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WORKING PAPER

# ESTIMATING AND REPORTING THE COMPARATIVE EMISSIONS IMPACTS OF PRODUCTS

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## EXECUTIVE SUMMARY


- This paper introduces a neutral framework for estimating and disclosing the greenhouse gas (GHG) emissions impact of a product (good or service), relative to the situation where that product does not exist.
- The differences may be either negative or positive. Positive differences are frequently called "avoided emissions" and have been the object of much interest among companies trying to develop and promote low-carbon products.
- Existing practices for estimating such product impacts vary in terms of many key issues. The intent of the framework is to identify important challenges, harmonize practices, and improve the credibility of companies' claims, including through the consideration of potential negative impacts.
- When estimates are used to inform decision-making, they should preferably be developed using "consequential" methods that measure total, system-wide changes in emissions. Because the data available to support these methods are often limited, alternative ("attributional") methods may also be considered as interim measures for applications that can be supported with an interim attributional approach. For all public claims on comparative emissions impacts that may involve market effects, we recommend the use of the consequential method.


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**Suggested Citation:** Russell, Stephen. 2018. "Estimating and Reporting the Comparative Emissions Impacts of Products." Working Paper. Washington, DC: World Resources Institute. Available online at http://www.wri.org/publication/comparative-emissions.

**Companies are increasingly interested in estimating and making claims about the GHG impacts of their products, relative to the situation where those products do not exist.** These comparative impacts may be estimated as the sum of all system-wide changes in emissions or removals occurring because of the product ("consequential estimation approach") or as the difference in total life-cycle GHG emissions between a company's product and some alternative product that provides an equivalent function ("attributional estimation approach"). The impact can be positive, such that the company's product reduces emissions relative to the base case. Alternatively, the impact can be negative, such that the company's product increases emissions relative to the base case.

**Companies have mostly focused on positive impacts, despite the fact that negative impacts are equally common and that consideration of both positive and negative impacts is needed to guide a company's product portfolio and climate change strategy.** Potential applications of these product comparisons include enhancing product research and development (R&D), improving corporate brand image, enabling product differentiation for customers and informing purchasing decisions, implementing new business models, and informing public policies related to climate change.

**The absence of a generally accepted framework for estimating and publicly reporting comparative impacts constrains companies' ability to pursue these applications.** Without clear direction, many companies and industry initiatives have independently developed their own methodologies or simply refrained from estimating comparative impacts because of concerns that claims (around positive impacts specifically) will be perceived as greenwashing.

**WRI researched existing accounting and reporting practices to identify the most important methodological issues.** This comprised desk research and interviews with over 20 experts in companies and nongovernmental organizations (NGOs). It covered the claims and/or targets of about 350 companies and all the major guidance documents and standards published to date in English.

**Many methodological issues are key to the relevance and credibility of comparative impact estimates.** These issues include how to identify which emissions sources should be assessed and how to identify credible base cases against which a company's products can be compared. Claiming positive impacts can introduce additional complexities, such as how to apportion total impact to different value-chain actors based on estimated contributions to the company's product ("attribution"); cherry-picking products or product applications; and aggregating results for claims at the level of product portfolios.

**Considerable variation in practice exists across each of these issues.** While most published guidance documents and standards for comparative impacts follow the attributional approach and are based on established life-cycle accounting approaches, they provide quite different specifications on many issues. Even greater variation in practices exists among individual companies. Little of this variation can clearly be ascribed to product- or sector-specific considerations or other identifiable reasons. Appendix B (available online) provides a detailed comparison of published guidance documents.

**The consequential approach—such as the method provided in the GHG Protocol *Policy and Action Standard*—directly addresses many of the methodological issues.** To date, however, companies have used only the attributional approach to estimate comparative impacts.

**Using the research findings, this paper outlines a neutral framework for estimating and disclosing both positive and negative impacts.** The framework is not intended to be exhaustive, offer detailed guidance, or address issues specific to product categories; instead, it aims to address generic issues likely to be frequently encountered when assessing comparative impacts.

**The framework recommends the consequential approach whenever comparative impact estimates are used to inform decision-making and whenever market effects mediate comparative impacts.** However, the current state of data availability and limited company resources may make this approach impractical for many businesses. Thus, while this paper strongly encourages use of the consequential approach in decision-making contexts, the attributional approach may be considered as an interim measure for applications that it can support.

**Key principles include the following:**

- Corporate inventory accounting and comparative assessments are complementary approaches to managing a company's impact on the climate, but they use fundamentally different methods.
- Companies should first calculate and report scope 1, 2, and 3 emissions and set science-based reduction targets for these emissions. Comparative assessments should neither take precedence over nor detract from efforts to do so.
- If a company reports positive impacts, it should also report a complete inventory of scope 1, 2, and 3 emissions. Companies should not make claims about positive impacts without being transparent about whether their scope 1, 2, and 3 emissions are increasing or decreasing.
- To be consistent with the requirements of the GHG Protocol corporate accounting and reporting standards, comparative impacts should not be used to adjust scope 1, 2, and 3 emissions. Further, comparative impacts should not be compared with corporate GHG inventories unless (1) the impacts have been estimated for a company's entire product portfolio using a consequential approach that covers negative and positive impacts and (2) the GHG inventories are comprehensive and conform to GHG Protocol requirements.
- The accounting and reporting of comparative impacts should adhere to the following criteria:
  - Relevance: Ensure that the comparative assessment appropriately reflects the GHG effects of the assessed product (in relation to the base case) and serves the decision-making needs of users and stakeholders.
  - Completeness: Include all life-cycle GHG emissions (under an attributional approach) or all changes in emissions arising from the assessed product (consequential approach) in the assessment.
  - Consistency: Use consistent accounting approaches, data collection methods, and calculation methods for the assessed product and base case.
  - Transparency: Provide clear and complete information to allow stakeholders to assess the credibility and reliability of the results, especially related to key methodological issues, such as the choice of the base case.
  - Accuracy: Reduce uncertainties as far as possible.

# 1. INTRODUCTION

### What is the purpose of this paper?

Using a review of current practices in comparative assessments, this paper identifies major accounting issues, evaluates the credibility of existing practices, and outlines general principles and good practices to guide future accounting efforts. These recommendations are not intended to serve as exhaustive or detailed guidance. The scope of the analysis and recommendations is global, covering all geographic regions and sectors.

### Who should read this paper?

This paper is primarily intended for companies interested in estimating and reporting the comparative greenhouse gas (GHG) impacts of their products. It should also be used by industry associations as a basis for developing sector-specific accounting and reporting guidance. Additionally, investors, environmental groups, policymakers, and academics can use this paper to learn about best practices for estimating and disclosing comparative GHG impacts.

### What is the role of business in closing the global emissions gap?

To limit global temperature rise to below 2°C and 1.5°C above preindustrial levels, GHG emissions must be reduced 20 percent and 45 percent, respectively, from 2010 levels by 2030 (IPCC 2018). The global community is not currently on that emissions trajectory, with substantial gaps between required and committed reductions through 2030.

The private sector can and must contribute additional reductions to fill this gap. It can do so, for example, through a combination of broader deployment of energy-efficiency products and low-carbon technologies and product innovation. Existing energy-efficiency and clean-energy technologies may be sufficient to meet interim global targets (e.g., through 2030), although their adoption will have to be scaled up significantly. Innovation is required to meet longer-term goals. For example, of the annual emissions reductions needed in the industrial

sector through 2050, almost 30 percent will have to come from technologies that are not commercially available today (IEA 2015).

An effective corporate climate change strategy requires a detailed understanding of a company's GHG impact. Increasingly, companies are interested in understanding whether their products (goods or services) increase or decrease emissions, relative to other products in the marketplace that provide an equivalent function. Understanding this comparative GHG impact can help companies identify and promote existing products or new technologies that can close the emissions gap.

**How are comparative product GHG impacts estimated?**

Comparative product GHG impacts ("comparative impacts") for a given product (the "assessed product") can be estimated using either attributional or consequential accounting approaches. These approaches differ in terms of the range of GHG emissions sources included in the analysis and how comparative impacts are estimated (Table 1). Research for this paper did not uncover any cases where companies used a consequential accounting approach. Consequential approaches are, however, applicable (see Section 4 for recommendations on when a consequential approach should be used).

Across both attributional and consequential methods, positive impacts are commonly referred to as "avoided emissions," as well as "environmental load reduction potential," "enabling effects," and "contribution to societal reductions." Positive impacts also frequently form part of companies' "net positive" targets, which extend beyond GHG emissions to include numerous social and environmental impact categories. This paper occasionally uses the term "avoided emissions" to connote positive impacts, especially when portraying aspects of companies' targets.

## Attributional approaches

Attributional approaches generate inventories of absolute emissions and removals that are attributed to a given entity, such as a product, company, city, or nation. Attributional life-cycle accounting (attributional LCA) is the basis for estimating comparative impacts using an attributional approach.

Comparative impacts are estimated as the difference between the total, attributional, life-cycle GHG inventories of a company's product (the "assessed" product) and an alternative (or "reference") product that provides an equivalent function (Figure 1).

