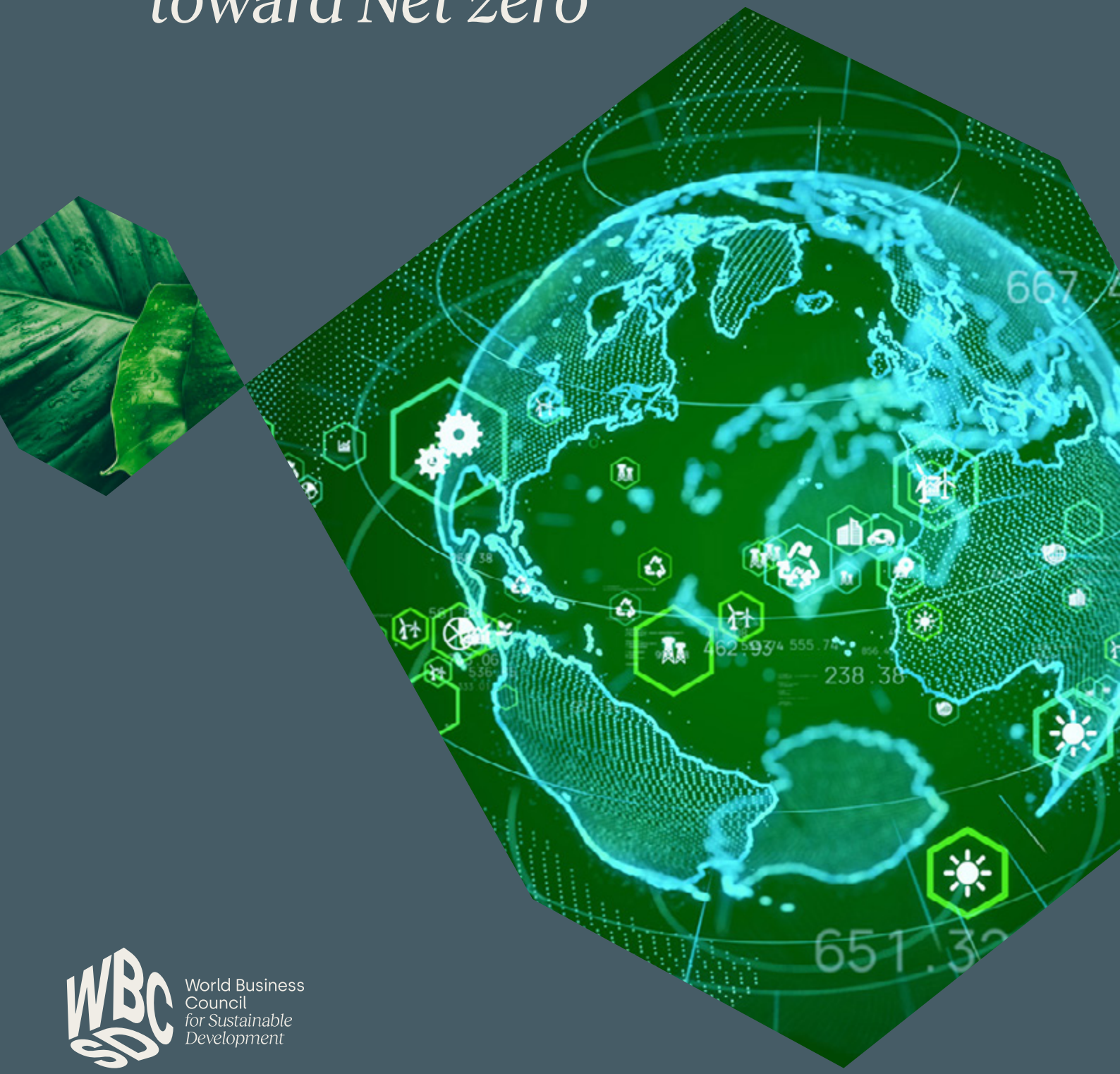
Guidance on Avoided Emissions

→ *Helping business drive innovations and scale solutions toward Net zero*



World Business Council for Sustainable Development

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Foreword

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Since we released our first *Avoided Emissions Guidance* in 2023, the urgency of the Net Zero transition has only intensified. Despite progress in setting emissions reduction targets and advancing mitigation actions, the world remains off track for limiting global warming to the levels science requires.

The challenge ahead demands a broader perspective – one that does not only see companies as responsible for reducing their own emissions, but also empowers them to drive decarbonization through the innovative solutions they bring to market. Avoided emissions offer this wider, more systemic approach. They help us understand the impact that low-carbon solutions have on other businesses' or consumers' emissions, and in which markets these solutions are most impactful.

The original Guidance, endorsed at the 2023 G7 Summit in Sapporo, laid the foundation for consistent assessment of avoided emissions. Since then, demand for a standardized approach has grown significantly. Investors, regulators, and businesses are calling for standardized methods to measure and report these impacts, so they can integrate avoided emissions into climate-aligned decision making. We are grateful for the support of our collaborators in the private and public space who have been key in moving this agenda forward in recent years.

In response, we have worked with our members and global experts to refine this Guidance. We have built in feedback from extensive stakeholder engagement, including a multi-stakeholder public consultation launched at COP29. This updated version is a pivotal step towards integrating avoided emissions and intervention-based impact accounting into globally recognized carbon accounting standards. It now includes refined definitions and more detailed methodologies in key areas such as data quality, impact monitoring, and reporting – offering enhanced practical guidance for both businesses and investors.

This Guidance enables businesses to tackle climate action head-on, by providing a technically robust method of reporting that can guide their strategy, product innovation, and competitive advantage.

We invite all actors to use and build on this framework. Incremental changes alone are not enough to achieve the scale of transformation needed to meet global climate goals. Instead, we must accelerate the introduction of the most impactful solutions where they are needed most.

Dominic Waughray
Executive Vice President, Imperatives, WBCSD

Executive *summary*

Executive Summary

It's time for system-level climate action

We have created this Guidance to inspire companies and other relevant stakeholders (financial institutions, regulators and customers) to promote the system-wide change needed to fast-track decarbonization. It focuses on the avoided emissions (AE) of climate solutions, which are a key part of the journey to decarbonizing the planet. This document offers a way for companies to clearly assess the suitability of their low-carbon solutions in a Net Zero-aligned world and their organizational ability to solve climate challenge. Organizations that can reliably asses AE are better able to scale these kinds of impactful climate solutions.

More robust and comprehensive guidance to assess and disclose AE

Our latest update of this Guidance focuses on more detailed and technically robust information, as well as including recent developments by aligning with other frameworks. We have also updated the methodology to make the process of calculation clear and easy to follow, and expanded the Guidance to address allocation, data and traceability, reporting, and verification. Our goal has been to contribution to a standardized approach to calculating and disclosing AE. Organizations using this Guidance are empowered to make decisions that maximize decarbonizing potential, leverage these decisions for competitive advantage, and avoid misuse, such as greenwashing.

What are AE?

AE (avoided emissions) are the positive impact created when comparing the greenhouse gas (GHG) emissions of a solution to a most likely, alternative scenario where the solution would not be used. Complementary to actions that reduce an organization's own direct and indirect emissions, these solutions prevent emissions for other actors. This Guidance therefore addresses intermediary and end-use solutions that lower emissions compared to a defined reference scenario.

Key topics explored in this Guidance

Defining the solution and system boundaries

There are two types of climate solutions:

1. Intermediary solutions – these are inputs or components that reduce the climate impact in production and delivery of *other* products or services.
2. End-use solutions – these are products or services with a positive climate impact that are consumed by the end-user in their *final form*.

It is important to define a solution's function based on its application in a specific market or geography. A company must then define the system boundary, which describes the relevant supply chain steps that are part of the assessment. When it comes to AE, these definitions are the starting point for determining a solution's eligibility and subsequent assessment.

Ensuring the eligibility of a climate solution

There are three eligibility criteria (or "gates") that any climate solution should meet before a company calculates and claims AE:

→ **Gate 1 – Climate action credibility:** The company has a climate strategy with emission reduction targets that are aligned (or in the process of alignment) with climate science and can be proven through existing frameworks.

→ **Gate 2 – Latest climate science alignment:** The solution has mitigation potential according to the latest climate science and recognized sources, and is not applied to the exploration, extraction, mining and/or production, distribution and sales of fossil fuels.

