category 2 Product/technology comparison across sectors	Chemical product* vs. non-chemical product/technology	e.g. • EPS vs. mineral wool. • Plastic packaging vs. tinplate. • Wind electricity vs. grid electricity. • Wind electricity vs. natural gas-based electricity. • Electric mobility vs. conventional mobility.
Category 3 Product/technology comparison within the same sector	Chemical product* vs. chemical product/technology	e.g. • Best-in-class insulation vs. chemical average insulation. • HPDE foam bottle vs. standard HDPE bottle. • Bio-based vs. fossil-based chemical product. • Best-in-class wind turbines vs. industry average wind turbines. • Best-in-class fuel additives for vehicle efficiency vs. standard fuel additives.

* Definition of product also includes services and low-carbon technlogies that make use of a chemical product such as wind electricity or electric mobility

3.2 Solution to compare to

In order to calculate avoided emissions, the solution involving[2] the chemical product being studied needs to be compared to a certain reference case or baseline. This baseline is the solution that is replaced and is called the "solution to compare to".

The solution to compare to shall meet a number of criteria to ensure a credible avoided emissions claim:

- Ideally one wants to compare the studied solution to what the studied solution really replaces.
- The solution being replaced could be the market average, an average of several solutions of the market, a very specific solution, the dominant solution, or a marginal solution (see figure 4).
- The comparison may also be done with a solution that would exist if the studied solution did not exist.
- If relevant, products soon to be phased out can also be used as the solution to compare to (but not products that have been phased out for a long time).

Past or future avoided emissions

Both past[3] or future[4] avoided emissions may be calculated and reported but shall not be mixed (and it shall be clearly stated which one of these two cases is reported).

Solution to compare to shall:

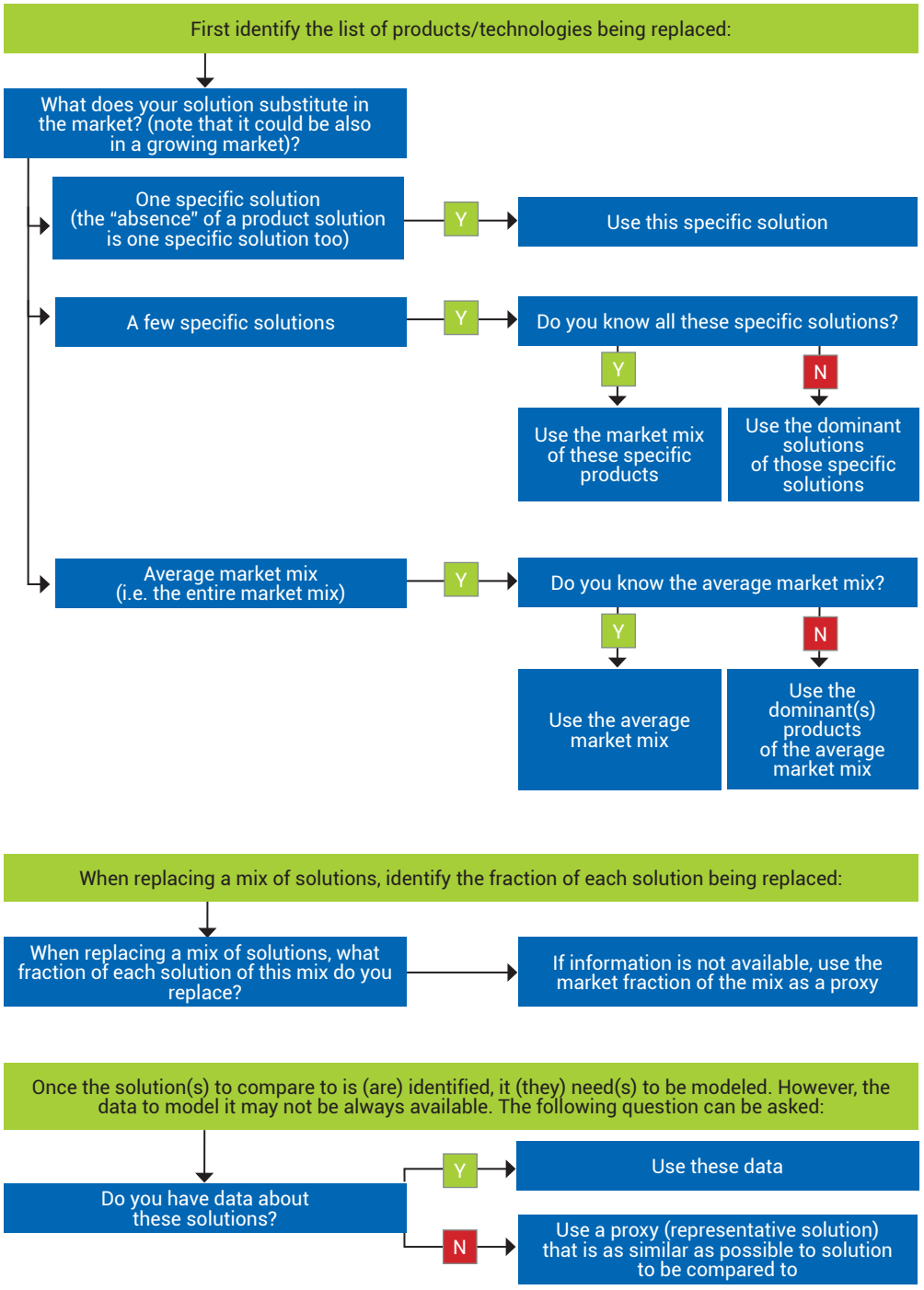
- Deliver the same function to the user as the solution of the reporting company. For example, if a customer requires energy with full-time availability (base load energy), the reporting company cannot compare as such wind energy with fossil-based energy as the alternatives are not exchangeable. However, the comparison can be made if the difference in performance between the alternatives is resolved, for example by including a back-up gas turbine or storage batteries for the wind energy option to ensure continuous power availability.
- Be distributed/used on the market, in the reference time period and geographic region[5] of the solution of the reporting company. When the solution(s) being replaced or the solution that would have been existed if the

[2] A solution can be based on a new chemical product or a new use of an existing chemical.
[3] Past avoided emissions may have occurred between two specific points in time in the past but could also be from a specific point in time in the past until « now ».
[4] Future avoided emissions may occur between « now » and a certain point in time in the future, but also between two specific points in time in the future.
[5] When identifying the solution to be replaced not only established markets are included but also growing markets where the solution to be replaced is the solution that would have been existed in the absence of the chemical product/solution.

studied solution has not been introduced (e.g. in a growing market) cannot be exactly identified, a fair proxy for what is replaced shall be chosen. It is important to make sure that the solution to compare to (or its proxy) chosen is not greenwashing (see decision tree "How to select the solution to compare to").

- Be exchangeable with the solution of the reporting company for the typical customer in the selected market in terms of quality criteria (see Section 3.3.2).
- Be as consistent as possible with the solution of the reporting company in terms of data quality, methodology, assumptions etc.