Comparative GHG Impact = Life-Cycle Emissions of Reference Product – Life-Cycle Emissions of Assessed Product

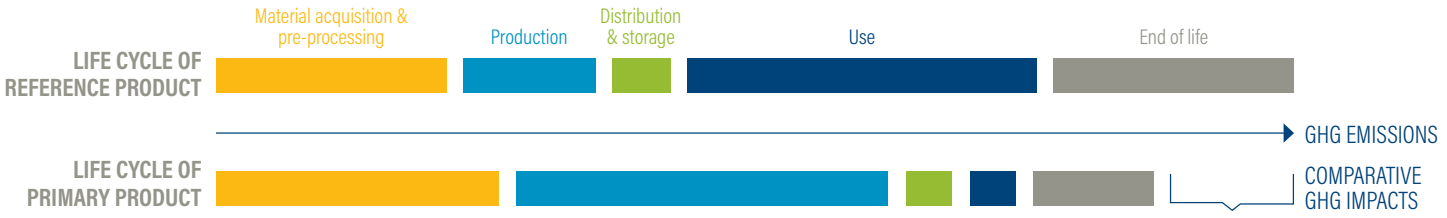
If the comparative impact is zero, the assessed and reference products emit the same amount of GHGs over their life cycles. If the comparative impact is negative, the assessed product emits more over its life cycle compared to the reference product. Conversely, if the comparative impact is positive, the assessed product emits less over its life cycle compared to the reference product.

Table 1 | **Key Differences between Attributional and Consequential Accounting**

| KEY CHARACTERISTICS | ATTRIBUTIONAL | CONSEQUENTIAL |
|---|---|---|
| What is described or modeled? | Static inventory of absolute emissions and removals | Change in emissions or removals caused by a specific decision or action |
| System boundary | Processes used directly in the life-cycle stages of the product physically produced or consumed | All and only the processes that change as a result of the decision studied, wherever they may occur in the system |
| How is it used to estimate comparative impacts? | Through comparisons of product GHG inventories developed using attributional life-cycle accounting (LCA) | Through consequential LCA or policy and action accounting (i.e., using the *Policy and Action Standard*) |

*Source*: Adapted from Brander and Ascui 2015.

Figure 1 | **Calculating Comparative GHG Impacts Using the Attributional LCA Approach**




*Source*: Graphic by authors.

Life-cycle analyses are built on the concept of the "functional unit," which establishes the basic reference point against which all inputs and outputs of the product system can be identified and related. The attributional approach essentially generates a static inventory of the absolute amount of GHG emissions and removals that results from the delivery of a specified amount of the functional unit. In comparative GHG assessments the assessed and reference products are compared using the same functional unit to ensure a like-for-like comparison. For example, to compare an electric vehicle and a conventional one, the functional unit might be "operating a medium-sized automobile for 200,000 kilometers using an electric engine versus a gasoline engine."

The GHG Protocol *Product Life Cycle Accounting and Reporting Standard* ("Product Standard"; WRI and WBCSD 2013b) outlines requirements and guidance for quantifying and publicly reporting product GHG inventories for individual products. The Product Standard is expressly intended to help track the performance of a single product over time. By itself, it cannot be used to estimate comparative GHG impacts because additional accounting guidance and rules are needed to ensure that the comparisons are valid (see Appendix A in the *Product Standard*). The *Product Standard* does, however, help show how comparative assessments should be conducted.

Other examples of attributional GHG accounting standards are the GHG Protocol's *Corporate Standard and Scope 3 Standard* (see below).

## Consequential approaches

Consequential methods estimate the total, system-wide *change* in emissions and removals that results from a given decision or intervention, such as the decision to produce one extra unit of the assessed product or the introduction of a new government policy. Consequential LCA and the GHG Protocol *Policy and Action Standard* (WRI 2014b; see below) are consequential methods that could be used to estimate comparative impacts.

Consequential LCA estimates the total, system-wide change in emissions and removals that occurs as the result of a change in output of the functional unit, in response to, for example, changes in production technology, public policy, or consumer behavior. In this approach, processes are included in the life-cycle boundary to the extent that they are expected to change because of a change in output.

The *Policy and Action Standard* estimates comparative impacts by subtracting emissions in the policy scenario from those of the baseline scenario, which represents the events or conditions most likely to occur in the absence of the policy or action being assessed. The *Policy and Action Standard* can be applied to policies, such as laws, regulations, and incentive schemes, as well as corporate actions, such as the introduction of a new product on the market.

Under a consequential method, if the comparative impact is zero, there is no net, system-wide change in emissions from the increase in production of a given product. If the comparative impact is negative, there is an increase in system-wide emissions, whereas if the comparative impact is positive, there is a decrease in system-wide emissions.

Comparative GHG Impact (*Policy and Action Standard)* = Emissions in baseline scenario – Emissions in policy scenario

## Pros and cons of attributional and consequential approaches

The use of attributional LCA to estimate comparative impacts implicitly assumes perfect substitution of one product for another and that activity and emissions levels scale linearly with product quantity. This approach assumes that indirect, market-mediated effects do not occur (Table 2). These effects include rebound effects, changes in market size that occur over and above any changes in market share, and changes in the market price of inputs. However, this assumption is unlikely to hold for most product systems. Empirical studies show that basing decisions on attributional LCA can result in mitigation actions that unintentionally increase rather than decrease emissions (e.g., Searchinger et al. 2008; Hertel et al. 2010). In contrast, consequential approaches explicitly account for such market-mediated effects.

Attributional and consequential approaches also differ in their levels of uncertainty. The uncertainty of attributional estimates is mainly parametric (i.e., around activity levels and emissions factors). In contrast, consequential accounting involves not only parametric uncertainty but also scenario uncertainty related to how a new technology affects the use of the incumbent technology, as well as the interactions of these technologies with the broader economy. While there is therefore greater uncertainty associated with consequential accounting, this is not a disadvantage because attributional estimates are based on simple models that exclude market-mediated effects.

One disadvantage of the consequential approach, however, is the relative lack of available input data and emissions factors, which often makes the approach more labor-intensive. This disadvantage is expected to diminish over time as databases for consequential life-cycle emissions factors become larger.

## Choosing between attributional and consequential approaches

As discussed in Section 4, the consequential approach is more appropriate for informing decision-making, but the current state of data availability and limited company resources may mean that the approach is not a practicable option for many companies. Thus, while this paper strongly encourages the use of the consequential approach in decision-making contexts and for comparative impacts that involve market effects, the attributional approach may be used as an interim solution for applications that can be supported with an interim attributional approach.

Table 2 | **Advantages and Disadvantages of Attributional LCA and Consequential Approaches to Estimating Comparative Impacts**

| ACCOUNTING APPROACH | PROS | CONS |
|---|---|---|
| Attributional | ■ Relatively simple estimation approach<br>■ Scalable to large product portfolios | Ignores market-mediated effects |
| Consequential | Considers market-mediated effects | ■ Lack of available data<br>■ More labor-intensive |

*Source*: Table by authors.

## How do comparative GHG impacts and corporate GHG inventories differ?

A corporate GHG inventory contains data on the historical GHG emissions from sources located within a company's internal operations and value chain. Developed using an attributional approach, corporate inventories are structured around three scopes under the GHG Protocol *Corporate Accounting and Reporting Standard* (WRI and WBCSD 2004):

- Scope 1 emissions are emissions from operations owned or controlled by the reporting company.
- Scope 2 emissions are emissions from the generation of electricity, steam, heating, or cooling that has been consumed by the reporting company.
- Scope 3 emissions are all indirect emissions (not included in scope 2) that occur in the value chain of the reporting company, including both upstream and downstream emissions. Scope 3 emissions are divided into 15 different categories, such as purchased goods and services (category #1), the use of sold products (category #11), and the end-of-life treatment of sold products (category #12).

Holding organizational boundaries and inventory methods constant, changes in inventory totals reflect increases or decreases in the absolute amount of emissions to the atmosphere from sources included in the inventory boundary. In contrast, comparative impacts need not translate into changes in aggregate absolute emissions to the atmosphere.