→ **Gate 3 – Contribution legitimacy:** The solution achieves measurable and significant GHG emissions reductions compared to a reference scenario, and these reductions are the direct result of the solution.

Assessing AE quantitatively

We outline a step-by-step approach to calculate the AE of eligible climate solutions:

- → **Step 1: Identify the timeframe of the assessment.**
- → **Step 2: Define the reference scenario.**
- → **Step 3: Assess the solution and reference lifecycle emissions.**
- → **Step 4: Assess the solution's AE.**
- → **Step 5: Validate contribution legitimacy.**

An optional step – separate from the five-step approach – is to assess AE at the company and value chain level. We provide recommendations how companies can allocate, aggregate, and consolidate AE.

Communicating and reporting

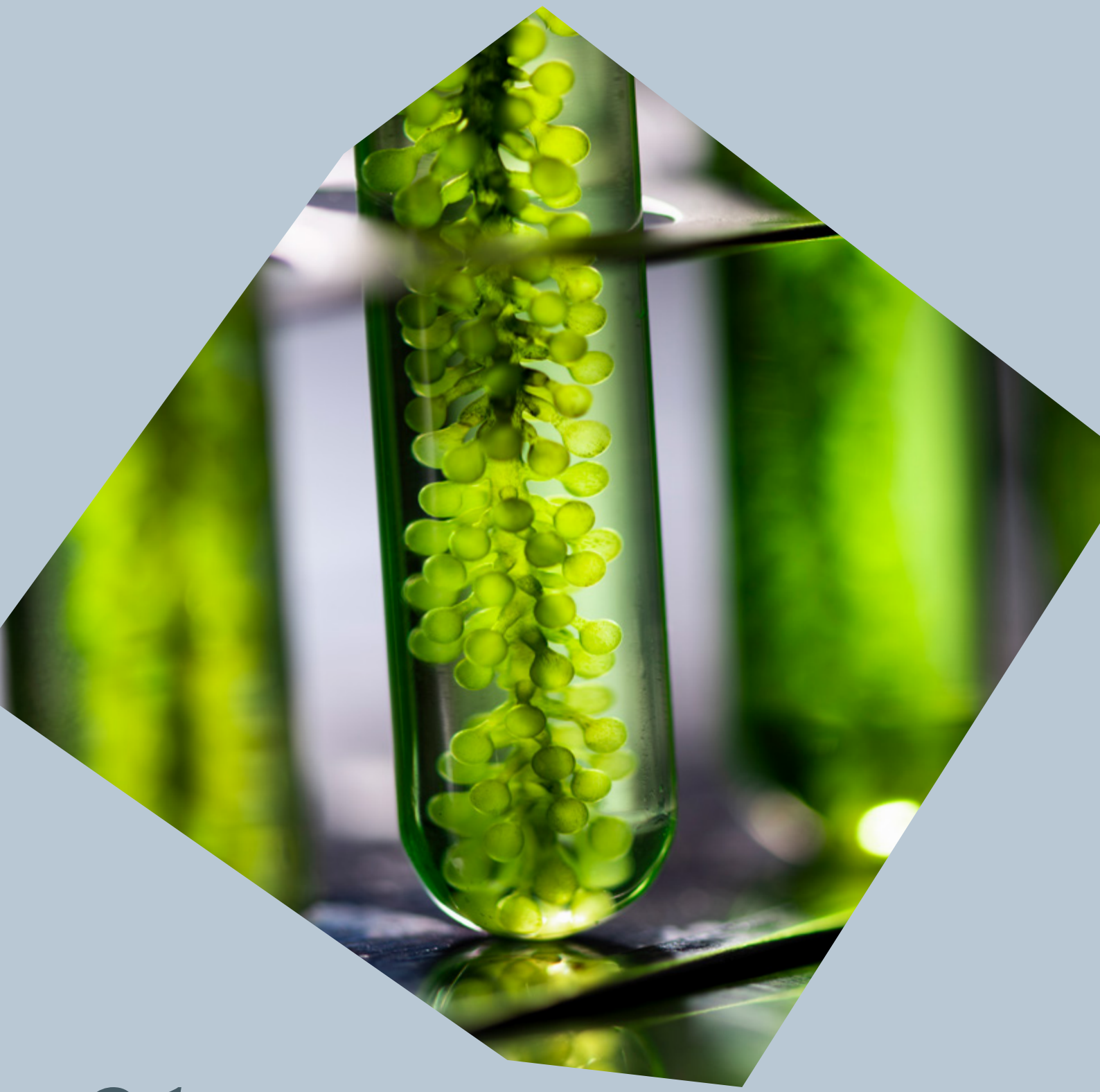
In creating this Guidance, we have aimed to support companies in adopting standardized reporting of AE – to enable greater comparability and consistency across companies, and minimize the risk of misstatements and misrepresentation of claims. To ensure transparency and credibility, companies can follow reporting requirements and recommendations for third party review, and use the provided template for reporting.

Implementation, monitoring, and continuous learning

We outline good practice and tools for data management, traceability and monitoring, especially across the value chain and in the use phase.

We want to encourage the widespread use of the Guidance through our Implementation Hub. There we develop and share sector-specific guidance, a technical template offering practical support and a use case repository showcasing examples of companies who have already applied the Guidance.

Introduction



01.

01. Introduction

The journey so far: how this Guidance came about

Climate action requires that businesses not only adapt to a changing and decarbonizing world, but also become initiators for this change. Companies working towards achieving Net Zero face the dual challenge of reducing their own GHG footprint while also developing low-carbon solutions that contribute to broader decarbonization efforts, known as "avoided emissions" (AE). AE – emissions savings that are realized through a company's products and services – offer an important way to accelerate decarbonization through the development of products and services that help other actors reduce their climate impact.

Companies calculate AE by comparing the low-carbon scenario created by their climate solution to a reference scenario. This shows them the potential impact of their solution on others' emissions.

These calculations are not straightforward and are in need of standardization. To support this, we released our *Guidance on Avoided Emissions* in 2023, with endorsement from the industry, finance and policy sectors, including the G7. We expanded our program in 2024, launching projects focused on methodology, implementation and finance integration to promote AE assessment and reporting in decarbonization efforts.

The initial Guidance was developed in close collaboration with the Net Zero Initiative (NZI) and was further tested and iterated because the field of intervention-based GHG assessment and reporting is moving fast and is still in the early adoption phase. We received feedback on the Guidance from companies in key sectors (including the built environment, agriculture and food, chemicals, energy, transport and mobility, digital) through a structured testing program in 2023 and 2024 before launching a multi-stakeholder public consultation at COP29 in Baku. We heard the perspectives of a broad set of stakeholders, which are reflected in this updated Guidance. This latest version:

- → Includes high-quality, technically robust content in line with existing and emerging methodologies and terminologies.
- → Provides comprehensive practitioner guidance that is based in practical evidence.
- → Supports adoption of intervention-based methodologies by standard setters in context of corporate climate action, market-based mechanisms, and transition finance.

How this document will help you

This Guidance will walk you through how to:

- → **Define AE**: You will understand the definition and scope of an avoided emissions solution and its system boundary (Section 2).
- → **Validate claim eligibility**: You will learn how to determine whether your AE assessments and claims are sound in the context of your climate action credibility on the company- and solution-level (Section 3).
- → **Assess AE**: Our step-by-step methodology will guide you in assessing your AE by defining reference scenarios robustly and consistently, collecting high quality data, (re-) validating the contribution legitimacy and considering allocation and aggregation (Section 4).
- → **Communicate, report, and validate your contribution to decarbonization**: Our reporting templates and best practice guidance will give you the tools you need to verify and share your impact, and strengthen your results through improved traceability and monitoring (Sections 5 and 6).