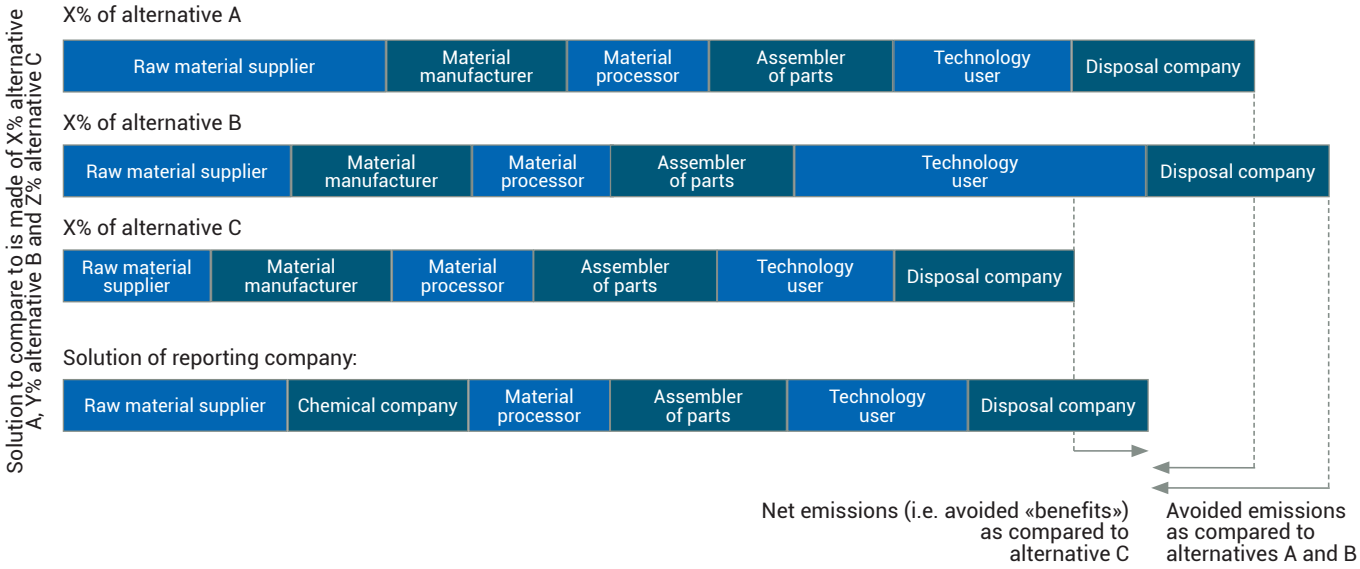
Figure 4: Decision tree on how to select the solution to compare to:



Solution to compare to made of several alternatives

Note that in the case of a solution to compare to made of several alternatives, some of these alternatives may actually have lower emissions than the solution being studied).

Figure 5.
Construction of a solution to compare to based on a mix of alternatives



Whether avoided emissions will occur will depend on the fraction of X, Y and Z that are expected to be substituted by the new solution [6] (i.e. in order to have avoided emissions, the amount of avoided emissions due to replacement of alternatives A and B should be higher than the amount of net "additional" emissions due to replacement of alternative C) (Figure 5).

An example of solution to compare to made of a mix of three solutions in presented in Figure 5. In this example, the solution to compare to is made of X% alternative A, Y% alternative B and Z% alternative C. In this example, the main advantage of the solution of the reporting company compared to solution A is a lower impact in terms of raw material supplier, the main advantage of the solution of the reporting company compared to solution B is a lower impact in terms of technology user, but there is also a solution C of the market that may be replaced (by the solution of the reporting company) that actually already had a lower carbon footprint than the new solution (for example due to lower impact in terms of raw material supplier). This solution C may be more environmentally friendly than the solution of the reporting company, but may be replaced by the solution of the reporting company for, for example, cost reason.

Note that in the example presented in Figure 5, the life cycles "Chemical company", "Material processor", "Assembler of parts" and "Disposal company" can be excluded from the system boundary since they are the same and will not change the "net" avoided emissions. Describing the two solutions being compared:

- The reporting company shall clearly describe how the boundaries of the market and the application have been defined.
- Both the solution of the reporting company and the solution to compared to shall be described in similar levels of detail.
- The description shall include market information including market shares and the reference flow, e.g. the amount of the chemical product on which the result of the study is based.
- The description shall discuss all aspects of all compared solutions which have a material impact on the emissions generated during the life cycle.
- If the end-use application is included in the study, the description shall detail how the chemical product is used as part of the end-use application.

[6] X, Y and Z are the fraction of the solution to compare to that are made of the solution expected to be substituted and not the fraction of the market share of each of the solution expected to be substituted.

3.3 Functional unit

3.3.1 Function of the product/application

According to ISO 14040 (2006) and ISO 14044 (2006), a functional unit shall be defined to which all inputs and outputs of the product system can be related and which establishes equivalency between the products/applications under study. Companies shall specify and quantify the functional unit, taking the following aspects into account:

- The functional unit is defined as the unit performance characteristics and services delivered by the solutions being studied.
- The functional unit shall be equivalent for all compared solutions.
- To ensure the product is exchangeable for the typical customer in the selected market, relevant quality criteria shall be taken into consideration (see Section 3.3.2 for an overview of types of quality criteria).
- The functional unit shall be consistent with the goal and scope of the study.

Examples of functional units:

- Insulating 1 m^2 of an exterior wall (using expanded polystyrene (EPS) versus stone wool), both achieving a U-value (wall) of 0.2 W/(m^2*K).
- Living in an existing single-family detached house in Germany with an average temperature for 40 years (from 2011 to 2051) (with polystyrene insulation and without).
- Pack and preserve, with a rigid material, 400 g of chocolate drink powder during one year using polypropylene (PP) (based on fossil versus biobased feedstock).
- Running a medium-sized gasoline automobile for 200,000 kilometres (with fuel efficient tires using special chemicals versus regular tires).

3.3.2 Quality requirements

The following three aspects should be used to assess whether compared solutions are truly exchangeable:

1. Functionality, related to the main function of the solution.
2. Technical qualities, such as stability, durability, and ease of maintenance.
3. Additional benefits rendered during use and disposal.

3.3.3 Service life of the solution(s)

- The reporting company shall specify the service life of the solution in the functional unit, i.e. for how long the performance of the final product or service needs to be maintained. The service life is defined by the end-use application and may not be the same as the lifetime of the chemical product.
- The defined service life shall be in line with standards used in the market, e.g. product category rules, studies from reputable organizations, and studies by leading companies in the value chain.
- The reporting company shall clearly report the basis and justification for the service life selected for the product or service.
- The service life influences the reference flow.

3.3.4 Time and geographic reference of the study

Companies shall specify the reference period chosen for the study. The data used shall be representative for the reference period. In case data are not available for the reference period, the reporting company shall use data covering periods as close as possible to the reference period.
The typical duration of a reference period is one year.
The reporting company shall report the reference period(s) for the used data.

Companies shall specify the geographic region chosen for the study. This includes the geographic region where the product is produced as well as where it is used. The reporting company should consider trade-offs that are relevant for the geographic regions chosen for the study, e.g. water depletion (see also Section 1.4).