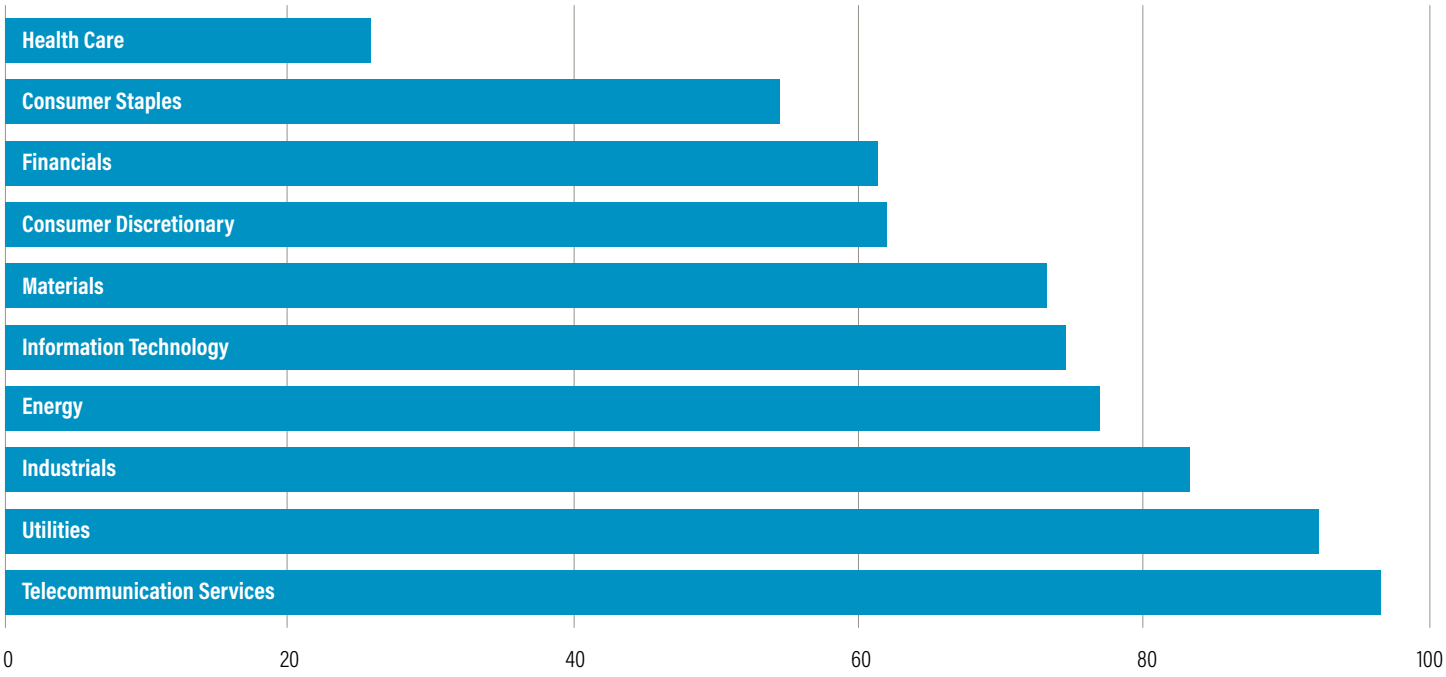
Also, when a company uses the attributional approach, its corporate inventory will only fully capture comparative impacts when the assessment compares products from the same company. For example, an electric motor might be more efficient compared with an older version of that model. This improvement in efficiency could be reflected as a reduction in scope 3 emissions (from the use of sold products), but it has also formed the basis of claims of positive impacts estimated using attributional LCA. Such overlapping claims are not uncommon—in 35 percent of a total of 81 claims involving product energy efficiency, companies used prior model versions as the reference product (see below for description of research methodology). In contrast, telecommunications software might generate positive impacts when compared with business travel, but this impact would never be captured within the software vendor's GHG inventory.

Companies have expressed much confusion as to whether overlapping claims are appropriate, reflecting uncertainty about the fundamental nature of comparative impacts (specifically, positive impacts) and what types of products can be said to give rise to them. In general, overlapping claims are not considered a problem in this paper and no recommendations are provided on this topic. This is because corporate inventories and comparative assessments provide different, but complementary, perspectives on a company's emissions reduction efforts. A product can contribute both to reductions in a corporate inventory and to broader reductions in society. Nonetheless, comparative impacts should be disclosed separately from GHG inventory data in public reports because the two have been calculated using fundamentally different and noncomparable approaches (see Appendix A).

## What claims do companies make about comparative GHG impacts?

Based on a review of reporting practices (see below for details), no company publicly reports negative impacts for its own products. This is perhaps not surprising. In contrast, many companies make claims about positive impacts. For instance, 70 percent of the 1,793 companies that responded to the 2014 Carbon Disclosure Project (CDP) climate change survey indicated that the use of their products by a third party "avoided" emissions. This view was held by the majority of companies in most sectors, particularly in the telecommunication services and utilities sectors (Figure 2).

Figure 2 | **Percentage of Companies in Different Sectors That Believe Their Products Have Positive GHG Impacts**




*Source*: 2014 CDP Climate Change Questionnaire (total of 1,793 companies surveyed).

Companies claim positive impacts for different types of products, including ones of the following types:

- Ones that are new in the market and emit less (either in a single life-cycle stage or across the entire life cycle), compared to alternative or conventional products already on the market.
- Ones that offer a low-carbon means of providing a service (e.g., teleconferencing systems that replace the need to travel or renewable energy that displaces fossil fuel–based power).
- Ones that represent incremental improvements to existing products (e.g., increasing the energy use efficiency of an existing line of home appliances).

These claims also reveal some of the variation in the type of reference product used in estimating comparative impacts, a key issue that will be explored later in this paper.

## What reasons have companies given for estimating or claiming comparative GHG impacts?

- Companies state the following objectives for comparative GHG assessments (roughly in order from most to least common):[1]
- Enable customers to differentiate products (e.g., product A is 20% more energy efficient than product B from a different company).
- Build company brand image for investors and the general public.
- Represent potentially positive aspects of business activities that cannot be reflected in corporate emissions inventories (see Box 1).
- Inform policymakers about the potential consequences of policy and regulatory choices.
- Guide product benchmarking and product research and development (R&D)—improving the design of individual products by increasing understanding of the GHG effects of different design choices.
- Enable investors to assess company risk and opportunities for investment decisions.
- Inform portfolio planning—the determination of which products to develop and which to retire.
- Support efforts among value-chain partners to improve and communicate the overall sustainability of product systems.

Many of these objectives have been pursued using products for which only positive GHG impacts have been found (e.g., building brand image). It is important to recognize, however, that a neutral estimation framework that can capture both positive and negative impacts is needed to ensure that the end results are credible. For example, a company may attempt to build its brand image by claiming that its overall product portfolio has a positive impact, but the claim may not be credible if the company makes no effort to estimate potential negative impacts.

Section 3 discusses ways companies have set targets around positive impacts to illustrate some of the applications of comparative assessments and highlight technical challenges in ensuring credible estimates.

## What uncertainties surround comparative GHG assessments?

Two major interlinked issues are associated with comparative GHG assessments. The first issue is technical: the assessment is often complex and there is currently no

### Box 1 | Capturing Emissions Impacts That Fall Outside of a Corporate Inventory

While a corporate inventory is the primary basis for measuring and managing scope 3 emissions, it may not fully capture impacts such as the following:

- An increase in product longevity may increase the scope 3 emissions reported under category #11 but may also result in positive GHG impacts.
- Certain products have no emissions in the use phase and may have positive impacts, relative to conventional products produced by other companies. For instance, a company may build wind turbines that have no use-phase emissions but may help displace nonrenewable sources serving the same grid.
- A company's scope 1, 2, and 3 emissions might increase as it scales up the production of products that avoid emissions.

Accounting for comparative GHG impacts has been positioned as one means of estimating and demonstrating such benefits outside of a scope 1, 2, and 3 emissions inventory.

global standard for attributional comparative assessments or consequential LCA. While certain sectors have recently developed their own attributional accounting guidelines, many companies have independently developed their own methodologies. For example, avoided emissions claims were made by at least 500 companies responding to the CDP's 2014 climate change questionnaire, almost entirely on the basis of company-specific methodologies. Considerable uncertainty exists regarding best practices. A survey conducted by WRI revealed that a large majority (79%) of the 375 respondents believed there was a strong need for standardization (WRI 2014a).

The second issue is broader: comparative impacts are not the same as changes in absolute emissions, so it is unclear what applications and claims can credibly be pursued, and to what extent comparative assessments can drive absolute emissions reductions. Relatively little information and evidence exists in the public domain, leading some to argue that companies should concentrate on reductions within their corporate value chains (i.e., reductions in their scope 1, 2, and 3 emissions).[2]

Together these issues can expose companies that make claims about positive impacts to reputational risks and charges of greenwashing. Identifying good accounting and reporting practices is important for ensuring robust and credible communications about potential comparative impacts.

## How was this paper developed?

A first draft was based on desk research and interviews with 22 organizations. The desk research covered two types of communications:

1. The six major guidance documents and standards that have been expressly developed for, or have applicability to, comparative assessments; that are in English; and that remain in current use (see Table 3). Of these documents, four estimate comparative impacts using attributional LCA. A fifth estimates them using attributional LCA, while also identifying the reference product through a project accounting approach. The sixth document is the *Policy and Action Standard*. Appendix AI compares these documents in more detail.

2. Claims made by companies when responding to the 2014 CDP Climate Change questionnaire and/or by companies on their websites. Claims were only reviewed when companies provided at least some information on the underlying methodology. Claims made by a total of 330 companies were included in the analysis.

The draft was then revised to incorporate feedback from 15 companies and NGOs, and then further revised to reflect feedback from internal WRI reviewers, prior to final publication. Contributors and reviewers are listed in the Acknowledgements section.