Figure 1: Development timeline of the WBCSD *Guidance on Avoided Emissions v2.0*

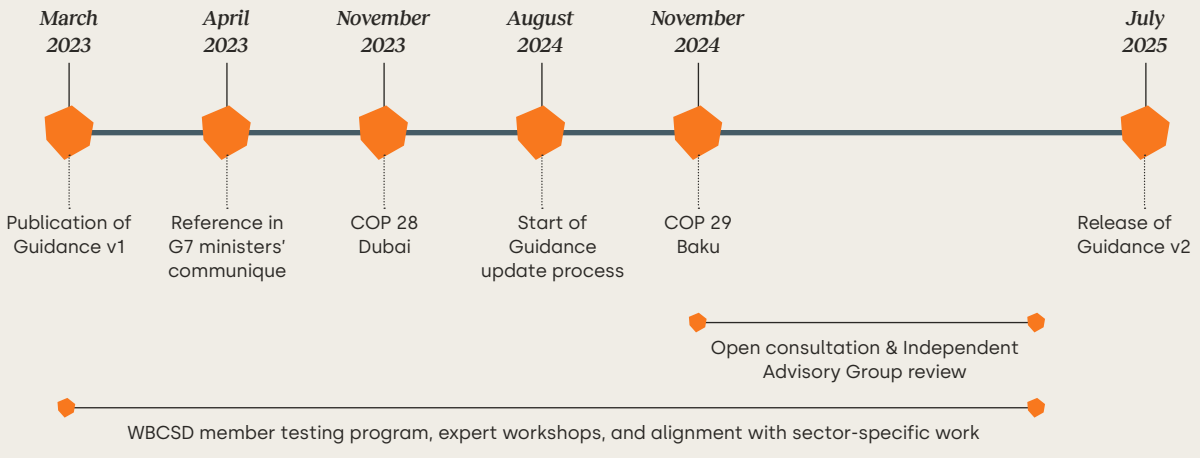
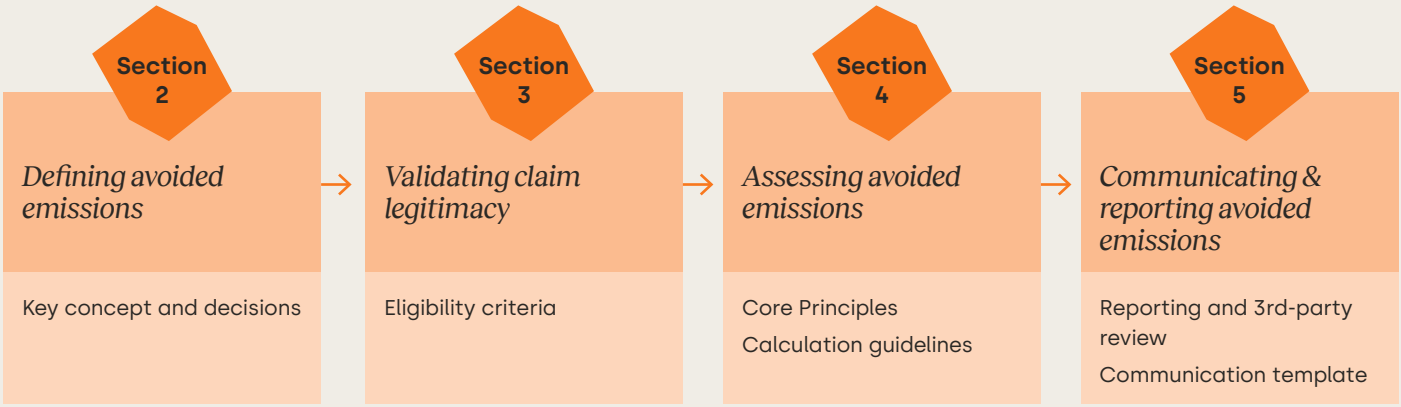


Figure 2: The four core methodological areas covered in this guidance



We also outline how companies, finance leaders and policymakers can leverage AE. When used in decision making, green finance, stakeholder engagement, innovation and ESG disclosure, AE can accelerate global Net Zero efforts by driving the shift to solution portfolios with high decarbonization impacts.

The goal of this document

Calculating AE comes with many challenges: data quality and availability, a reliance on assumptions and hypotheses and unclear accountability across a value chain. In creating this document, we have sought to guide readers in addressing these methodological challenges in a way that is robust and consistent. Though not a standard yet, it is an important step in that direction and serves as a practical basis for global standardization. relationships.

Next to the first version of the Guidance on Avoided Emissions, we have built on existing reports and frameworks on avoided GHG emissions (see Bibliography) to contribute to methodological convergence and to offer guidance that supports all actors to make credible, consistent and transparent assessments and claims. In doing so, our aim is to accelerate the shift to scalable climate solutions that bring about system-wide change. Businesses that build AE assessments into their strategic decision-making processes will not only improve their positive climate impact, but they will also be better placed to scale their solutions and strengthen the business case for climate action.

Please note: this AE methodology is not meant for direct applications in carbon markets or for Scope 1-3 GHG inventory compensation.

Who this document is for

This Guidance can support five main types of stakeholders in their joint efforts towards global Net Zero:

- Businesses who want to prioritize markets and solutions with high decarbonizing impact and report on their solutions' AE. Industry associations can also use it as a basis for developing sector-specific guidance.
- Financial institutions using AE metrics to guide their investment strategies and conducting due diligence on climate-related investment opportunities.
- Policymakers aiming to support the development and scaling of decarbonizing solutions in key markets.
- Voluntary standard setters who are integrating AE into their carbon accounting standards suites.
- Customers, non-financial rating agencies, NGOs, academics or any other stakeholders who want to learn about best practices for assessing and disclosing avoided GHG emissions, and understand companies' ability to become solution providers for climate challenges.

How to interpret terms used in this document:

"**Requirement**" ("must" or "shall"): refers to parts that are mandatory and must be followed to comply with the Guidance. As this Guidance is not a formal standard, we follow plain language guidance and use "must" to express a mandatory requirement.

"**Recommendation**" ("should") refers to parts of the Guidance that are best practice but can be deviated from (if justified).

The scope of this Guidance

This Guidance focuses on AE generated through the introduction of low-carbon solutions that prevent emissions compared to a reference scenario. This includes carbon capture and storage solutions (CCS and CCS at source) as long as the eligibility requirements on company- and solution-level are met.

It **does not** cover:

- Solutions applied to the exploration, extraction, mining and/or production, distribution and sales of fossil fuels. However, this Guidance does not exclude fossil-derived efficiency solutions by default – see Section 3.2.2.
- Solutions to manage the phase out of fossil fuel-based products, such as lower-emitting fossil fuel-based products. These solutions may have a significant emissions reduction potential, but they require specific guidance on methodological choices, technical calculations and other sector-specific implications.
- The sphere of advisory, influence, prescription, education, nudges or advertising in AE assessments. This kind of specific methodological guidance should be further studied and would be complementary to our Guidance.
- AE through the financing of climate mitigation projects. It is therefore not primarily intended to create a voluntary crediting or trading mechanism to reduce (offset) Scope 1, 2 and 3 emission inventories. In practical applications, this Guidance can be used jointly with certificate schemes such as regional credit systems or white certificates to create tradeable certificates. In such cases, it should always be clearly and transparently communicated what the share of sold/tradeable credits are that are related to any AE claim, and what certification methodology has been used.
- Solutions related to carbon removal where emissions are not avoided at the emission source.

This Guidance **only partly addresses** sector- and solution-specific assessment rules, although this is an important component in harmonizing AE assessment and disclosure. Our Implementation Hub[1] aims to offer sector-specific methodologies and use cases to harmonize assessment and disclosure at a sector- and solution-level. See more in Section 8.

Understanding *avoided emissions*

02.

02. Understanding *avoided emissions*

Companies create carbon emissions, but they can also contribute to decarbonization through low-carbon products and services. These are known as avoided emissions (AE).

For example, an innovative new livestock feed could result in lower methane from the cows that eat it. This would prevent emissions that may otherwise have occurred – so we can say that this livestock feed solution creates AE.

Although companies can detect emission reductions related to the use of their solutions over time through the monitoring of GHG inventory emissions, this contribution is difficult to measure. In most cases a company cannot credibly assess whether their solution has resulted in increased or decreased emissions for other businesses or consumers compared to if the solution was not used.

For a company to fully understand its decarbonization impact, it must assess the positive impact of its solutions while also keeping track of any negative impacts associated with its portfolio. This is the only way to paint a complete picture, and can usefully guide its climate strategy.

Unlike GHG inventory assessments, which look at how a company's inventory emissions change between two points in time, AE assessments focus on the difference in emissions between two scenarios.