3.4 Calculation methodology

3.4.1 Boundary setting

Whenever possible, the full life cycle should be considered when calculating avoided emissions, in order to comply with the requirements of ISO 14044[7] . However, when calculating avoided emissions, the solution of the reporting company and the solution to compare to might have a number of identical life cycle stages or processes in their life cycles. The system boundary shall consider all processes that may be influenced by the solutions being compared (and may exclude the processes that are the same for the different solutions[8]).

All system boundaries shall be explicitly mentioned in order to clarify what life cycle stages and processes are excluded or included. Life cycle stages and processes included and excluded shall be explicitly mentioned. The exclusion of some life cycle stages or processes should be justified.

The reporting company shall describe the value chain steps of all solutions being compared:
- A flow diagram shall be provided to show the value chains for each of the solutions being compared. The reporting company should consider all activities from cradle to grave (see Section 3.4.3).
- A qualitative description of the value chain shall be provided for clarification.
- The diagram shall indicate which life cycle stages or processes of the value chain were assumed to be identical in the calculation of life cycle GHG emissions of the alternative solutions.

3.4.2 Data quality

Different methodologies may be valid to assess data quality. The importance is that the company doing the assessment applies correctly the data quality method to the solutions assessed. An estimation of data quality shall be done to show that it satisfies the comparison done.
The reporting company shall provide transparency on data quality.

[7] ISO 14044 states the following: "The deletion of life cycle stages, processes, inputs or outputs is only permitted if it does not significantly change the overall conclusions of the study. Any decisions to omit life cycle stages, processes, inputs or outputs shall be clearly stated, and the reasons shall be explained."
[8] Indeed, identical life cycle stages or processes in the life cycle contribute equal amounts of GHG emissions to each solution and so do not affect the absolute amount of avoided emissions.

3.4.3 Methods/formulas used

The reporting company shall describe the method used to account for emissions at each step:

- For both solutions the life cycle GHG emissions shall be calculated in the same way according to existing standards.
- The reporting company shall explain:
  - Its choices of methodology and standards used.
  - Methods/formulas used to calculate the cradle-to-grave inventories.

This includes the choices for allocation. For allocation, recognized approaches shall be used (model used shall be clearly exposed). Sensitivity analysis should be done to test the influence of the allocation choices on the final results.

All GHG emissions shall be converted to a mass of CO_2 equivalents ("CO_2-eq", "CO_2eq" or "CO_2e") according to the most recent IPCC version[9] , over a 100 year time horizon.

3.4.4 Simplified assessment

If some life cycle stages or processes can be excluded from the system boundary because they are the same in the two solutions being compared, the calculation of avoided emissions is some sort of simplified assessment can be performed (where identical parts or processes in the life cycle of the products/solutions to be compared are omitted) (see Figure 6). The simplified assessment takes into account the sixth accounting principle of this document, feasibility (see Section 2).

When a simplified assessment is used, the following additional reporting requirements shall be applied.

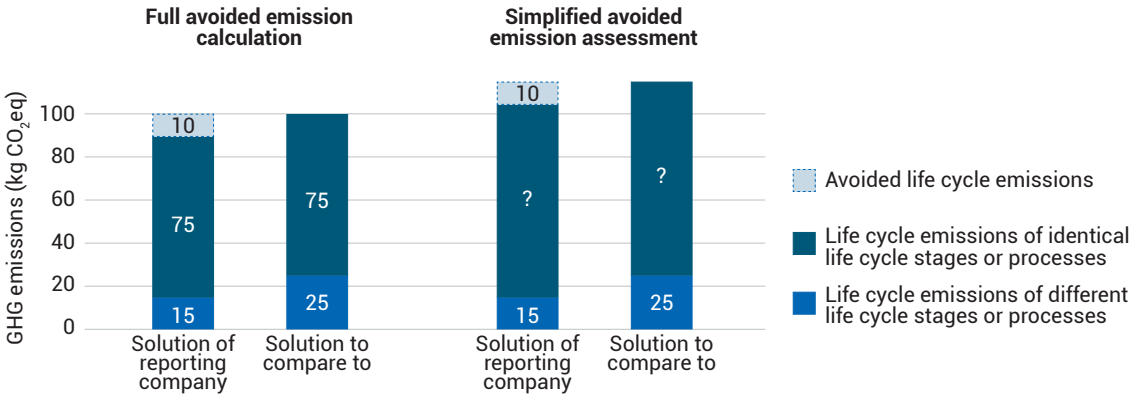
- The report shall specify what life cycle stages and processes are omitted and why.
- The report shall indicate the significance of the emissions being omitted relative to total emissions of the solution to compare to preferably in a quantitative manner but at least in a qualitative manner.
- Data sources or assumptions used to estimate omitted emissions shall be reported.
- The report shall clearly and noticeably describe the limitations of the study arising from omitting identical processes. These might include change in the significance of life cycle stages or processes, increased uncertainties, etc.

A reduction percentage, i.e. x% GHG emissions avoided in comparison to the reference solution, shall not be reported.

The significance of emissions omitted relative to total emissions of the solution to compare to can be determined by basing estimates of omitted emissions on published LCAs or own estimates. If a quantitative estimate is made, results should be shown in a scenario analysis.

[9] At the time of publication of this guidance, the most recent version of IPCC was of the year 2013. In case not the most recent version of IPCC was used, state the reason not to use the most recent version (e.g. non availability in the LCA software, etc.). Make sure it is used consistently (i.e. the same list of characterization factors) among the scenarios compared.

Figure 6. Illustration of simplified assessment. GHG emissions expressed in kg CO_2eq per functional unit



3.4.5 Key parameters driving emissions

The reporting company shall specify which activities and parameters mainly drive the generation of GHG emissions and the calculated avoided emissions, and how sensitive these are to the identified parameters. Examples are use of gasoline, service life of product, etc.

3.4.6 Scenarios of future developments and uncertainties

Upstream steps in the value chain of a manufactured chemical product can be calculated from existing data, since they have already taken place. But the use stage and end-of-life stage might extend several years into the future. User behavior and end-of-life treatment might change in the future, impacting future avoided emissions. Uncertainties over future conditions include, but are not limited to, changes in energy mix and energy efficiency, regulatory policies, market conditions, recycling practices, etc.

Though assumptions on future conditions can have a big impact on avoided emissions calculated, the reporting company shall first consider a solution to compare to that assumes no future changes (i.e. use most recent actual data). For products with a long use stage, for example more than ten years, the reporting company should provide a qualitative scenario analysis, explaining how each key parameter in the avoided emissions calculation might change in the future and how this may influence the calculated avoided emissions.

Companies shall report the results of the base case and should report the scenario taking into account the most probable future changes.

4.

Guidelines on contribution of value chain partners to avoided emissions

Life cycle avoided emissions almost always arise from efforts and contribution by multiple partners along the value chain. Avoided emissions are result from the sum of contributions by the different value chain actors. These include raw material suppliers, material manufacturers such as chemical companies, material processors, part-assemblers and users of the technology. Avoided emissions cannot, in general, be attributed to one partner alone – they should primarily be attributed to the complete value chain.