Table 3 | **Major Existing Guidelines or Standards Applicable to Avoided Emissions, Ordered by Year of Publication**

| PUBLICATION | SECTOR | GENERAL METHODOLOGY |
|---|---|---|
| *Evaluating the Carbon-Reducing Impacts of ICT: An Assessment Methodology* (GeSI and BCG 2010) | Information and communications technology (ICT) | Attributional: Compare product GHG inventories; the impact is calculated at the level of a functional unit. |
| *Addressing the Avoided Emissions Challenge* (ICCA and WBCSD 2013) | Chemical | Attributional: Compare product GHG inventories; the impact is calculated at the level of a functional unit. |
| Greenhouse Gas Protocol *Policy and Action Standard* (WRI 2014) | All sectors | Consequential: GHG effects of a policy or action are estimated relative to a baseline scenario. |
| *Guidance on Quantifying Greenhouse Gas Emissions Reductions from the Baseline for Electrical and Electronic Products and Systems*, IEC/TR 62726:2014 (IEC 2014) | Electrical and electronic products and systems (e.g., ICT systems and components of renewable energy systems) | Impact of a product is quantified relative to either another product or an actual project. |
| *Methodology for Environmental Life-Cycle Assessment of Information and Communication Technology Goods, Networks and Services*, ITU-T L.1410. (ITU 2014) | ICT goods, networks, and services; guidance also provided on software | Attributional: Compare product GHG inventories; the impact is calculated at the level of a functional unit. |
| *Guidelines for Assessing the Contribution of Products to Avoided Greenhouse Gas Emissions* (ILCA 2015) | All sectors | Attributional: Compare product GHG inventories; the impact is calculated by multiplying the avoided emissions per functional unit by the amount of final product(s) in use and then by an attribution factor. |

*Source*: Table by authors.

## 2. CORE TERMS IN ESTIMATING COMPARATIVE IMPACTS

Different companies and guidance documents often use quite different terms when describing comparative impacts. This paper uses the following terms:

- **Assessed product:** The product that generates or contributes to the comparative impact. The assessed product may be an intermediate product (used as an input to the production of other products) or a final product (consumed by the end user).
- **Assessment period:** The period over which the comparative impact is assessed.
- **Attribution:** The qualitative or quantitative allocation of the total product-level, comparative impact to specific value-chain partners.
- **Attributional approach:** A method that estimates comparative GHG impacts as the difference in product GHG inventories (constructed using attributional LCA) between the reference product and assessed product.
- **Attributional LCA:** A method used to quantify the total emissions from the processes and material flows directly used in the life cycle of a product.
- **Baseline scenario:** A reference case that represents the events or conditions most likely to occur in the absence of the assessed product. Used in the GHG Protocol *Policy and Action Standard*.
- **Comparative impact:** The net difference in GHG emissions and removals between a base case without the assessed product and the case with the assessed product.
- **Consequential approach:** A method that estimates comparative GHG impacts as the total, system-wide change in emissions and removals that results from a given decision or intervention.
- **Ex-ante assessment:** A forward-looking assessment of a comparative impact expected to occur in the future.
- **Ex-post assessment:** An assessment of a comparative impact that has occurred in the past.
- **Extraboundary effects:** Changes in emissions or removals that occur outside of the life cycle of both the assessed product and the reference product.
- **Functional unit:** "The performance characteristics and services delivered by the product being studied. A defined functional unit typically includes the function (service) a product fulfills, the duration or service life (amount of time needed to fulfill the function), and the expected quality level" (WRI and WBCSD 2013b).
- **Marginal emissions factor:** The incremental change in GHG emissions from power sources serving an electrical grid system as a result of a change in demand.
- **Market effects:** Rebound effects; changes in market size that occur over and above any changes in market share, and changes in the market price of inputs.
- **Nonpolicy drivers:** Conditions other than government policies and actions—such as socioeconomic factors and market forces—that are expected to affect the emissions sources and sinks included in the system boundary.
- **Policy drivers:** Interventions taken or mandated by a government—such as laws, regulations, and standards; taxes, charges, subsidies, and incentives; and information instruments—that are expected to affect the emissions sources and sinks included in the system boundary.
- **Policy scenario:** A scenario that represents the events or conditions most likely to occur in the presence of the policy or action being assessed. Same as the baseline scenario except that it includes the policy or action being assessed. Used in the GHG Protocol *Policy and Action Standard*.
- **Product:** Any good or service.
- **Product GHG inventory:** The compilation and evaluation of the inputs, outputs, and potential GHG impacts of a product system throughout its life cycle. Sometimes referred to as a product carbon footprint.
- **Reference product:** The product against which the assessed product is compared in the attributional approach.

- **System boundary:** The set of processes, activities, sources/sinks, or life-cycle stages that are part of the assessment.
- **Value chain:** All activities associated with the operations of the reporting company that give rise to scope 3 emissions. Includes upstream and downstream activities, such as the use of sold products by consumers and the end-of-life treatment of sold products after consumer use.

## 3. SETTING TARGETS FOR COMPARATIVE IMPACTS

This section discusses the ways companies have set targets around comparative impacts, further highlighting some of the applications of comparative assessments and the technical challenges in ensuring credible estimates. This section also includes general recommendations for setting targets around comparative impacts. While the company examples are based exclusively on the attributional approach, the lessons learned are equally applicable to the consequential approach.

The research found at least 30 companies that had set one or more corporate-wide targets that involved comparative impacts and that had either expired in 2014 or were still active over the 2015–16 period. (Examples are provided in Figure 3.) Regarding these targets, we can identify the following four types:

1. Absolute targets, wherein companies aim to avoid emissions by a specific amount. Example: "Company A will avoid 1,000 tons $CO_2e$ by 2030."
2. Ratio targets, wherein companies aim to avoid X times the emissions from their internal operations and value chains. Example: "Company B's avoided emissions will be five times its scope 1 and 2 emissions by 2025." This category includes "net-positive" targets that aim to avoid at least 100 percent of a company's emissions.
3. Revenue targets, wherein companies aim to increase the revenue from sustainable or green product portfolios. Example: "Company C will increase its revenues from its Green Product Portfolio 50 percent by 2025." In some cases, a positive GHG impact is an absolute criterion for inclusion in a green portfolio. In other cases, it is optional and one of many environmental impact qualifying criteria.
4. Product development targets, wherein companies aim to increase the number or percentage of products that offer a positive GHG impact. Example: "Company D will increase the number of products that avoid emissions by at least 25 percent by 2020."

This categorization does not capture the many companies that have set targets around product R&D but that calculate comparative impacts only to communicate the benefits of such targets.

Interviews and secondary research revealed information on how 22 companies intend to reach their targets. Product innovation and/or increasing sales are common strategies for companies with all four types of targets. Reducing emissions from scope 1, 2, and 3 sources is a common strategy for those with ratio targets. And, in one instance, a company indicated that it expected to reach its target without any change in business practices at all. While companies did not rank their strategies, it is clear from company interviews that increasing sales is usually, if not always, the primary strategy.

Taken at face value, the targets suggest that such targets can help drive the sales and development of low-carbon technologies, both of which are required to attain global climate goals (see Section 1). It is unclear, however, whether the targets are simply translations of existing corporate sales, R&D, and value-chain efficiency goals into a positive impact figure.

In other words, it is unclear whether they are actually useful in driving actions that a company would not otherwise have taken. This is not necessarily problematic—a target can still have value even if only used to track the effects of strategies to which a company has previously committed. Nonetheless, anecdotal evidence from companies does indicate that comparative impact targets have driven change in at least some companies, through raising internal awareness and focusing efforts on identifying and selling products that enable avoided emissions.

The credibility of these targets is diminished because they do not include negative impacts. Other methodological issues exist, too. For example, for one ratio target, the use phase of energy-intensive sold products was reflected in the comparative impact calculations but not in the scope 3 calculations. For at least three other targets, the calculations used baseline product data from between 2001 and 2005. Such choices would tend to overestimate the positive impact. The next section elaborates on these issues.

Figure 3 | **Examples of Corporate-wide Targets around Comparative Impacts**

**ABSOLUTE TARGETS**

- **3M:** Help our customers reduce their GHG emissions by 250 million tons of $CO_2$ equivalent through use of 3M products (target period: 2015–25).
- **EXELON:** Eliminate 17.5 million metric tons of GHG emissions per year by 2020.
- **FUJI ELECTRIC:** Provide products with the aim of contributing to reducing society's $CO_2$ emissions by 17 million tons in the year 2020.
- **FUJITSU:** Contribute to reducing society's emissions by a cumulative total of 38 million tons over 2013–15.
- **HITACHI:** Contribute to reductions totaling 28 million tons from products and services sold in 2014.
- **LEGRAND:** Avoid the production of 1.5 million tons of $CO_2e$ over the 2014–18 period.
- **MITSUBISHI CHEMICAL HOLDINGS COMPANY:** Generate reductions of $CO_2$ emissions by 3.5 million tons through products.
- **VEOLIA:** Achieve 50 million metric tons $CO_2e$ of avoided emissions from 2015 to 2020, globally.

**RATIO TARGETS**

- **ALCOA:** Enable carbon savings from the use phase of the company's products that are three times the emissions from the production of those products.
- **ASN BANK:** 100 percent net climate neutrality by 2030.
- **AT&T:** Enable carbon savings 10 times the footprint of operations by 2025.
- **BT:** By 2020, help customers reduce carbon emissions by at least three times the end-to-end carbon impact of BT's business.
- **DOW:** By 2025, Dow's products will offset three times more $CO_2$ than they emit throughout their life cycle.
- **ERICSSON:** Reduce societal carbon emissions by a factor of two in relation to carbon emissions from Ericsson's own activities in 2014 by implementing ICT-enabled solutions, such as smart meters and smart transport solutions.
- **NEC:** Attain a level of $CO_2$ reduction that is five times the total volume of $CO_2$ emissions from its entire supply chain in fiscal 2020.
- **NTT:** By 2020, societal emissions reductions enabled by products are over five times more than company's own emissions (with total societal reductions of over 20 million tons of $CO_2$ in 2020).