The figure below shows how AE relate to the GHG inventory. The darker color in the center indicates that a company's direct influence is highest at the level of its Scope 1 GHG emissions where it has control over direct operations. As control diminishes in Scope 2 and 3, so does a company's influence. AE are separate from a company's GHG inventory and typically sit outside its organizational boundary. The emissions savings are usually related to other actors such as the solution user or the end of life value chain actor.

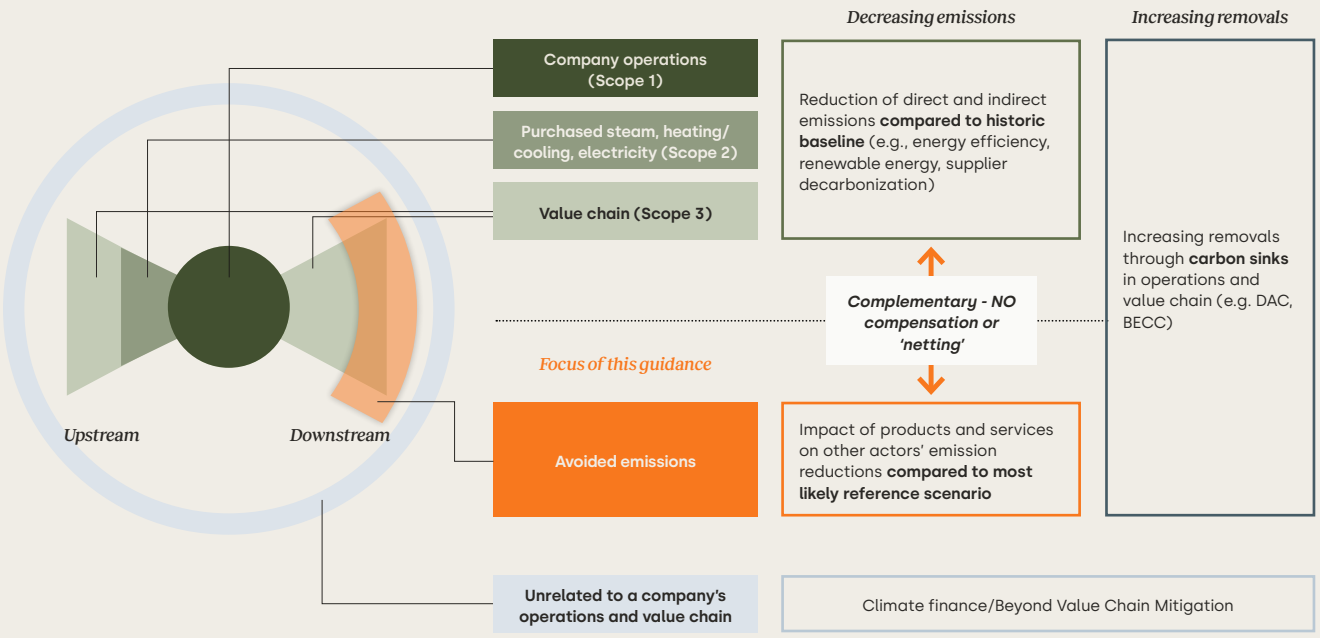
Avoided emissions refer to the estimated difference in full life cycle GHG emissions that results from a scenario with a solution in place, compared to a reference scenario without the solution. When the solution scenario emissions are lower than the reference scenario emissions, emissions have been avoided.

A **solution** refers to a product or service, such as energy-efficient insulation or plastics recycling. It can also be a project or innovation, such as an initiative or a technology to reduce energy demand.

The **reference scenario** reflects the most likely situation that would have occurred without the solution.

Refer to the Glossary at the end of this document for definitions of these and other technical terms.

Figure 3: Conceptual overview of AE and GHG inventory



Sources: IPCC (2018), GHG Protocol.

2.1. The relationship between avoided emissions and GHG inventory

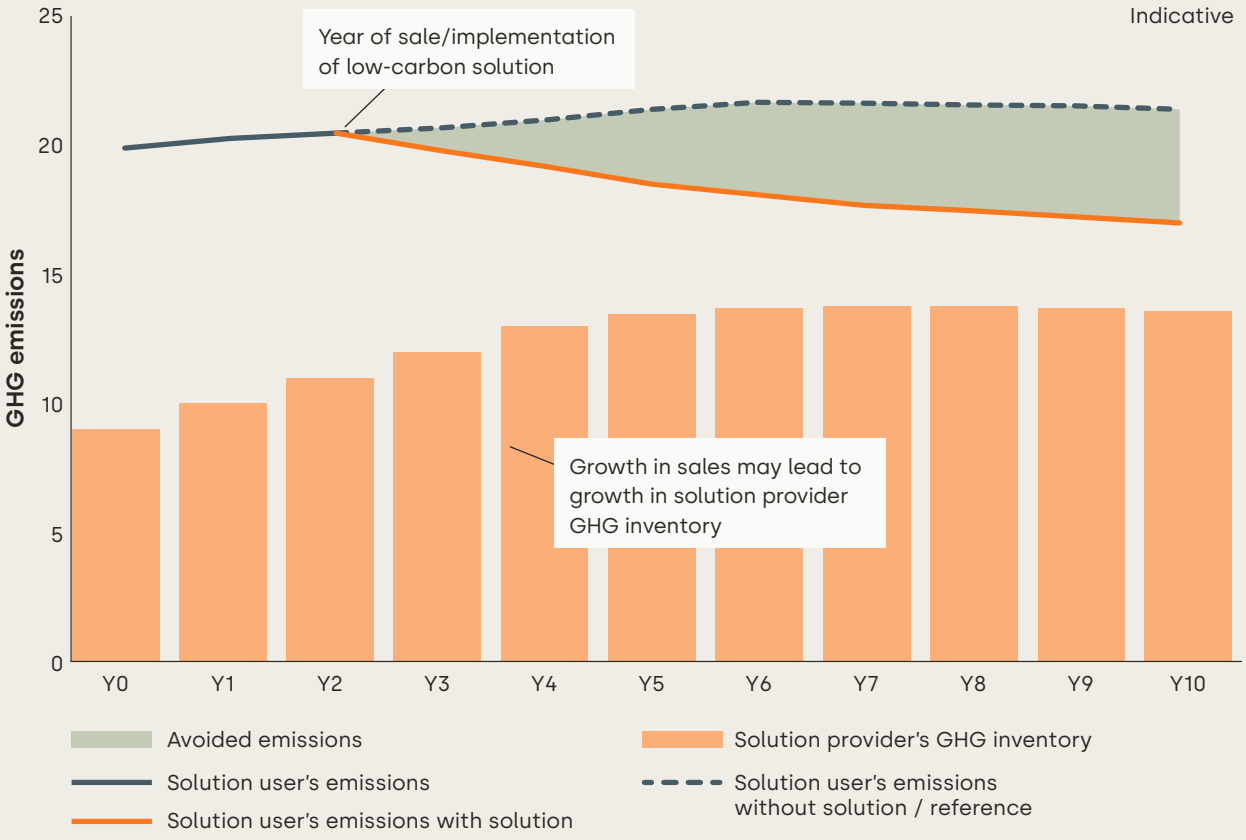
People often confuse Scope 3 emissions and AE. It's important to understand that these two concepts are very different.

They are calculated differently: a company's GHG inventory looks at historic emissions relative to a base year, whilst AE are assessed either on a year-on-year or forward-looking timeframe. And, unlike GHG inventory calculations, AE calculations compare a low-carbon scenario with a hypothetical reference scenario. Even if AE calculations become reliable and robust, we recommend keeping them separate from GHG inventory results.

It is also important to note that these different calculations each reveal a different part of the picture. A solution provider of a "low-carbon" solution may experience an increase in their Scope 1, 2 and 3 GHG inventory as growing demand drives higher production volumes. Conversely, users of the solution will see their GHG inventory emissions decrease compared to the most likely alternative as they adopt the new "low-carbon" solution. When the provider calculates the AE for the future roll-out of its "low-carbon" solution compared to the most likely alternative in the market, they may find that it contributes to decarbonization efforts. So, while their GHG inventory shows increasing emissions, their AE results may show a positive impact of their solutions.

In this way, the AE assessment offers a valuable framework for the solution provider to account for these reductions and assess contributions to system-wide decarbonization.