4.1 Qualitative assessment of the contribution of a chemical product to value chain avoided emissions

Individual partners in the value chain often wish to claim part of the emissions avoided. To increase the credibility of such statements, the reporting company must clarify the role of its product in the value chain and refrain from reporting value chain avoided emissions if its own contribution is too small to claim. **Reporting companies shall use the schema presented in Table 3 to qualify the contribution of their product to value chain avoided emissions.** The schema classifies products according to their contribution to avoiding GHG emissions (functionality approach).

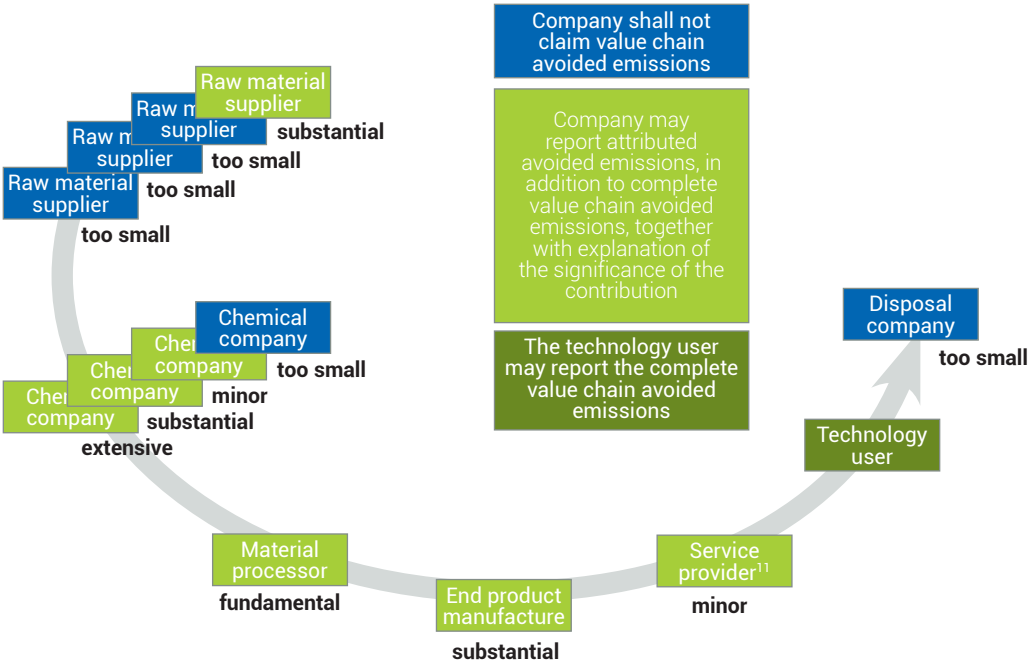
Table 3. The significance of the contribution of chemical products[10] to value chain avoided emissions based on the functionality approach

Significance of contribution	Relationship between chemical product and avoided GHG
Fundamental	The chemical product is the key component that enables the GHG emission avoiding effect of the solution.
Extensive	The chemical product is part of the key component and its properties and functions are essential for enabling the GHG emission avoiding effect of the solution.
Substantial	The chemical product does not contribute directly to the avoided GHG emissions, but it cannot be substituted easily without changing the GHG emission avoiding effect of the solution.
Minor	The chemical product does not contribute directly to the avoided GHG emissions, but it is used in the manufacturing process of a fundamentally or extensively contributing product.
Too small significance of contribution to claim	The chemical product can be substituted (by a different chemical product for example) without changing the GHG avoiding effect of the solution.

[10] The principles of this table are also valid for any part of the system (e.g. « chemical product », « non-chemical product », or « service »).

Figure 7. Example: illustrates an example of the significance of the contribution of individual partners to avoided emissions in a typical low-carbon technology value chain. The contribution of the technology user is slightly different from that of other value chain partners: although the user does not make a technological contribution he enables implementation of the technology by investing in and using it.

Figure 7. Example of communication on value chain avoided emissions by individual partners in a typical low-carbon technology value chain based on the functionality approach (see Table 3)



The reporting company shall report total emissions avoided along the complete value chain and shall report the significance of the contribution of its product to the end-use solution according to the functionality approach as presented in Table 3. In addition, the reporting company shall describe the specific role of its product in such a way that the reader understands how it is related to the GHG emission avoiding function of the end-use solution.

Example:
X million tonnes of emissions are avoided by using wind turbines backed by battery storage for power generation instead of the average European power production
technology mix (grid mix). Company A makes two minor contributions to these avoided emissions by manufacturing resin components and coatings for the wind turbine blades.

Note that avoided emission figures referring to a complete value chain, to which the reporting company contributes, cannot be compared with emissions caused by the reporting company since the reporting boundaries are different. If the reporting company chooses to report the emissions associated with its activities (such as Scope 1 and Scope 2)[12], then the reporting company shall clearly state that the reporting boundaries for activity emissions are different from those of avoided emissions.

[11] Note for « Service provider » : Installation, assembler, etc. may significantly contribute to the solution by special skills, etc.
[12] For Scope 1 and 2 definitions see GHG Protocol "A Corporate Accounting and Reporting Standard" (WRI and WBCSD, 2004).

4.2 Pros and cons of attributing value chain avoided emissions to individual value chain partners

Companies may wish to quantify their contribution to emissions avoided by a complete value chain for reasons including:

- Transparency: Every player along the value chain may communicate on emissions avoided by the complete value chain. There is a risk of double counting, but this can be avoided if value chain partners agree how to attribute avoided emissions.
- Internal management: Companies increasingly compile detailed quantitative data on the emissions caused by their activities - within their corporate boundaries (scope 1) as well as along the value chain (scope 2 and scope 3) – to help them plan and control efforts to reduce emissions. Likewise they are looking for methodologies that help them quantify their role in emission avoiding value chains, to underpin the development of R&D and marketing strategies, as well as to develop performance targets and monitor their implementation.
- Comprehensive corporate external reporting: Companies often wish to present a true and fair picture of their overall impact on climate change. If the emissions caused by a company's activities are reported quantitatively, avoided emissions may be quantified and reported as well.
- Support understanding of value chains: External stakeholders including investors, policy makers and citizens are looking for reliable and comparable figures to understand and compare the role of different organizations in emission avoiding value chains.
- Communication of benefits of a whole industry sector: The chemical industry or other industry sectors may want to use avoided emission calculations to illustrate their contribution/benefits to society.
- Partners along the value chain, that make a contribution that is considered too small to report value chain avoided emissions, might want to report on their (small) individual share.