**REVENUE TARGETS**

- **AKZONOBEL:** Achieve 20 percent of revenue from ecopremium solutions that have a downstream sustainability benefit by 2020.
- **DUPONT:** By 2015, DuPont will grow its annual revenues by at least $2 billion from products that create energy efficiency and/or significant greenhouse gas emissions reductions for our customers.
- **SIEMENS:** Exceed €40 billion in revenue from company's Environmental Portfolio by the end of fiscal year 2014.
- **SKF:** Quadruple the revenue from the BeyondZero portfolio from 2.5 billion Swedish kronur (US$300 million) in 2011 to 10 billion kronur (US$1.2 billion) by 2016.

**PRODUCT DEVELOPMENT TARGETS**

- **NEC:** Increase the number of "Eco Symbol Star" qualifications to 25 by fiscal 2018.

*Note*: Companies' own phrasing may have been adjusted for conciseness.
*Source*: Company websites.

### Key recommendations:

- Companies should first calculate and report scope 1, 2, and 3 emissions and set science-based reduction targets for these emissions. Comparative assessments should neither take precedence over nor detract from efforts to do so.
- Corporate inventory accounting and comparative assessments are complementary but fundamentally different. To be consistent with the requirements of the GHG Protocol corporate accounting and reporting standards, comparative impacts should not be used to adjust scope 1, 2, and 3 emissions. Comparative impacts should also not be compared with corporate GHG inventories unless (1) the impacts have been estimated for a company's entire product portfolio using a consequential approach that covers negative and positive impacts; and (2) the GHG inventories are comprehensive and conform to GHG Protocol requirements.
- Companies should only set ratio targets (including net-positive targets) if corporate GHG inventories and comparative impact estimates are comprehensive, as outlined above.

In the event comprehensive impact estimates and inventories are unavailable, companies could take the following actions:

- Consider setting targets around product performance and R&D. For example, "Company A will increase the number of products that have a positive impact by

30 percent by 2020" or "Company B will increase the share of zero- and low-carbon products to *X* percent of overall products."

- Make secondary claims (but not set targets) regarding the positive impacts associated with these products. For example, "Company C avoided *X* tons of emissions through increased sales of products in its Green Portfolio."

# 4. ACCOUNTING ISSUES AND RECOMMENDATIONS

The research identified a wide range of accounting issues that have critical bearing on comparative impact assessments. Core issues include how to identify which emissions sources should be assessed ("setting the system boundary"), how to identify credible baseline options, and how to ensure data quality. Additional issues come into play when companies desire to claim positive impacts, such as how to apportion total positive impacts to different value-chain actors on the basis of estimated contributions to the assessed product ("attribution"); avoiding cherry-picking products or product applications; aggregating results for claims at the level of product portfolios; and making claims that overlap with the emissions reductions reflected in corporate GHG inventories.

This section describes these issues and the different approaches that individual companies and published guidance documents have adopted. It also offers key recommendations for dealing with these issues when estimating comparative impacts. Many issues are relevant to both attributional and consequential approaches. Therefore, while most existing standards and all known company applications have hitherto used attributional approaches, this section generalizes the discussion to both approaches where possible. This section also discusses the relative efficacy of attributional and consequential approaches in resolving these issues, and makes recommendations about which approach should be used and when.

## Choosing between attributional and consequential approaches

Decision-making is a forward-looking process that requires selecting among alternative actions on the basis of their expected outcomes. Decision-making is best supported by an analysis that anticipates the effects of the decision, to help mitigate the risk of unintended consequences. Hence, a consequential analysis is more suitable whenever comparative impact estimates are used to inform decisions. For this reason, the International Reference Life Cycle Data System (EC-JRC-IES 2010), for example, recommends the consequential approach for analyses that will inform policymaking and the attributional or accounting approach only in contexts where no decision is to be made on the basis of the results of the analysis. In the context of product-level comparative impact assessments, a consequential approach is more suitable when the assessment is used to support actions such as the following:

- Informing policymakers about the potential consequences of policy and regulatory choices regarding individual technologies.
- Determining which products to develop and which to retire.
- Enabling investors to fully assess company risk and investment opportunities.
- Helping customers differentiate products.
- Guiding product R&D by increasing understanding of the GHG effects of different design choices.

While the consequential approach may be better for making decisions, the current state of data availability and limited company resources may make the approach impractical for many companies for the time being.

**Key recommendations:**

Use a consequential approach when comparative impact estimates are used to inform decision-making and whenever market effects mediate comparative impacts. Where a consequential approach is not feasible, use an attributional approach for applications that can be supported with an interim attributional approach.

Use only an attributional approach when helping customers understand the scope 3 implications of their procurement decisions. This is because consequential approaches capture changes in system-wide emissions that cannot be recognized in a scope 3 inventory.

## Core accounting issues

### Setting the baseline option

Against which product(s) should the assessed product be compared? In an attributional approach, the assessed product's life-cycle emissions are compared to those of the reference product. In contrast, the consequential approach considers how emissions are expected to change because of the assessed product.

Using the attributional approach, the choice of reference product is simplest when the assessment is made purely for the purpose of product differentiation for customers (e.g., "Appliance A emits 20% less over its life cycle compared to Appliance B").

In other situations, many options for the reference product have been advanced or used to make claims about positive impacts under the attributional approach. These options include the average of the existing market stock, the average of products sold on the market in one year, product(s) with the highest market share, "conventional" products, the best available technologies, previous versions of the same product from the reporting company, and regulatory requirements, among others.

The accounting for renewable energy products, such as turbine blades and solar cell panels, is illustrative of this variation. In these cases, there is a need to define the reference emissions profile of the electricity generation that would be displaced by the products, once they have been installed. Companies have variously used grid-average emissions factors, nonbaseload emissions factors that are weighted toward plants that operate coincident with peak demand for electricity, and emissions factors that represent the grid-average profile 10 years into the future.

In general, different reference options can differ substantially from one another, impacting the credibility and relevance of the overall assessment. For example, the use of the market average or the product with the highest market share might overstate positive impacts when the solution is a highly energy-efficient product. In this case, the most appropriate reference product would be other highly energy-efficient products (if available) that a customer is more likely to purchase in the absence of the assessed product.

For both attributional and consequential approaches, a particular concern for long-lived products is that policy and nonpolicy drivers may cause changes in the business environment over the lifetime of the assessed product. Such changes may involve, but are not limited to, energy mix and energy efficiency, regulatory policies, consumer behavior, economic and market conditions, and recycling practices. In short, products cannot be innovative and have positive impacts indefinitely, but most guidance documents and company assessments do not consider such potential long-term changes.

Another challenge lies in identifying appropriate reference products for intermediate products or final products with multiple end-use applications. The manufacturer may not know the exact range and distribution of end uses, which may also vary geographically. Or it may not have information on how the final product has been redesigned to incorporate the intermediate product.

In short, there is considerable variation in terms of reference options, and a key issue—the degree to which the assessment should incorporate changes in policy and nonpolicy drivers—is frequently ignored.

**Key recommendations:**

Attributional approach:

- If the goal is to claim impacts have occurred in the marketplace, select a reference product that represents what is most likely to be sold on the market in the absence of the assessed product, rather than what already exists on the market (e.g., a market average).

Attributional and consequential approaches:

- If the assessed product is a component of more than one final product in one or more sectors, calculate and report impacts for a few representative final products and reference products to ensure representative results.
- Justify the choice of reference product (attributional approach) and baseline scenario (consequential approach).
- When accounting for long-lived products:
  - Incorporate relevant and identifiable policy and nonpolicy drivers (e.g., changes in regulatory and market conditions) that are expected to significantly affect the sources and sinks included in the system boundary over the assessment period (e.g., projected changes in efficiency standards). (*Note*: The *Policy and Action Standard* explicitly includes these drivers in its analytical framework.)

- Alternatively, if the attributional approach is used, limit the validity of the assessment to one year, to minimize the influence of drivers on the assessment's results.

- To account for the GHG impacts of renewable energy products, use "marginal" emissions factors to define the emissions profile of the comparable product.