Figure 4: Schematic emissions profiles of a Solution provider's GHG inventory and Solution user's GHG inventory over time and its effect on GHG inventory and AE



The examples below illustrate different ways in which the solution provider and user emissions may change when an AE solution is introduced, depending on the use case. Note that the graphs are highly schematic and depend on a variety of conditions. In many cases, AE solutions lead to an increase in GHG inventory emissions for the solution provider and a reduction in inventory emissions for the solution user compared to a likely alternative scenario.

Companies use this Guidance to create AE assessments that will complement their GHG inventory accounting. AE assessments highlight the mitigation potential of their products and services, and make it possible for them to receive recognition for their contributions to decarbonization outside of their own operations.

It is important to emphasize that there should be no compensation or "netting" between a company's GHG inventory emissions and AE.

Example 1: LED light bulbs
A solution provider switches from offering standard incandescent bulbs to LED light bulbs. Both solutions have similar GHG emissions in their manufacturing, so the inventory remains largely the same. For the user, however, the LED light bulbs enable a Scope 2 emissions reduction due to lower electricity requirements compared to the likely alternative solution.

Example 2: High-performance glazing

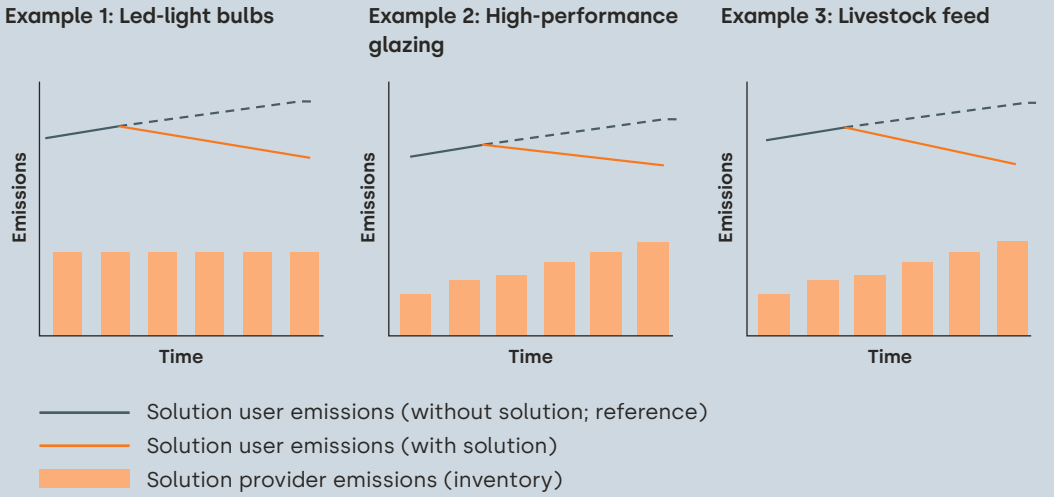
A solution provider of high-performance glazing with higher manufacturing carbon content compared to their legacy standard glazing product sees an increase in Scope 1, 2 and potentially Scope 3 emissions.

The building owner, on the other hand, has lower Scope 1 and 2 GHG emissions due to the energy-efficiency gains from the glazing solution compared to a likely alternative or market average glazing solution.

Example 3: Livestock feed

A solution provider manufactures cattle feed supplements that reduce methane emissions from ruminants. To manufacture the solution, the provider faces higher Scope 1 and 2 emissions and potentially Scope 3 emissions, while farmers that use the solution will note a reduction in their Scope 1 emissions compared to standard cattle feed supplements.

Figure 5: Schematic emissions profile of Solution provider's GHG inventory and Solution user's GHG inventory for the examples shown above



2.2.The interplay between avoided emissions and Scope 3 emissions

As we have seen, Scope 1, 2 and 3 emissions differ conceptually from AE. However, in certain cases, the solution provider's Scope 3 downstream reductions may directly reflect the impact of the AE solution – for example, when the provider's existing solutions align closely with the reference scenario and existing solutions are being replaced with new low-carbon solutions (see examples below).

In practice, identifying and quantifying this interplay is challenging for different reasons:

- → The actual emissions are calculated differently in the context of GHG inventory accounting and AE.
- → The definition of the system boundary of AE assessments and Scope 3 inventory boundaries are not exhaustively specified for every solution.
- → Data on the use phase of products and services can be difficult to collect.

As good practice, we recommend transparently disclosing any interplays between AE and Scope 3 inventory reduction/increase by explaining how this interplay occurs. This is particularly relevant when there is a large overlap between downstream inventory emission reductions of the solution provider and AE claims.

Example: Company A introduces a new line of low-emission vehicles, partially replacing their existing fleet

Company A is a major vehicle manufacturer in the automotive industry. By launching low-emission vehicles, the company aims to decarbonize the industry by replacing ICE cars, including their own car fleet. The following can be true at the same time:

- → AE may be generated through replacing ICE cars (the reference scenario) with the low-emission vehicles solution.
- → Company A's Scope 3 emissions will decrease, as some of the cars they will be replacing are produced by them, resulting in lower use phase emissions.
- → End users' Scope 1 and 2 emissions (e.g., a ridesharing company) will decrease as a result of switching to the low-emission vehicles.

Example: Company B replaces a portion of their existing energy-intensive equipment with a low-carbon solution for their clients

Company B launches a new business unit that manufactures low-emissions comminution equipment (for reducing materials to powder) to replace existing equipment in certain market segments. The following can be true at the same time:

- → AE may be generated for mining companies using the new equipment produced by Company B, instead of the old equipment.
- → Company B's Scope 3.11 "Use of Sold Products" emissions will decrease as a result of substituting in the low-emissions equipment for selected clients.
- → Company B's Scope 1 and 2 emissions may increase with the manufacturing of the new equipment.

2.3. Defining and scoping avoided emissions solutions

This Guidance defines two solution types based on existing definitions adapted from the GHG Protocol:

1. Intermediary solutions are inputs in the production of other products or services that require further processing, transformation or inclusion in another solution before use by the end user. Products or services that enable other solutions are intermediary. In most cases, the end user does not consume intermediary solutions in their current form. However, it is possible that an intermediary solution is used exactly as supplied within a broader system or end-use solution (see definition below).
   For example:
   - Batteries for electric vehicles (EVs).
   - Blades for wind turbines.
   - EV chargers.
   - Geo-location software to optimize solar installations.
   - Projects that consist of a portfolio of solutions, like updating industrial machinery for efficiency or automation (where the machinery is part of a project).
2. End-use solutions are products and services consumed by the end user in their current form, without further processing, transformation or inclusion in another solution. For example:
   - EVs.
   - Heat pumps.
   - Solar panel
   - Animal feed supplements to reduce methane emissions.
   - Low-carbon lighting solutions.
   - Grid optimization software for EV charging.
   - Projects that consist of a portfolio of solutions, like retrofitting a building to increase energy efficiency (efficient lighting, appliances, insulation, new windows) and updating industrial machinery for efficiency/ automation (where the machinery is the end-use project).
   - Digital solutions where performance data can be directly accessed, such as in machine optimization in manufacturing, building management systems (BMS), high-precision farming and transport routing.

Example: End-use solutions

End-use solution: livestock feed supplement

A manufacturer produces cattle feed supplements designed to reduce enteric methane emissions caused by fermentation in ruminants. A feed supplement can be considered an end-use solution since it does not require any further processing, transformation or inclusion in another solution. It is directly consumed by cattle in farms. Although feed supplement is an end-use solution, it is also part of the wider system of cattle farming. The AE are assessed by comparing emissions from cattle fed with the supplement versus those without it while the functional unit may be on output-level, i.e., kg of beef or l of dairy produced.

End-use solution: recycling solution

A recycling solution can give a second life to a waste product. The technology itself is an end-use solution that recycles a waste material into a new material. AE potential arises when comparing the impact of one kilogram of recycled material to one kilogram of the material with the same properties that is produced with an average reference technology.

Note: a component to increase recycling process efficiency may be an intermediate solution in this case and it could either assess AE on the output-level as explained above or on the process level, e.g., AE per amount of material that can be recycled with/without the component

A key question to answer before starting an AE assessment is: what is the scope of the solution? This will help to clarify a solution's components, activities, stakeholders, value chain steps and expected effect on GHG emissions.