However, important drawbacks of attributing avoided emissions to individual partners along the value chain have to be underlined:

- This may undermine understanding that implementation of low-carbon technologies is only possible through cooperation by different value chain partners.
- No single attribution method truly reflects the contribution of each value chain partner to the avoided emissions. Neither the physical characteristics of products, such as mass and volume, nor the price are proportionately correlated to the emission avoiding ability of a product. As a result, contributions of a partner may be over- or under-represented.
- Different attribution methodologies often lead to different avoided emissions results, with discrepancies being quite large in some cases. So figures for attributed avoided emissions quoted by different companies might not be comparable, but might be interpreted as if they are.
- If there is no agreement among value chain partners on how to attribute avoided emissions to individual partners, total attributed avoided emissions may be counted several times or do not add up to 100%.
- There is a reverse effect in economic as well as in physical attribution:
  For example, product improvements by individual companies that reduce material use whilst achieving the same functionality may result in less avoided emissions being attributed to this company.

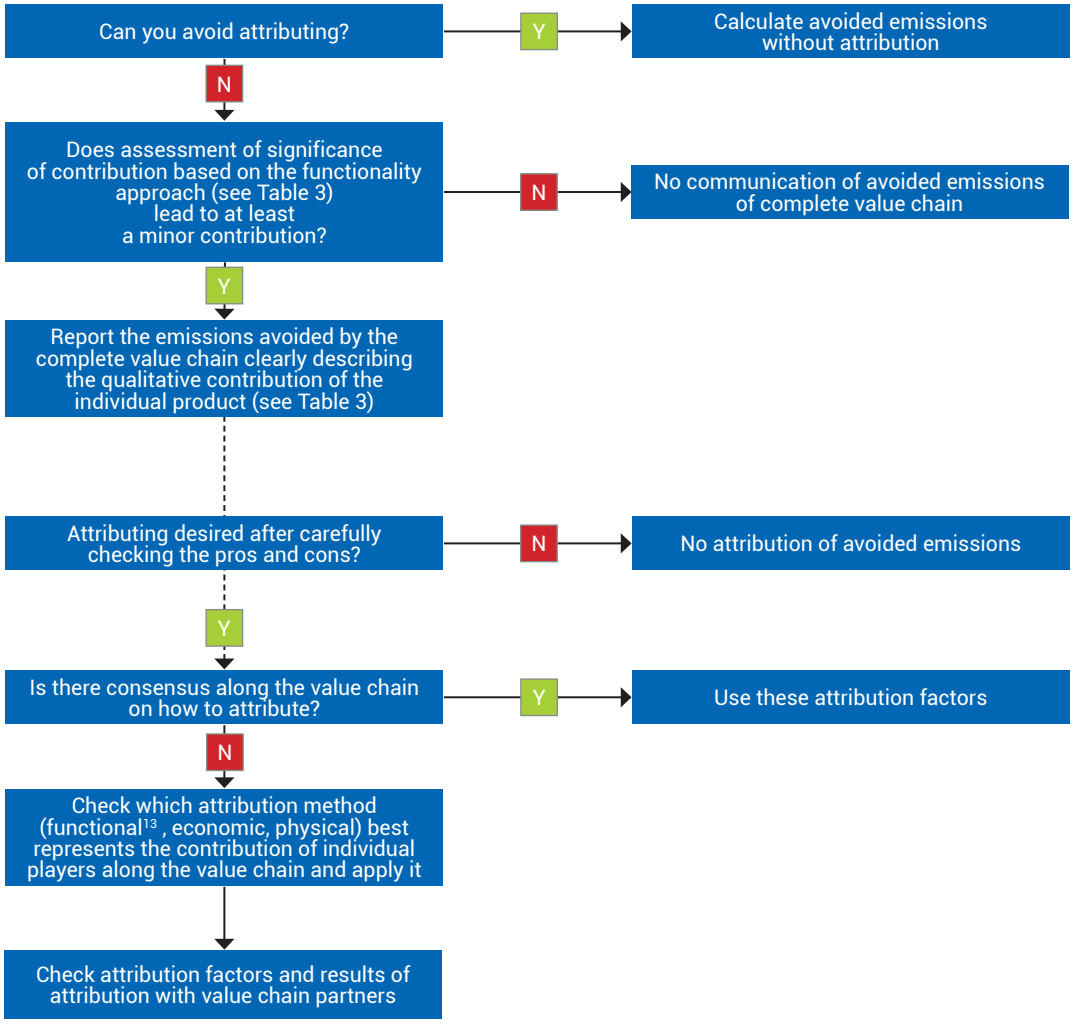
Given the ongoing debate on the advantages and disadvantages of quantitatively attributing avoided emissions among value chain partners, this document does not promote quantitative attribution of avoided emissions. However, to explore the possibilities of attributing avoided emissions to value chain partners and to offer companies a possible solution, the following section shows how avoided emissions could be attributed to value chain partners in a quantitative way.

4.3 Possible approaches to attribute value chain avoided emissions to individual value chain partners

If companies see a compelling need to attribute a fraction of the avoided emissions to the use of their products, they should do so very transparently. They are recommended to follow well-defined steps and fully document the basis of their calculation. A proposed process is described below.

The reporting company is recommended to use the decision tree in Figure 8 when assessing and reporting avoided emissions to which several partners along the value chain contribute.

Figure 8. Decision tree on attribution to be used by companies when assessing and reporting avoided emissions



13 Functionality can be used to first group components (of the value chain) into classes of high and low functionality, then decision of which fraction of the avoided emissions can be attributed to each group (e.g. by giving typically a higher fraction of the avoided emissions to higher functional elements than it would get with economic allocation), and finally attribution (e.g. economic) can be done within each group. See Annex B.can be given to each group (e.g. by giving typically a higher fraction of the avoided emissions to higher functional elements than it would get with economic allocation), and finally attribution (e.g. economic) can be done within each group. See Annex B.

When a reporting company applies attribution methodologies, it is recommended to address the following:

- Include all value chain partners that are addressed in the avoided emissions study (start from the defined user benefit and look upstream in the value chain to see which partners are needed to achieve the user benefit).
- If service providers are part of the value chain, attribution of emissions based on physical relationship is not possible.
- In principle, avoided emissions attributed to a single company in the value chain can be compared with emissions caused by that company as the system boundaries are the same. However, since no prescriptive guidelines have been developed for attribution of avoided emissions among value chain partners, results may vary considerably. Companies are recommended to refrain from such comparisons.

The reporting company shall always report total emissions avoided along the complete value chain. It shall report on the significance of the contribution of its product to the end-use solution according to the functionality approach as presented in Table 3 in Section 4.1. The reporting company may report figures for attributed avoided emissions as additional information.

In that case, companies are recommended to clearly describe the applied attribution methodology and the reasoning underlying the attribution factors. When other value chain partners use a different attribution method, companies are recommended to include this method as a separate scenario. If attribution is done, companies should seek consensus with their partners along the value chain.

The recommendations put forward in this section are a first attempt to provide guidance in quantifying avoided emissions attributable to individual value chain partners. The chemical industry intends to work with its value chain partners to further improve this approach and produce guidelines supported broadly by different stakeholders.

More on functional allocation: see annex B.

5.

Guidelines on reporting avoided emissions

This section provides guidance on how to report on a study on avoided emissions.

Table 4 provides an overview of all reporting requirements that have been mentioned in previous sections. The reporting company shall comply with the requirements in Table 4 and additional reporting requirements as specified in this section.