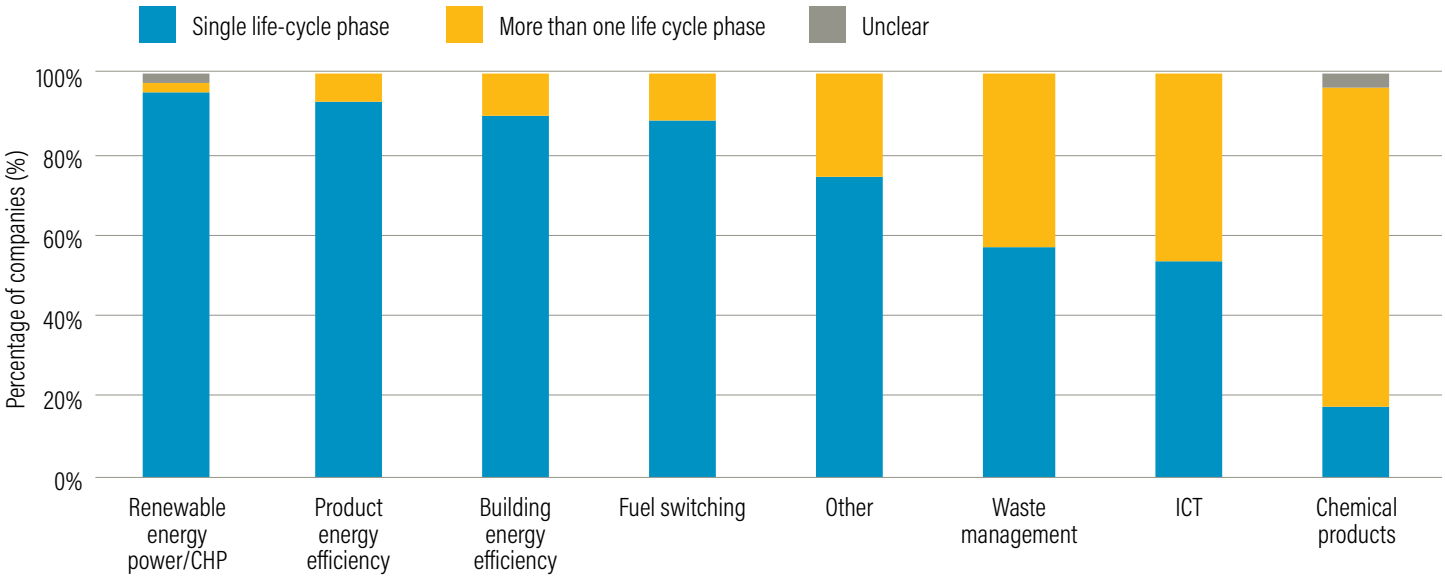
## Setting the system boundary

A variety of issues are relevant when setting the system boundary. When using an attributional approach, the most important is the selection of life-cycle stages to include in the assessment. Most companies focus on only one life-cycle phase for most types of products (Figure 4). For example, claims for the vast majority of renewable energy, combined heat and power (CHP) systems, and building and product energy efficiency are based solely on the use phase. In contrast, assessments that include more than one life-cycle phase are typical for chemical products and common for information and communications technology (ICT) products. This may reflect, in part, the influence of industry standardization efforts, as well as the long history of the use of attributional LCA within the chemical industry in designing chemical product portfolios. Most guidance documents appropriately employ a life-cycle approach.

Another issue is that certain changes in emissions or removals may occur outside of the life cycle of both the assessed and reference products but may nevertheless be relevant to include in an assessment. These extraboundary effects are typically harder to predict in either likelihood of occurrence or potential magnitude, but they may be relevant when considering the large-scale adoption of the assessed product (e.g., see Table 4). One common type of extraboundary effect is rebound effect, where savings from energy efficiency are offset by increases in other carbon-intensive behavior (e.g., gains from increases in an appliance's energy use efficiency are offset by the increased use of that appliance). While some guidance documents do cover extraboundary effects (they are explicitly considered by the *Policy and Action Standard*), they are seldom addressed in practice—in only one case did a company explicitly take such effects into account.

Finally, a company's product may have a positive impact but adversely affect other environmental indicators, such as air or water quality. In such cases, companies must decide whether to report the trade-off, ignore the trade-off, or forgo reporting the comparative impact altogether. Limited guidance is provided on such issues in existing guidance documents and few companies take trade-offs into account.

Figure 4 | **Percentage of companies estimating positive impacts using one or more life cycle phases**




*Sources*: 2014 CDP Climate Change Questionnaire and company websites.

Table 4 | **Examples of Extraboundary Effects That May Increase or Reduce Emissions**

| CASE | EFFECTS OCCURRING OUTSIDE THE LIFE-CYCLE BOUNDARIES OF COMPARED PRODUCTS |
|---|---|
| Telecommuting ICT products that replace the need to travel to and from work | ■ Increased home energy use (e.g., from heating and lighting at home) (+).<br>■ Increased urban sprawl from employees' ability to live farther from office (+).<br>■ The direct effect of ICT products is reduced travel by cars (–). |
| More fuel-efficient cars | ■ Consumers use fuel savings to drive more (+).<br>■ Increased need for transport infrastructure (+).<br>■ The direct effect of more fuel-efficient cars is reduced emissions from cars (–). |
| Introduction of more energy-efficient electrical equipment | ■ Increased demand for goods and services due to increase in disposable income from energy savings (+).<br>■ The direct effect of more efficient equipment is reduced emissions from electrical equipment (–). |

*Notes*: These examples are purely illustrative, and real-world indirect effects will vary considerably depending on the specific type of product and market. (+) connotes an increase in emissions, while (-) connotes a reduction in emissions.
*Source*: Table by authors.

**Key recommendations:**
Attributional approach:

- Include the complete product life cycle in the assessment boundary.
- Companies may omit identical life-cycle stages in the assessed and reference products, on the basis of modeled, secondary, or primary data.
- As an alternative to excluding life-cycle phases: use proxy data or simplified estimation methods.
- Companies can also omit specific processes in a single product's life cycle when all of the following conditions are met: primary or secondary data cannot be collected; extrapolated and proxy data cannot be determined to fill the data gap, and an estimation determines that emissions from the process are insignificant.
- If identical life-cycle phases or specific processes have been omitted, do not claim that emissions have changed on a percentage basis (e.g., that a product avoids emissions *X* percent, relative to the reference product).

Attributional and consequential approaches:

- Disclose any identified trade-offs with other (non-GHG) environmental impact categories.
- Include all significant positive and negative impacts in the assessment boundary, wherever they occur and whenever they can be assessed using reliable and verifiable data.

## Data quality and uncertainty analysis

The quality of data used as input to a comparative assessment critically shapes the overall reliability and accuracy of the results. Ideally, data for both the assessed and reference products should be as specific as possible with regard to geography, technology, and time. While high-quality data are typically available for processes in the assessed product's life cycle that are under the control of the reporting company, they are rarely available for the reference product or other sources. This can impair the relevance and fairness of comparisons.

Uncertainty analysis can help characterize the impact of data quality and aid in the proper interpretation of the assessment's results. It involves a systematic approach to identifying and documenting sources of uncertainty, then a quantitative or qualitative assessment of uncertainty. Uncertainty analysis can thereby help companies understand the steps needed to improve data quality and increase users' confidence in the results.

In only a few instances have companies provided details on data quality or the results of an uncertainty analysis when making public claims about positive impacts. Existing guidance documents are generally consistent, however, in requiring uncertainty analyses.

**Key recommendations (attributional and consequential approaches):**

- Determine the desired level of accuracy and completeness of the assessment on the basis of factors including the following:
  - Objectives of the assessment and intended uses and users of the results
  - Data availability
  - Capacity, resources, and time available to carry out the assessment
- Collect primary data for all processes under the reporting company's ownership or control.
- Assess the data quality of activity data, emissions factors, and emissions data following the GHG Protocol *Product Standard*. That is, assess data quality against five data-quality indicators: technological representativeness, geographical representativeness, temporal representativeness, completeness, and reliability.
- Conduct and report the results of quantitative and/or qualitative uncertainty assessments.
- Match the rigor of the uncertainty assessment to the objectives of the assessment, the required level of accuracy, data availability, and resources. See Chapter 10 of the *Product Standard* and Chapter 12 of the *Policy and Action Standard* for further guidance.
- Particularly for products with a long use phase, conduct a sensitivity analysis of key parameters and assumptions in the assessment. Key parameters are ones that are highly variable or most likely to significantly affect the results.
- Where uncertainty is high (e.g., multiple baseline options seem equally likely), use the most conservative assumptions.

## Accounting issues involved in making claims broader than a single unit of product

### Attribution

Irrespective of how comparative impacts are calculated, they reflect the collective efforts of multiple partners along the entire value chain, including raw material suppliers, material manufacturers and processors, part assemblers, retailers, and customers. For example, the positive impacts of an electric vehicle would not be possible without the manufacturers of intermediate components (e.g., engines) or the end consumer who chooses the electric vehicle over the conventional product. Reporting all of a product's comparative impact can be useful in communicating the results of an entire sector—for example, in demonstrating the value of particular product systems to policymakers.

Many companies, however, have sought to attribute portions of the total comparative impact to different partners. Stated reasons for doing so have included helping individual partners assess the specific impacts of their decisions and understanding opportunities to increase positive impacts. Another reason is helping prevent the double-counting that would arise when multiple partners report full value-chain impacts.

The accurate and credible attribution of impacts faces a variety of challenges (Table 5). First, value-chain partners may not agree on a consistent attribution approach (e.g., percentage value-added versus mass) and/or attribution percentage that should be assumed by a given partner. Second, in many cases no single attribution method is likely to truly reflect the contribution of each partner to the comparative impact. Third, attribution may be more difficult to implement for certain segments of the value chain (e.g., financial institutions that provide loans versus manufacturers). And, finally, attribution may be difficult to justify for products that customers have designed.

Existing guidance documents provide little direction on these issues. Only two guidance documents address attribution and provide quite different specifications.