Defining the scope of the solution entails defining the goal of the assessment, the solution system to be evaluated (including its function and the system boundary) and the reference scenario:

- → **Assessment goal**: define the aim of the AE assessment – for example, will the results be used internally or externally? This will affect the next scoping steps.
- → **Type of solution**: identify whether it is an end-use solution or intermediary solution and its corresponding end-use solution(s)/ application(s).
- → **Function and functional unit (FU):** define the function of the solution in the context of a specific market or geography. For intermediary solutions, the end-use solution application should be defined, as what can result in AE that lead to system-wide change. The FU quantifies the end-use solution's expected performance.
- → **System boundary**: define the system boundary based on the supply chain logic. All supply chain steps and related processes (e.g. activities and components) required for the specific function (defined above) should be clearly defined. The system boundary can be established in different ways. Generally, a narrow system boundary focuses mostly on the core product or service, while a broader boundary considers the implementation of the solution in a wider system. Setting the boundary to a wider system may be desirable as it can provide a more complete picture, however it also introduces greater uncertainty (see Figure 6 below).
- → **Reference scenario**: AE can only be assessed by comparing the solution to the most likely alternative market situation. Determine whether the solution is meeting a new or existing demand, to inform the scope of the reference scenario (see Section 4.2.2).

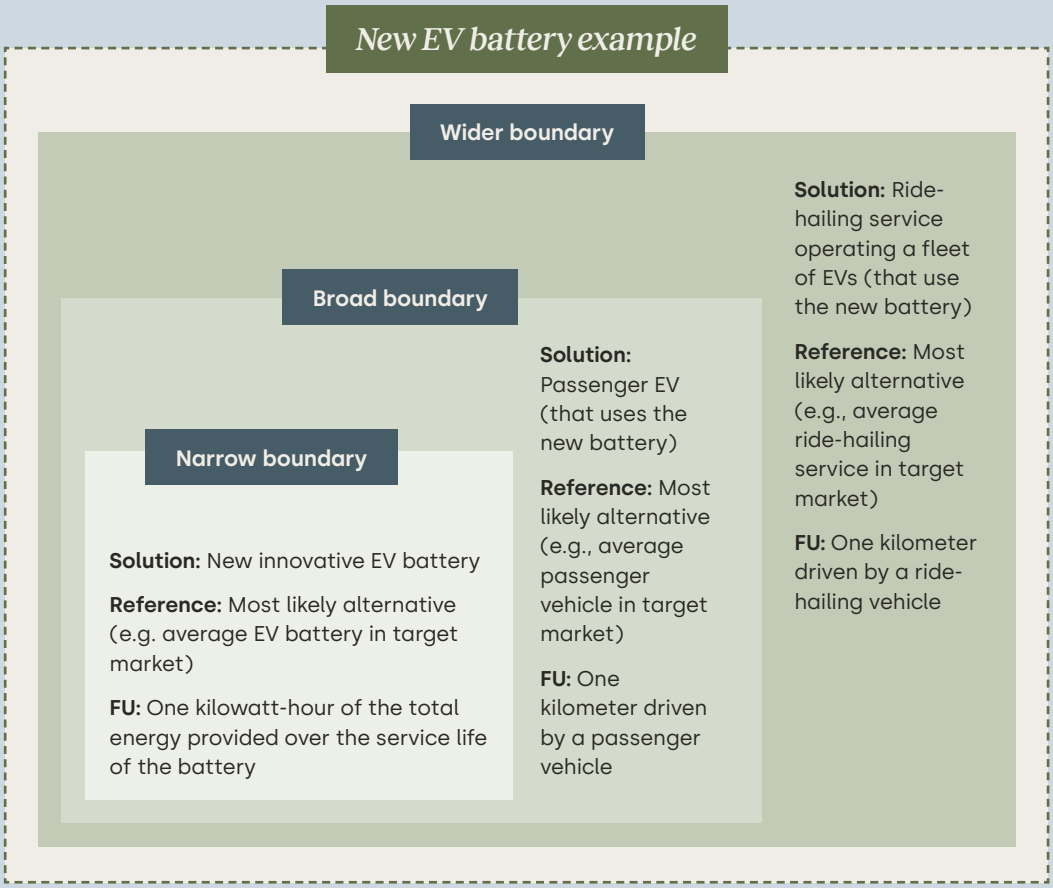
Example: Defining the scope of an EV battery solution

1. **Type of solution**: An EV battery is an intermediary solution. The EV battery manufacturer identifies that the end-use solution of their battery is a passenger plug-in EV.
2. **Function and FU**: The function of the EV battery in the end-use solution is the operation of the EV in the passenger plug-in EV market. The function is to provide transportation for passengers over a certain distance. A typical FU is defined as one kilometer driven by a passenger vehicle, over the service-life of the vehicle. This represents the amount of energy needed for the total kilometers driven over the vehicle's lifetime (scaled per km).
3. **System boundary**: To provide transportation for one kilometer driven by a passenger vehicle, the system required includes processes which cover the electric vehicle and its operation.

Example: EV battery – different system boundary options

Based on the function, a manufacturer of an energy-efficient EV battery can define the system boundary in different ways. The EV battery example above corresponds to the "broad boundary" situation below.

Figure 6: System boundary options for a new EV battery



Why define a narrow boundary?

- → Better data availability and lower uncertainty regarding the cause-effect chain between the solution and the estimated AE.
- → Closer focus on product innovation and competitive comparison.
- → The end-use solution is already established, so the goal is optimization of a specific part of the solution and how an intermediary solution integrates into the end-use solution.

Why define a wide boundary?

- → To better depict the systemic change the solution aims to achieve and is a part of.
- → A broader view provides a more complete AE assessment, as AE depend on multiple processes to be realized (more detail in the example below).
- → The solution is designed specifically for that system.

Assessing the intermediary solution without considering the broader system can lead to AE calculations that do not fully reflect the actual system change that the solution aims to achieve. To accurately assess the AE potential of an intermediary solution like a battery, always consider the end-use application. See the following example.

Relevant considerations

As the system scope broadens from a product to a wider system, the number of components and actors involved also increases. The consequence of that is:

- → The likelihood of double counting increases.
- → The significance of individual contributions diminishes.
- → The traceability of impacts becomes more challenging.
- → The reliance on assumptions increases.
- → The access to data deteriorates and levels of control decrease.

Example: EV battery – the importance of considering the end-use application

Battery 1 has a lower impact per kWh than Battery 2 and achieves the same performance, but the battery is heavier. The extra weight of Battery 1 reduces the EV's efficiency, leading to more frequent charging and higher overall energy consumption. As a result, despite its lower per-kWh impact, an EV using Battery 1 may have higher GHG emissions in its lifetime than an EV using Battery 2. So, when comparing both batteries, AE occur when the EV operates with Battery 2 instead of Battery 1. If only the battery without its end-use application in an EV is assessed, the AE calculation would not be representative in this context.

Note that even when considering the end-use solution, it is not always necessary to calculate the GHG emissions of the complete end-use application, provided that all relevant parameters that affect the wider system change are accounted for.

Solutions are often designed for a specific end-use application. An EV battery may be engineered for longevity and explicitly intended for use in a ride-hailing service. In such cases, the best level of assessment is the broader ride-hailing system. The same logic applies to EVs: some may be specifically designed for durability to operate efficiently in ride-hailing fleets. It is important to identify the end-use application of a solution in order to properly define the function and system boundary.

Example: defining the scope based on wider system boundary

Carbon fiber is both strong and lightweight, making it valuable in various end-use applications, including vehicles and wind turbine blades.

Vehicles as end-use solution for carbon fiber: Carbon fiber production is energy-intensive, meaning that one kilogram of carbon fiber may have a higher carbon footprint than one kilogram of steel with equivalent strength and properties. However, using carbon fiber in vehicles reduces its weight, leading to energy savings during operation. The AE potential is evident when comparing the lifecycle impact of a vehicle with carbon fiber components to one with traditional steel parts.

Wind turbines as end-use solution for carbon fiber: Carbon fiber allows for the production of longer wind turbine blades compared to fiberglass. Although one kilogram of carbon fiber may have a higher carbon footprint than one kilogram of fiberglass with similar properties, the longer blades enable greater energy generation over the turbine's lifetime. AE potential increases when assessing a wind turbine with carbon fiber blades versus one with fiberglass blades.