Table 4. Overview of reporting requirements from the previous sections

Section	Requirements
3.1 Purpose of study	• In defining the purpose of the study, the following items shall be clearly stated: - The name and description of the organization(s) commissioning the study and the organizations performing it. - The objectives of the study. - What chemical product the study focuses on.
3.2 Solutions to compare to	Describing the solutions to compare to: • The reporting company shall clearly describe how the boundaries of the market and the application have been defined. • Both the solution of the reporting company and the solution to compare to shall be described in similar levels of detail. • The description shall include market information including market shares and the reference flow, e.g. the amount of the chemical product on which the result of the study is based. • The description shall discuss all aspects of all compared solutions which have a material impact on the emissions generated during the life cycle. • If the end-use application is included in the study, the description shall detail how the chemical product is used as part of the end-use application.
3.3.1 Function of the product/ application	• A functional unit shall be defined to which all inputs and outputs of the product system can be related and which establishes equivalency between the products/applications under study. • Companies shall specify the service life of the product or service in the functional unit, i.e. for how long the performance of the final product or service must be maintained. • The reporting company shall explain how the service life is determined.
3.3.3 Service life of the solution	• The reporting company shall specify the service life of the product or service in the functional unit. • The reporting company shall clearly report the basis and justification for the service life selected for the product or service.
3.3.4 Time and geographic reference of the study	• Companies shall specify the reference period chosen for the study. • Companies shall report the reference period for the data used. • The reporting company shall explain the scenarios used to project the future. • Companies shall specify the geographic region chosen for the study.
3.4.1 Boundary setting	• The reporting company shall describe the value chain steps of all solutions being compared: - A flow diagram shall be provided to describe the value chains for each of the solutions being compared. - A qualitative description of the value chain shall be provided for clarification. - The diagram shall indicate which life cycle stages or processes of the value chain were assumed to be identical in the calculation of life cycle GHG emissions of the alternative solutions. • All system boundaries shall be explicitly mentioned in order to clarify what processes are excluded and included. • Life cycle stages and processes included and excluded shall be explicitly mentioned.
3.4.2 Data quality	• The reporting company shall provide transparency on data quality.

Section	Requirements
3.4.3 Methods/formulas used	• The reporting company shall describe the method used to account for emissions at each step. • The reporting company shall provide transparency on: - Methodological choices made and standards used. - Methods/formulas used to calculate the cradle-to-grave inventories. - Allocation choices.
Reporting	- Companies shall report the main results of the study of their own solution and of the comparative solution (the "solution to compare to"). - Avoided emissions shall be presented as the difference between the two emission profiles, and differentiated by life cycle stage. - Both past or future avoided emissions may be reported but shall not be mixed (and it shall be clearly stated which one of these two cases is reported). - Companies shall clearly state that the credit for the avoided emissions belongs to the complete value chain and shall describe and qualify their specific role in the value chain based on the functionality of their product. - If trade-offs with other environmental impacts occur, the reporting company shall report on these environmental impact categories in the same way as it reports on GHG emissions or should consider not reporting avoided emissions at all. - If the analysis does not comply with ISO requirements, this shall be stated and the reasons shall be explained. - If the study underwent a critical review, the critical review process and status shall be clearly reported.
3.4.4 Simplified assessment	If the simplified assessment is used the following additional reporting requirements apply: • The report shall specify the omitted life cycle stages and processes and the justification behind it. • The report shall give an indication of the significance of the emissions being omitted in relation to total emissions of the solution to compare to preferably in a quantitative manner but at least in a qualitative manner. • Data sources or assumptions used to estimate omitted emissions shall be reported. • The report shall clearly and noticeably describe any limitations of the study arising from omitting identical processes such as change in the significance of life cycle stages or processes, greater uncertainties, etc. • Companies shall not report a reduction percentage, i.e. x % GHG emissions avoided in comparison to the reference solution.
3.4.5 Key parameters	• The reporting company shall specify which activities and parameters drive the generation of GHG emissions.
3.4.6 Scenarios of future developments and uncertanties	• Companies shall report the results of the base case and should report the scenario taking into account future changes that are deemed most probable.
4.1 Qualitative assessment of the contribution	• The reporting company shall report on the significance of the contribution of its product to the end-use solution according to the functionality approach as presented in Table 3. • The reporting company shall describe the specific role of the product so that the reader understands how it is related to the GHG emission avoiding function of the end-use solution. • If the reporting company chooses to report the emissions associated with its activities (such as Scope 1 and Scope 2), then the reporting company shall clearly state that the reporting boundaries for activity emissions are different from those of avoided emissions.
4.3 Possible approaches to attribute value chain avoided emissions to individual value chain partners	• The reporting company shall always report the total emissions avoided along the complete value chain and shall describe its specific role in the value chain according to Table 3 in Section 4.1.

Additional reporting suggestions

- Companies should report the full cradle-to-grave emissions of their own solution and full cradle-to-grave emissions of the solution to compare to. Companies should present the results of the study in a table to enhance clarity for external stakeholders (see Table 5).
- Additionally, companies should provide a graph of results for every value chain step (see Figure 10).
- Companies should describe the type of comparison (see Table 2).
- The final result may additionally be communicated in terms of:
  - Total absolute avoided emissions.
  - % emissions avoided compared to total emissions of the solution to compare to. However, this way of presenting results is not allowed when the reporting company used the simplified assessment.

- The reporting company should finalize the report with an overview of:
  - Conclusions and implications from the study.
  - Additional steps/updates that might be planned to improve the results of its study.
- Appendices may be included to provide:
  - Additional information on sources used.
  - Results from the critical review.
  - A glossary.

Figure 9. Avoided emissions are the difference between the cradle-to-grave emissions from the solution of the reporting company and those of the solution to compare to

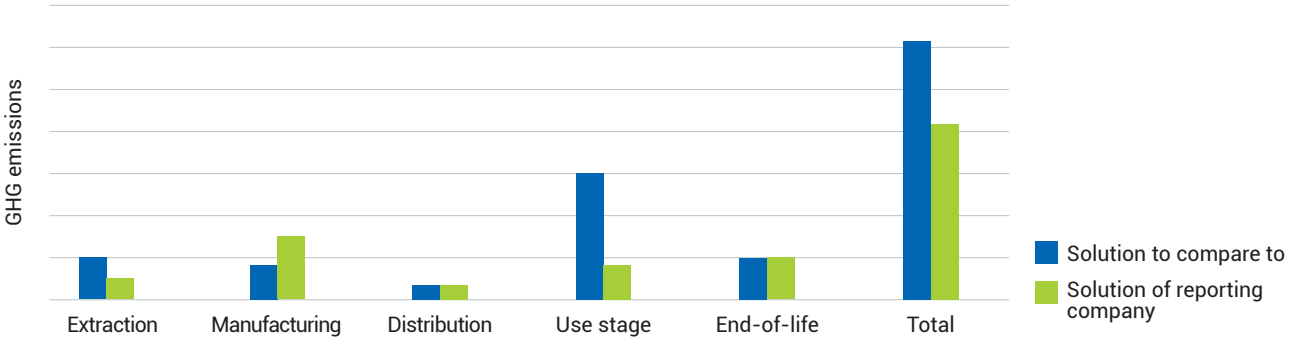


Table 5. Example of a table presenting all results of a study on avoided emissions

Emissions per stage (mass of CO_2e)	Reporting company's solution	Solution to compare to
Raw material extraction	.....	.....
Manufacturing / processing	.....	.....
Distribution	.....	.....
Use stage	.....	.....
End of life	.....	.....
Total emissions	**P1**	**P2**
Avoided emissions	**= P2 - P1**	

Public disclosure of LCA comparative assertions requires critical review by a panel in order to comply with ISO 14044. For avoided emissions studies, companies should be consistent with ISO 14044. If the study underwent a critical review, the critical review process and status shall be clearly reported.