Table 5 | **Pros and Cons of Attributing Comparative Impacts to Value-Chain Partners**

| OPTION | PROS | CONS |
|---|---|---|
| Do not attribute comparative impacts | ■ Emphasizes that impacts result from the collective efforts of entire value chains.<br>■ Enables whole sectors to illustrate their contributions and benefits to society. | ■ Multiple partners along a given value chain may double-count impacts. |
| Attribute comparative impacts | ■ Helps enable assessment, comparison, and communication of the impacts of single companies within individual value chains.<br>■ Enables better understanding of potential opportunities to increase positive impacts.<br>■ Helps prevent the double-counting of impacts within individual value chains (as long as partners use a consistent attribution approach). | ■ May undermine the understanding that impacts result from the collective efforts of entire value chains.<br>■ Multiple attribution approaches exist and none is likely to truly reflect the contribution of each value-chain partner to the impacts.<br>■ Difficult to agree on appropriate attribution factor with value-chain partners.<br>■ Challenging to implement for complex product systems (e.g., engines that involve hundreds of parts).<br>■ Incomplete knowledge or awareness often exists regarding what activities result in or are required for materializing the impact. |

*Source*: Table by authors.

One (ICCA and WBCSD 2013) states that attribution is optional and that if attribution is desired, a company must qualitatively communicate the contribution of its product to the overall positive impact before attempting quantitative attribution. No specific quantitative approach is recommended. The other document (ILCA 2015) requires quantitative attribution (see Appendix B for details).

**Key recommendations (attributional and consequential approaches):**

- If the assessment has been performed with value-chain partners, conduct attribution on the basis of a percentage agreed upon with those partners and report the attribution method and percentage.
- Disclose that the total comparative impact reflects the collective effort of the entire value chain.

## Scaling results to a product's market size

Using an attributional approach, comparative impacts are calculated at the level of the functional unit. How can the result be scaled up to a product's market size to estimate the overall impact of a product? Companies and guidance documents have variously used the actual or budgeted sales, production, or shipment volumes as a proxy for the number of final products in use. This approach is intuitive and easy to apply, although budgeted data may not closely correspond to actual data for any number of reasons, such as changes in product prices or product recalls. Another limitation of the attributional approach is the failure to distinguish changes in market size from changes in market share. Only increases in market share can yield positive impacts. For example, a tablet may have lower life-cycle emissions compared to a desktop computer, but it would have a positive impact only to the extent that it replaces desktop computers. Any additional tablets beyond the replacement number (i.e., an increase in market size) would not generate a positive impact because they were purchased as an additional computing platform. In only one case has a company attempted to estimate this share, on the basis of assumptions of typical product lifetimes.

The *Policy and Action Standard* overcomes these limitations because it is explicitly designed to be applied to interventions at the market level.

**Key recommendations:**
Attributional approach:

- As a starting point, use actual (ex-post) or estimated (ex-ante) sales records or, if sales data are unavailable, production or shipment numbers. Where possible, adjust these data to reflect only the number of products estimated to replace existing or future stock.

- Report results at the functional unit level separately from results at the market level.

Consequential approach:

- Consequential approaches are inherently better at addressing market effects and are therefore preferred, especially if market effects are likely to be significant.

## Cherry-picking products and product applications

Cherry-picking means a company, intentionally or otherwise, selects products (or product applications) that have positive impacts, while overlooking other products in its product portfolio that have negative impacts. While this issue is clearly serious, no examples were found where companies explicitly included negative impacts in their assessments. Also, with the exception of the *Policy and Action Standard*, existing guidance documents focus exclusively on positive impacts.

**Key recommendations (attributional and consequential approaches):**

- Transparently disclose why comparative impacts have been estimated for the selected products and the underlying methodology (see Appendix A for more detailed disclosure recommendations).
- Describe the percentage this product represents in terms of the company's total product portfolio.
- Describe the products that have been excluded from the portfolio assessment.

## Aggregating results across products

Aggregating comparative impacts across multiple products can be resource-intensive. Using the *Policy and Action Standard* approach, one would have to quantify a baseline scenario for each product. In turn, using an attributional approach, one would have to develop a product GHG inventory for both the assessed and reference products. Traditionally, product GHG inventories are often performed manually and one product category at a time, although some companies are gradually introducing systems that automate the calculations across product portfolios. A typical product GHG inventory can require over 100 data inputs and hundreds of staff hours. Quantifying product GHG inventories for hundreds or even thousands of individual products therefore demands very large amounts of dedicated resources (Meinrenken et al. 2012).

How can companies practicably estimate portfolio-wide comparative impacts with any accuracy? Existing guidance documents do not address this topic because they focus on individual, product-level comparisons. Many companies do, however, report portfolio-wide positive impacts, sometimes by following an abridged version of existing guidance documents. Other approaches include the following:

- Using screening approaches or product category averages.
- Identifying a "typical" product and multiplying by the total number of contracts or sales across all products.
- Creating a regression equation for a subset of contracts that relates positive impacts to the sales value of those contracts and then using the regression equation to extrapolate to other contracts.
- Using only a few products as a surrogate for the company's entire portfolio, and estimating company-wide positive impacts using only these products.

Some of these approaches, especially regression analyses, may not be appropriate for varied product lines. Also, cherry-picking is a real concern when companies estimate positive impacts at the portfolio level using only a subset of (purportedly representative) products. The research showed that companies almost universally based portfolio-wide estimates on a subset of products known or predicted to offer positive impacts.

**Key recommendations (attributional and consequential approaches):**

- Describe how products were selected for inclusion in the portfolio-wide estimate and describe the methods used to obtain this estimate (e.g., any extrapolation techniques).
- Describe the number of products assessed and the percentage these products represent in terms of the company's total product portfolio.
- Consider getting external stakeholder feedback on the credibility of the accounting methodology.

## 5. SUMMARY AND CONCLUSIONS

There is considerable uncertainty and variation in practice across a wide range of accounting topics, even among published guidance documents (Table 6). These differences are most acute in terms of setting the baseline option and setting the system boundary. Claiming impacts can introduce additional subjectivities around attributing claims to value-chain partners, cherry-picking products or product applications, and aggregating results at the level of product portfolios. Each issue has the potential to affect the relevance and credibility of comparative impact estimates and claims, and, in most cases, the variation in existing guidance documents is not clearly tied to sector-specific considerations.

Still, comparative assessments may help drive meaningful change. This is at least clear in terms of their role in product development and design, helping customers differentiate products, and informing policy decisions. It is less apparent that other applications are meaningful (e.g., building brand image or informing portfolio planning), because of either more complicated underlying accounting or a lack of evidence.

The research identified good practices that are presented in this paper as high-level recommendations. These recommendations are not intended to be exhaustive, to offer detailed guidance, or to address issues specific to product categories. Rather, they are intended to form a generic framework to help guide, and improve the credibility and consistency of, comparative assessments. Appendix A consolidates all of the issue-specific recommendations.

Most generally, consequential approaches such as the *Policy and Action Standard* address many of the accounting challenges inherent in estimating comparative impacts, including market effects, extraboundary effects, and policy and nonpolicy drivers. For this reason, consequential approaches are generally preferred, although their practicability may be limited by data availability and company resources. Companies should invest in data collection to overcome any data limitations, use the best available data to make informed decisions about which products to produce and sell, and report credibly on the emissions impacts of their product portfolio.

Table 6 | **The Potential Impact and Level of Consensus of Different Accounting Issues in Published Guidance Documents**

| ISSUE | CAPACITY TO IMPACT THE ACCURACY OR CREDIBILITY OF ESTIMATES | LEVEL OF CONSENSUS AMONG EXISTING DOCUMENTS |
|---|---|---|
| Selecting the baseline option | **H** | **L** |
| Setting the system boundary | **H** | **M** |
| Data quality and uncertainty analysis | **H** | **M** |
| Attributing comparative impacts to value-chain partners | **H** | **L** |
| Scaling results to product's market size | **H** | **L** |
| Cherry-picking products and product applications | **H** | **L** |
| Aggregating results to the level of an entire company or product portfolio | **H** | **L** |

*Note*: H = high, M = medium, L = low.
*Source*: Table by authors.

# APPENDIX A: CONSOLIDATED RECOMMENDATIONS

## General principles

- Corporate inventory accounting and comparative assessments are complementary approaches to managing a company's impact on the climate but use fundamentally different methods.
- Companies should first calculate and report scope 1, 2, and 3 emissions and set science-based reduction targets for these emissions. Comparative assessments should neither take precedence over nor detract from efforts to do so.
- If a company reports positive impacts, it should also report a complete inventory of scope 1, 2, and 3 emissions. Companies should not make claims about positive impacts without being transparent about whether their scope 1, 2, and 3 emissions are increasing or decreasing.
- Comparative impacts should not be used to adjust (e.g., "net") scope 1, 2, and 3 emissions.
- The accounting and reporting of comparative impacts should adhere to the following principles:
  - Relevance: Ensure that the comparative assessment appropriately reflects the GHG effects of the assessed product (in relation to the base case) and serves the decision-making needs of users and stakeholders.
  - Completeness: Include all life-cycle GHG emissions (under an attributional approach) or all changes in emissions arising from the assessed product (consequential approach) in the assessment.
  - Consistency: Use consistent accounting approaches, data collection methods, and calculation methods for the assessed and reference products (attributional approach) and the baseline and policy scenarios *(Policy and Action Standard)*.
  - Transparency: Provide clear and complete information to allow stakeholders to assess the credibility and reliability of the results, especially those related to key methodological issues, such as the choice of a reference product or baseline scenario.
  - Accuracy: Reduce uncertainties as far as possible.