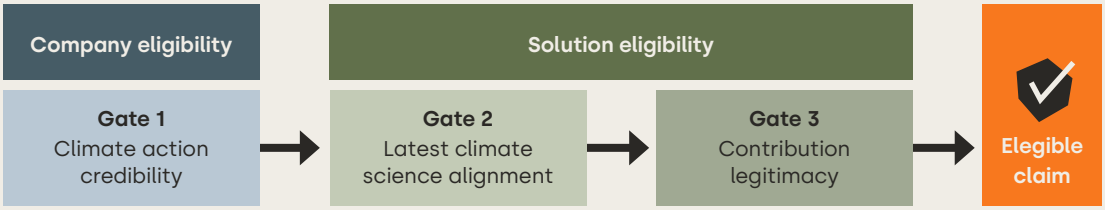
Validating *claim eligibility*

03.

03. Validating *claim eligibility*

It is important to ensure integrity and prevent misuse when it comes to measuring and reporting AE. The following eligibility criteria - or "gates" - must be met before AE should be calculated and claimed.

Figure 7: Eligibility gates for AE claims



3.1. Gate 1: Climate action credibility

To pass Gate 1, the company must have a climate strategy with emissions reduction targets that are aligned, or in the process of alignment, with climate science and can be proven through existing frameworks. The latest climate science at the point of publication of this guidance states that companies should reduce their emissions in line with the 1.5ºC pathway presented, e.g., by the IPCC Assessment Report 6.

3.1.1. Eligibility requirements

The Gate 1 requirements aim to ensure companies claiming AE are assessing and verifying their GHG emissions inventory and practice regular monitoring and reporting. These requirements are essential for mature companies. For newer or smaller companies, the only applicable requirement is disclosure of a recent GHG inventory, with the other practices mentioned below recommended as good practice to inform action as the company matures.

An eligible company must:

1. **Verify its GHG emissions inventory**: Provide a recent,[2] third-party verified GHG emissions inventory for Scope 1, 2 and 3 emissions that is publicly disclosed and regularly updated.
   - **For newer or smaller organizations, startups and scale-ups**: Report a recent[2] GHG emissions inventory for Scope 1, 2 and 3 emissions.
2. **Commit to 1.5℃ pathway**:[3] Publicly set near-term[4] targets aligned with a 1.5℃ pathway. We recommend that companies pursue a higher level of ambition by setting both near-term and long-term targets that are 1.5℃-aligned and in accordance with an emissions reduction framework which must be disclosed. See below for guidance on how to select an appropriate framework.

In addition, we recommend that companies:

3. **Monitor and report progress**: Regularly monitor and publicly report progress on the established targets using emissions-based key performance indicators (KPIs).
4. **Define a transition plan**: Develop and publish a transition plan aligned with a 1.5℃ pathway and targets. In cases where a company does not have a formal transition plan, users of this Guidance – including financial institutions – should present any elements of a credible transition plan across their business to support a more robust credibility assessment.

Companies who do not meet these eligibility requirements (e.g., not yet in line with a 1.5℃ pathway) are not precluded from meeting the Gate 1 requirements and may still be eligible. See the next sections for further guidance.

3.1.2. How to select an emissions reduction framework

To ensure credibility, the frameworks applied should be internationally recognized and include a third-party review of climate targets.

While the Guidance does not mandate a specific framework, the selected framework should be science-based and applicable at a global, national, regional or sectoral level. The selected framework should:

a. Aim to help organizations and regions achieve Net Zero emissions by 2050 in alignment with a 1.5℃ pathway;

b. Encourage clear, measurable target-setting with interim milestones, continuous tracking of progress, an emphasis on transparency and requirements or provisions for third-party verification to ensure compliance.

For any framework that meets the above requirements except a third-party verification, the company must provide one instead (except if the company is an SME).

Organizational boundary

The organizational boundary for which targets are submitted should be defined according to the respective framework used. As a best practice, we recommend that organizations commit at the overarching level (i.e., the organization as a whole or the parent company, instead of just subsidiaries or new business units) to avoid selective disclosure and greenwashing.

If the selected framework allows for setting organizational boundaries at lower levels, the company should:

- → Clearly identify the eligible division.
- → Provide evidence that the solution is provided by that division.
- → Transparently indicate that the AE claims pertain specifically to it, and not to the whole organization.

Cross-sector initiatives and guidelines aligned with the latest climate science

A non-exhaustive list of cross-sector initiatives and guidelines aligned with the latest climate science[6]:

- → Science Based Targets initiative (SBTi) Corporate Net-Zero Standard
- → United Nations Climate Change (UNFCCC) Race to Zero and other Race to Zero accredited organizations
- → Exponential Roadmap Initiative 1.5°C Business Playbook
- → Net Zero Initiative
- → Transform to Net Zero by 2050
- → International Organization for Standardization (ISO) Net Zero Guidelines
- → National or regional decarbonization pathways compatible with 1.5°C
- → Accelerate Climate Transition (ACT) Framework: Assessing the transition towards low GHG emissions
- → Transition Pathway Initiative (TPI)
- → Climate Action 100+
- → Climate Bonds Initiative (CBI) Company Certification

For small and medium-sized enterprises (SMEs)[6], the SME Climate Hub Commitment or SBTi requirements for SMEs are sufficient, and a third-party review is optional.

These documents are subject to updates – always refer to the latest version.

3.1.3. Recommendations for companies not meeting the eligibility requirements

Some companies will not comply with the criteria to select frameworks. Examples include micro, small- and medium-sized enterprises (MSMEs), pure players in the climate solutions field, low emitters or those operating in high-emissions, hard-to-abate sectors or companies with existing targets in place. In some cases, broader systemic factors outside a company's control (e.g., electricity grid, infrastructure constraints) hinder the alignment with 1.5°C pathways despite a company's climate action efforts.

In line with global efforts[5] to recognize climate action and support accountability across various actors, this Guidance acknowledges climate action, transparency and continuous improvement efforts.

In such cases, the climate action credibility should be assessed on a case-by-case basis. The company should:

- → Clearly explain why compliance with the referenced frameworks is not possible. Companies with existing targets or commitments should disclose the framework or criteria under which these targets were set, the validity of the targets (date of update and revalidation), and any intended new commitments in the coming two years to align these with a 1.5°C threshold.
- → Provide evidence of alignment with alternative frameworks to those mentioned in Box 1. These should be science-based and meet the conditions mentioned in Section 3.1.1.
- → Provide third-party verification of alignment with the alternative framework(s), demonstrating that compliance is clear, verifiable and conforms to the standards outlined in this guidance (optional for MSMEs).

Example: Situations in which companies may be eligible for Gate 1:

Company A is an SME that has publicly committed to halve GHG emissions before 2030, achieve Net Zero emissions before 2050 and disclose their progress on a yearly basis in line with the SME Climate Hub Commitment. Their GHG inventory calculations are third-party verified, while their targets and transition plan are developed internally and have not undergone third-party review.

Company B's targets are at the initial pre-validation stage, so have not yet undergone review by the framework in use. They can select an emissions reduction framework, because the company has made a public commitment to align with science-based targets and expressed their intention to set targets in line with the latest climate science.

Company C operates in a hard-to-abate sector, and has approved SBTi near-term emissions reduction targets but has not set any long-term goals under the same framework. They have set a Net Zero goal for their operations under a different framework and have published a transition plan aligned with the Task Force on Climate-Related Financial Disclosures (TCFD).

Company D has SBTi approved near-term goals in line with well-below 2°C and these were published in 2020. The company plans to review its active targets in 2025, with a commitment to resubmit them in alignment with the latest SBTi criteria to set more ambitious, 1.5°C-aligned targets.

3.2. Gate 2: Latest climate science alignment

To pass Gate 2, the solution for which AE are assessed and reported must have mitigation potential according to the latest climate science[6] and recognized sources. Fossil-derived efficiency solutions are not excluded by default, but additional requirements apply.

3.2.1. Eligibility requirements

The Gate 2 requirements aim to ensure that companies only claim AE for solutions that are identified within one of the recognized taxonomies for sustainable activities and not directly associated with fossil fuels. If the company cannot prove this, the solution may still be eligible to pass Gate 2 by complying with the criteria outlined in Section 3.2.2. Further guidance on the assessment and disclosure of solution-specific rebound and side effect is provided in Section 4.2.3.