Annex A contains a proposed reporting template for avoided emissions studies.

6.

Annexes

Annex A. Report template

TITLE of study
Commissioner and performer of the study
Short executive summary (typically 100 words).

Sections to be included:

1. Purpose of study
[explain the objective and goal of the study; the methodology used (ICCA-WBCSD Avoided Emissions Guidelines) and other relevant high-level information].

2. Solutions to compare to

2.1 Description of the solution to compare to
[describe what solutions are being compared and provide relevant information about each solution].
2.2 Definition of the boundaries of the market and the application.

3. Functional unit and reference flow

3.1 Description of the function and the functional unit
[describe the function and functional unit of the product].
3.2 Reference flow
[indicate the amount of the chemical product on which the result of the study is based].
3.3 Quality requirements
[indicate any quality criteria that are taken into consideration to ensure compared products are exchangeable for the typical customer in the selected market].
3.4 Service life of the solution
[Indicate service life of product taken into consideration].
3.5 Time and geographic reference of the study
[indicate the time and geographic reference].

4.Boundary setting

[describe the boundaries of the case study:
- Describe the value chain steps of all solutions to compare, making explicit which processes are included and excluded from the case study.
- Include a flow diagram for each of the solutions to compare, indicating which parts are identical in the calculation of life cycle GHG emissions of the alternative solutions.
- Describe the cut off threshold and how the threshold was determined].

5. Calculation methodology and data

[indicate any relevant general information related to calculation methodology; specific information about data and databases used; data quality; methods/formulas used; key parameters]

5.1 Methods and formulas used

[in case the simplified assessment has been used this should be mentioned explicitly in the report (at the beginning and in Section 6), and the report requirements of Section 3.4 of the guidelines should be taken into account].

5.2 Allocation

[indicate the allocation chosen].

5.3 Data, data sources and data quality

[specify which databases are used and report the data quality, including most important data in a table].

6. Results

[indicate study results from compared solutions with figures, tables, descriptions, etc.]

6.1 Avoided emissions

[present the avoided emissions as the difference between the two emission profiles, and differentiated by life cycle stage:

- Clearly state that the credit for the avoided emissions belongs to the complete value chain.
- Report the full cradle-to-grave emissions of the reporting company's solution and the full cradle-to-grave emissions of the solution(s) to compare.
- Present the results in a table (see Figure A1 and Table A1) describe key parameters].

Figure A1. Results of the case study

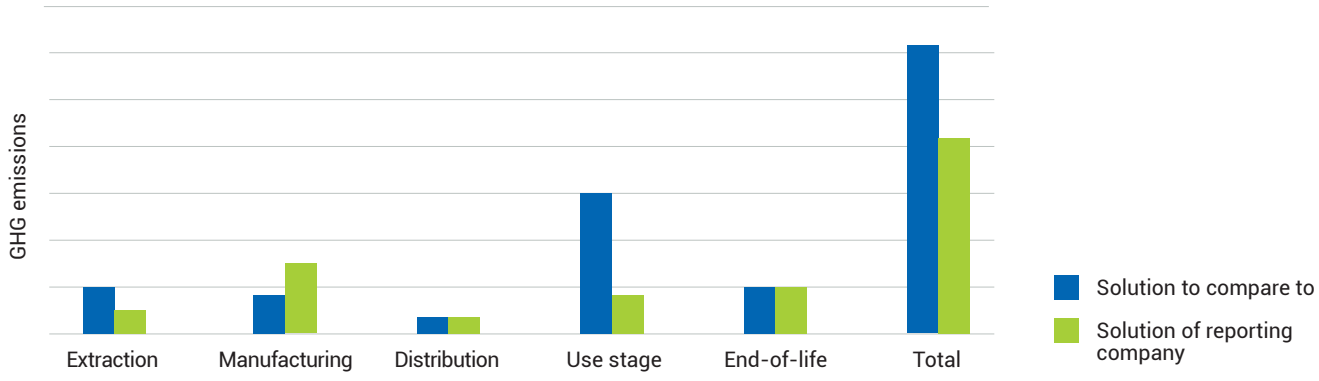


Table A1. Results of the case study

Emissions per life cycle stage (mass of CO_2e)	Reporting company's solution	Solution to compare to
Raw material extraction	.....	.....
Manufacturing / processing	.....	.....
Distribution	.....	.....
Use stage	.....	.....
End of life	.....	.....
Total emissions	**P1**	**P2**
Avoided emissions	**= P2 - P1**	

6.2 Scenario analysis

[describe used scenarios, e.g. to take into account future changes or to test the sensitivity of the results to the allocation choices; describe the results from scenario analysis].

7. Significance of contribution

[describe the significance of the contribution of the studied chemical product to overall value chain avoided emissions (see Section 4 of the guidelines); describe the specific role of the product so that the reader understands how it is related to the GHG emission avoiding function of the end-use solution; describe attribution methods, if they are used in the study].

8. Review of results

[indicate any review of the results that were undertaken and which standard was followed – such as a critical review based on ISO 14040 (2006), ISO 14044 (2006) and ISO/TS 14071 (2014); in case a critical review was done, the critical review report is put in appendix].

9. Study limitations and future recommendations

[describe any limitations of the study (including the assessment on how robust the solution to compare to chosen is) or improvements/recommendations for future revisions of the study].

10. Conclusions

[describe the main conclusions obtained from the study; indicate if the conclusions of other studies are not consistent with the present case].

11. References

[list any relevant references].

12. Appendices

[optional:

- Additional information on sources used.
- Use of data from reporting company and databases.
- Critical review report.
- Glossary].

Annex B. Functional allocation of avoided emissions to selected components of the solution

In some product systems it becomes essential to distinguish between components, so as not to take into account components that are "trivial" and do not really influence the efficiency of the solution that allows to avoid greenhouse gas emissions.
A functional allocation that allocates avoided emissions to the system components that are influential to the avoidance of greenhouse gas emissions may be preferred. This should be preferred every time it is possible and if it better ensures that components that contribute directly to the avoidance of greenhouse gas emissions get a fair share.
Distinguishing between these influential and non influential components may be relatively straightforward, or not, depending on cases. This may be done based on criteria similar to those to select the significance of the contribution of the considered chemical product (see Table 3). Only the elements that have a fundamental, extensive, or substantial contribution to the greenhouse gas avoiding effect of the solution shall be considered (see Table A2). The economic allocation will then focus on these elements only.