## Accounting recommendations

### General guidelines

- Use a consequential approach when comparative impact estimates are used to inform decision-making and whenever market effects mediate comparative impacts. Where a consequential approach is not feasible, use an attributional approach for applications that can be supported with an interim attributional approach.
- Use only an attributional approach when helping customers understand the scope 3 implications of their purchasing decisions.
- When using the attributional approach,
  - the product GHG inventories for the assessed and reference products should have identical functional units to ensure that the products can be compared on a like-for-like basis; and
  - the product GHG inventories should be calculated using equivalent methodological considerations, such as performance, system boundary, data types and quality, and allocation procedures.

### Setting the assessed and reference products

**Attributional approach:**

- If the goal is to claim impacts have occurred in the marketplace, select a reference product that represents what is most likely to be sold in the market in the absence of the assessed product, rather than what already exists on the market (e.g., a market average).

**Attributional and consequential approaches:**

- If the assessed product is a component of more than one final product in one or more sectors, calculate and report impacts for a few representative final products and reference products to ensure representative results.
- When accounting for long-lived products, take the following steps:
  - Incorporate relevant and identifiable policy and nonpolicy drivers (e.g., changes in regulatory and market conditions) that are expected to significantly affect the sources/sinks included in the system boundary over the assessment period (e.g., projected changes in efficiency standards). (Note: The *Policy and Action Standard* explicitly includes these drivers in its analytical framework.)

- Alternatively, if the attributional approach is used, limit the validity of the assessment to one year, to minimize the influence of drivers on the assessment's results.

- To account for the GHG impacts of renewable energy products: use "marginal" emissions factors to define the emissions profile of the comparable product.

## Setting the system boundary

**Attributional approach:**

- Include the complete product life cycle in the assessment boundary.

- Companies may omit identical life-cycle stages in the assessed and reference products, on the basis of modeled, secondary, or primary data.

- As an alternative to excluding life-cycle phases, use proxy data or simplified estimation methods.

- Companies can also omit specific processes in a single product's life cycle when all of the following conditions are met: primary or secondary data cannot be collected; extrapolated and proxy data cannot be determined to fill the data gap, and an estimation determines that emissions from the process are insignificant.

- If identical life-cycle phases or specific processes have been omitted, do not claim that emissions have changed on a percentage basis (e.g., that a product avoids emissions X percent, relative to the reference product).

**Attributional and consequential approaches:**

- Disclose any identified trade-offs with other (non-GHG) environmental impact categories.

- Include all significant positive and negative impacts in the assessment boundary, wherever they occur and whenever they can be assessed using reliable and verifiable data.

## Data quality and uncertainty analysis (attributional and consequential approaches):

- Determine the desired level of accuracy and completeness of the assessment on the basis of a range of factors, including the following:
  - Objectives of the assessment and intended uses and users of the results
  - Data availability
  - Capacity, resources, and time available to carry out the assessment

- Collect primary data for all processes under the reporting company's ownership or control.

- Assess the data quality of activity data, emissions factors, and emissions data following the GHG Protocol *Product Standard*. That is, assess data quality against five data quality indicators: technological representativeness, geographical representativeness, temporal representativeness, completeness, and reliability.

- Conduct and report the results of quantitative and/or qualitative uncertainty assessments.

- Match the rigor of the uncertainty assessment to the objectives of the assessment, the required level of accuracy, data availability, and resources. See Chapter 10 of the *Product Standard* (attributional approach) or Chapter 12 of the *Policy and Action Standard* (consequential approach) for further guidance.

- Particularly for products with a long use phase, conduct a sensitivity analysis of key parameters and assumptions in the assessment. Key parameters are those that are highly variable or most likely to significantly affect the results.

- Where uncertainty is high (e.g., multiple baseline options seem equally likely), use the most conservative assumptions.

**Attribution (attributional and consequential approaches):**

- If the assessment has been performed with value-chain partners, conduct attribution on the basis of a percentage that is agreed upon with those partners.

## Scaling results to a product's market size

**Attributional approach:**

- As a starting point, use actual (ex-post) or estimated (ex-ante) sales records or, if sales data are unavailable, production or shipment numbers. Where possible, adjust these data to reflect only the number of products estimated to replace existing or future stock.
- Report results at the functional unit level separately from results at the market level.

**Consequential approach:**

- Consequential approaches are inherently better at addressing market effects and are therefore preferred, especially if market effects are likely to be significant.

## Reporting recommendations

- Make clear that the comparative impact is not equivalent to changes in the amount of GHGs emitted into the atmosphere.
- When using the attributional approach, clearly describe the assessed and reference products, and why they were selected, and report the life-cycle emissions for each.
- When using a consequential approach, clearly describe the baseline and policy scenarios, and why they were selected, and report the emissions of each.
- Mention that the total comparative impact reflects the collective effort of the entire value chain.
- Report the total comparative impact and, for solutions that are intermediate products, qualitatively describe how the assessed product contributes to comparative impact of the final product.
- Describe the assumptions, data sources, and methodologies used to estimate the comparative impacts.
- If attribution is attempted, report the attribution method and ratio.
- Provide a quantitative estimate or qualitative description of the uncertainty of the results, as well as the range of results from sensitivity analyses for key parameters and assumptions.
- Disclose any identified trade-offs with other (non-GHG) environmental impact categories.

**When a company has estimated the aggregate comparative impact for product portfolios, take the following steps:**

- Describe how products were selected for inclusion in the portfolio-wide estimate and describe the methods used to obtain this estimate (e.g., any extrapolation techniques).
- Describe the number of products assessed and the percentage these products represent in terms of the company's total product portfolio.
- Describe the products that have been excluded from the portfolio assessment.
- Consider getting external stakeholder feedback on the credibility of the accounting methodology.

## Recommendations for setting targets

- Before setting targets for comparative impacts, companies should set science-based reduction targets for their scope 1, 2, and 3 emissions (e.g., to reduce scope 3 emissions from sold products).
- Companies should not set ratio targets (including net-positive targets) unless (1) the impacts have been estimated for a company's entire product portfolio using a consequential approach that covers negative and positive impacts and (2) the GHG inventories are comprehensive and conform to GHG Protocol requirements.

**In the event comprehensive impact estimates and inventories are unavailable, companies could take the following actions:**

- Consider setting targets for product performance and R&D. For example, "Company A will increase the number of products that have a positive impact by 30 percent by 2020" or "Company B will increase the share of zero- and low-carbon products to *X* percent of overall products."
- Make secondary claims (but not set targets) regarding the positive impacts associated with these products. For example, "Company C avoided *X* tons of emissions through increased sales of products in its Green Portfolio."

## ENDNOTES

1. As determined by interviews with companies conducted for this paper.
2. For a summary of different viewpoints on the merits of avoided emissions accounting, see WRI (2014a).

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## ACKNOWLEDGMENTS

We are pleased to acknowledge our institutional strategic partners, who provide core funding to WRI: Netherlands Ministry of Foreign Affairs, Royal Danish Ministry of Foreign Affairs, and Swedish International Development Cooperation Agency.

WRI extends its gratitude to the following organizations whose representatives were interviewed and/or provided feedback on drafts of this paper:

| | | |
|---|---|---|
| 3M | DuPont | NEC |
| Alcoa | Ecofys | NTT |
| AT&T | Evonik | Ricoh |
| BASF | Fujitsu | Siemens |
| Carbone 4 | GE | SKF |
| Citi | JCI | Stockholm Environmental Institute |
| Dell | Mitsubishi Chemical Holdings Company | Tetrapak |
| Dow | | |

The author would like to thank Pankaj Bhatia, Cynthia Cummis, and David Rich for extensive contributions, expert guidance, and feedback. Nate Aden and Eliot Metzger provided insightful internal reviews, Alex Martin copyedited the manuscript, and Julie Moretti and Romain Warnault assisted in the graphic design of the paper.

We are also indebted to the Alcoa Foundation and UPS Foundation for their generous financial support.


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## ABOUT WRI

World Resources Institute is a global research organization that turns big ideas into action at the nexus of environment, economic opportunity, and human well-being.

**Our Challenge**

Natural resources are at the foundation of economic opportunity and human well-being. But today, we are depleting Earth's resources at rates that are not sustainable, endangering economies and people's lives. People depend on clean water, fertile land, healthy forests, and a stable climate. Livable cities and clean energy are essential for a sustainable planet. We must address these urgent, global challenges this decade.

**Our Vision**

We envision an equitable and prosperous planet driven by the wise management of natural resources. We aspire to create a world where the actions of government, business, and communities combine to eliminate poverty and sustain the natural environment for all people.

**Our Approach**

COUNT IT

We start with data. We conduct independent research and draw on the latest technology to develop new insights and recommendations. Our rigorous analysis identifies risks, unveils opportunities, and informs smart strategies. We focus our efforts on influential and emerging economies where the future of sustainability will be determined.

CHANGE IT

We use our research to influence government policies, business strategies, and civil society action. We test projects with communities, companies, and government agencies to build a strong evidence base. Then, we work with partners to deliver change on the ground that alleviates poverty and strengthens society. We hold ourselves accountable to ensure our outcomes will be bold and enduring.

SCALE IT

We don't think small. Once tested, we work with partners to adopt and expand our efforts regionally and globally. We engage with decision-makers to carry out our ideas and elevate our impact. We measure success through government and business actions that improve people's lives and sustain a healthy environment.