Table A2. Significance of contribution

Significance of contribution	Relationship between component of the solution and avoided emissions
Fundamental	The component is the key to the greenhouse gas emission avoiding effect of the solution.
Extensive	The component is one of the key components: its properties and functions are essential for enabling the greenhouse gas emission avoiding effect of the solution.
Substantial	The component does not contribute directly to the avoided greenhouse gas emissions, but it cannot be substituted easily without changing the greenhouse gas emission avoiding effect of the solution.
Too small significance of contribution to allocate	The component does not influence the efficiency of the solution: it does not contribute directly to the avoided greenhouse gas emissions, it can be substituted without changing the greenhouse gas avoiding effect of the solution.

Example
An example for such a case is a photovoltaic (PV) system used to generate electricity. A PV system consists of PV cells, that are grouped together to form a PV module, and the auxiliary components called "balance of system" (BOS) that includes the inverter, controls, etc. (Solar Photovoltaics undated, Fraunhofer 2016, Renewable energy institute 2016, NREL 2011). The capital cost of a PV system is composed of the PV module cost and the balance of system cost.

Table A3 shows a typical example of functional allocation of avoided emissions to selected components of the solution for a residential and small-scale PV system.

The PV system components that can be categorized as influential in converting solar energy in electricity are: glass, cells, EVA, Tedlar, and inverter. For offgrid systems, batteries for electricity storage will also be

categorized as contributing components. On the contrary, the majority of the balance of system components do not influence the efficiency of electricity generation and play a supporting role rather than a fundamental, extensive, or substantial role in electricity generation. Economic allocation over the full system, as shown (4th column), would allocate a large part of avoided emissions to these supporting components. Taking into account the functions of every component would be a better choice for the PV system example. The functionality based selection of the components to be taken into account allows to focus on five components of the overall solution namely glass, cells, EVA, Tedlar, and inverter that form 58% of the system cost. Economic allocation is then applied only amongst these components.

Table A3. Example of allocation of avoided emissions to selected components of the solution

Elements	Components	% Contribution to system cost (representative cost)	Economic allocation over the full system	Significance of contribution in generating renewable electricity	Can be easily replaced by other materials to serve same functionality?	Economic allocation focused on the selected components
PV module	Frame	4%	4%	Too small contribution	Yes	(0%)
	Glass	4%	4%	Substantial	Yes	6.9%
	Cells	30%	30%	Fundamental	No	51.7%
	EVA	2%	2%	Extensive	Maybe	3.4%
	Tedlar	2%	2%	Extensive	Maybe	3.4%
	Others components	3%	3%	Too small contribution	Yes	(0%)
Balance of system	Inverter	20%	20%	Fundamental	No	34.5%
	System installation (material)	20%	20%	Too small contribution	Yes	(0%)
	System installation (service)	15%	15%	Too small contribution	Yes	(0%)
Total		100%	100%			100%

Remarks on costs of the PV system: The PV module cost is determined by raw material costs, notably silicon prices, cell processing/manufacturing and module assembly costs. The PV module cost is typically between 33% to 50% of the total capital cost of a PV system, depending on the size of the project and the type of PV module (Solar Photovoltaics undated). In this example, PV module cost is estimated to be 45% of system capital cost. The balance of system costs and installation comprise the remaining capital costs for a PV system. The balance of system costs largely depend on the nature of the installation. For residential and small-scale systems, the balance of system and installation costs comprise 55% to 60% of total PV system costs (Solar Photovoltaics undated). The balance of system cost includes items, such as the cost of the structural system (e.g. structural installation, racks, site preparation and other attachments), the electrical system costs (e.g. the inverter, transformer, wiring and other electrical installation costs) and the battery or other storage system cost in the case of offgrid applications.

Annex C. Glossary

Attribution

Dividing up avoided greenhouse gas emissions among the different partners in a low-carbon technology value chain.

Chemical product

The chemical product is the product sold by the reporting company.

Functional unit

Functional unit is the quantified performance of a product system for use as a reference unit (ISO 14044, 2006).

May

The term “may” is used in this document to indicate a course of action permissible within the limits of the document (ISO/IEC, 2011).

Shall

The term “shall” is used in this document to indicate requirements strictly to be followed in order to conform to the guidelines in this document and from which no deviation is permitted (ISO/IEC, 2011).

Should

The term “should” is used in this document to indicate that among several possibilities one is recommended as particularly suitable, without mentioning or excluding others, or that a certain course of action is preferred but not necessarily required, or that (in the negative form) a certain possibility or course of action is deprecated but not prohibited. (ISO/IEC, 2011).

Solution

Any product that is sold along the value chain, a chemical product, a material from another industry, a component or a final technology.

Solution to compare to

The alternative solution providing the same benefit to the customer as the reporting company`s solution.

PAS

Publicly Available Specification.

Annex D. References

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About the International Council of Chemical Associations (ICCA)

The International Council of Chemical Associations (ICCA) is the worldwide voice of the chemical industry, representing chemical manufacturers and producers all over the world. Responding to the need for a global presence, ICCA was created in 1989 to coordinate the work of chemical companies and associations on issues and programs of international interest. It comprises trade associations representing companies involved in all aspects of the chemical industry.

ICCA is a chemical industry sector with a turnover of more than 3,600 billion euros. ICCA members (incl. observers & Responsible Care members) account for more than 90 percent of global chemical sales.

ICCA promotes and co-ordinates Responsible Care® and other voluntary chemical industry initiatives. ICCA has a central role in the exchange of information within the international industry, and in the development of position statements on matters of policy. It is also the main channel of communication between the industry and various international organizations that are concerned with health, environment and trade-related issues, including the United Nations Environment Programme (UNEP), the World Trade Organization (WTO) and the Organisation for Economic Co-operation & Development (OECD).

ICCA operates by coordinating the work of member associations and their member companies, through the exchange of information and the development of common positions on policy issues of international significance. Three main issues focused on by ICCA are: Chemicals Policy & Health, Climate Change & Energy, Responsible Care®.

ICCA also serves as the main channel of communication between the industry and various international entities, such as inter-governmental organizations (IGOs) and NGOs that are concerned with these global issues.

www.icca-chem.org

About the World Business Council for Sustainable Development (WBCSD)

The World Business Council for Sustainable Development is a CEO-led organization of forward-thinking companies that galvanizes the global business community to create a sustainable future for business, society and the environment. Together with its members, the Council applies its respected thought leadership and effective advocacy to generate constructive solutions and take shared action.

Leveraging its strong relationships with stakeholders as the leading advocate for business, the Council helps drive debate and policy change in favor of sustainable development solutions.

The WBCSD provides a forum for its 200 member companies - who represent all business sectors, all continents and a combined revenue of more than $7 trillion - to share best practices on sustainable development issues and to develop innovative tools that change the status quo. The Council also benefits from a network of 60 national and regional business councils and partner organizations, a majority of which are based in developing countries.

www.wbcsd.org

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