An eligible solution must:

Prove its science-based mitigation potential. The company should describe the solution's mitigation potential citing one of the recognized sources based on the latest climate science and complying with Gate 2 as described in this Guidance (see examples in Table 1).

Recommended points of reference for science-based mitigation potential:

- → IPCC Sixth Assessment Report (AR6) Working Group III Summary for Policymakers[7]: mitigation options mentioned in the report and in "**Figure: SPM.7**: Overview of mitigation options and their estimated ranges of costs and potentials in 2030."
- → EU Taxonomy[8]: taxonomy-relevant activities that contribute significantly to the mitigation criteria applicable to them[9] and that are in scope of this Guidance.
- → Project Drawdown[10]: The Drawdown Climate Solutions Library lists solutions, their relevant sectors and their impact (CO_2-equivalent reduced) under 2°C and 1.5°C temperature rise scenarios by 2100.
- → Other recognized international, regional or national taxonomies (e.g., Singapore-Asia Taxonomy for Sustainable Finance, UK Green Taxonomy, Common Ground Taxonomy – Climate Change Mitigation co-chaired by the EU and China, Climate Bonds Taxonomy, Australia's sustainable finance taxonomy). Companies can cite these taxonomies based on the geographic scope of the solution.

Note: It is required that companies always refer to the latest version of these documents, as they are subject to updates.

See Section 3.2.2 for cases not covered by the taxonomies outlined above.

An **intermediary solution** can be considered eligible if it has not been developed exclusively for fossil fuel-based applications and is part of one or more eligible end-use solutions (i.e., an end-use solution that has passed Gate 1, Gate 2 and Gate 3, or for application in multiple end-use solutions, Gate 2 and Gate 3).

This Guidance does not cover solutions that directly or indirectly extend the life of assets incompatible with a Net Zero future, regardless of short-term benefits. This applies to all types of solutions related to the exploration, extraction, mining and/or production, distribution and sales of fossil fuels, transitional activities and managed phase out of high-emitting assets. Examples include efficiency solutions for ICE vehicles, equipment extending the life of coal plants or software that optimizes oil drilling.

We encourages further methodological work to assess and disclose efforts related to the managed phase-out and impact reduction of fossil applications, as these are important to achieve emissions reductions in the near-term future (see Section 3.2.2).

Example: An ineligible case

Company A is connecting an oil field to the grid, enabling the oil extraction site to operate with lower carbon intensity energy from the grid instead of using oil. Company A cannot claim AE for this intervention, as it is applied to oil extraction, which is not compatible with the long-term global Net Zero target.

Table 1: Illustrative interventions with a link to mitigation options from the IPCC AR6 Working Group III Summary for Policymakers

Solution	*Recognized mitigation potential*
A reflective roofing solution that provides use phase benefits by regulating the operational energy demand of a building, especially in warmer climates	Avoid demand for energy services
A compact design, tubular push conveyor and a new integrated grinding system enabling energy savings at customer sites	Energy efficiency in industry
Production of biogas from animal manure, organic waste or landfills	Reduce CH4 and N2O emissions in agriculture
Roof recycling programs at customer sites	Enhanced recycling in industry
Upcycled or recycled materials	Material efficiency (avoids new manufacturing)
Insulation solutions for buildings	Avoid demand for energy services in buildings
Route optimizer software for ships enabling fuel savings	Shipping efficiency
A modeling tool to optimize the installation of PV panels	Solar energy
Services promoting and enabling micro-local tourism ("staycation")	Avoid demand for transportation
An application allowing users to buy food at low cost that would have otherwise been wasted	Reduce food loss and food waste
Biofuel for vehicles made from organic food waste	Biofuels in transport
Production of secondary materials (e.g., plastics, glass, aluminum, steel)	Circular material flows (e.g., enhanced recycling)

3.2.2. Recommendations for solutions that do not meet the eligibility requirements

If the solution does not meet the requirements outlined in Section 3.2.1, there may still be an opportunity to pass Gate 2. Here we discuss two categories of solutions: (A) those within the scope of the Guidance and potentially eligible, and (B) those outside the scope of the Guidance.

A. Solutions that are in scope and potentially eligible to claim AE

Solutions not related to fossil fuels: innovations and emerging solutions

Emerging technologies in early development (Technology Readiness Level[11] <6), solutions applied to low-emitting sectors and circular innovations may not yet be able to assess substantial contributions to climate change mitigation in a standardized approach or be included in global taxonomies such as the EU taxonomy and IPCC AR6.

In such cases, to prove Gate 2 eligibility, the company should be able to show, on a solution level:

→ **Justified lack of alignment**: Explain the reasons for the lack of alignment with the IPCC AR6, EU Taxonomy or other established taxonomies.

→ **GHG emissions reduction potential**: Provide evidence of the solution's potential to reduce GHG emissions, based on one of the following:

1. The disclosure of credible and internationally recognized sources or;
2. Published, peer-reviewed scientific research, no more than three years old, that explicitly proves the mitigation potential of innovations with the same or similar function.

Solutions related to fossil fuels: fossil-derived efficiency solutions

Fossil-derived efficiency solutions can be relevant drivers of decarbonization and necessary inputs for eligible end-use solutions.

In general, we advise caution for end-use solutions with decarbonizing potential that rely on fossil-derived efficiency solutions. These may lead to carbon lock-in in the long-term, hindering the exploration of cleaner alternatives and conflicting with the transformative nature of AE solutions.

The Guidance does not explicitly exclude these types of solutions but requires a closer examination compared to non-fossil based solutions. Companies should substantiate related claims with evidence that:

1. No scalable or at-scale, non-fossil-derived alternatives with comparable impact on the emissions reductions of the end-use solution are available in the same market or context.
2. Increased impact monitoring and traceability of AE is in place – to ensure that the solution is applied to eligible end-use solutions, e.g., based on use phase data and market share.
3. Efforts are being taken to prevent fossil fuel lock-in activities related to the solution's production (i.e., a transition plan or a public report).

In case of doubt or unclear methodological choices, apply the more conservative scenario or assumption.

Examples: Lubricants for EVs, plastic foil for food conservation, lightweight plastic composites replacing heavier metals in transportation, non-renewable low-carbon fertilizers, coke-derived graphene.

B. Solutions that are out of scope of the Guidance

Solutions directly related to fossil fuels, or part of high-emitting technologies or phase-out strategies

AE aim to incentivize and support climate solutions, focusing on scalable, opportunity-driven innovations designed to drive systemic change and support a Net Zero future.

This Guidance does not address solutions related to high-emitting technologies as part of fossil phase-out strategies as they require a different approach (see Table 2). Given their important role in short- and mid-term global transition efforts, we encourage the development of a dedicated approach to provide guardrails and incentives for assessment and disclosure of accelerated phase-down activities, and are open to contributing to such efforts.

Table 2: **Overview of different categories and solution types and their Gate 2 eligibility**

Category	*Solution type*	*Gate 2 eligibility*
Not related to fossil fuels	Climate solutions	In scope of the Guidance and potentially eligible
Related to fossil fuels	End-use solutions that use fossil-derived efficiency solutions; or fossil-derived efficiency solutions claiming AE as part of eligible end-use solutions	In scope of the Guidance and potentially eligible
	Solutions directly applied to activities involving exploration, extraction, mining or production, distribution and sales of fossil fuels	Out of scope of the Guidance
	Solutions accommodating (energy) security needs	
	Solutions used when no technologically or economically feasible low-carbon alternatives are available in the specific context	
	Activities related to the managed phaseout and retirement of high-emitting assets	

3.3. Gate 3: Contribution legitimacy

To pass Gate 3, the solution must achieve measurable GHG emissions reductions compared to a reference scenario and these reductions must be significant ("significant decarbonization impact") and demonstrably attributable to the solution ("substantiated impact").

3.3.1. Eligibility requirements

A solution must be qualitatively assessed to determine that it meets the definitions of significant decarbonization and substantiated impact (see Table 3). Once the company has calculated the AE, they can then quantitatively validate the legitimacy of the solution's contribution.

For a solution to be eligible, the company must prove that it:

1. Enables **significant decarbonization** by using verifiable primary data (see Section 4.2.3), recognized resources to describe or estimate the emissions reductions[12] compared to a reference scenario, or by explaining why the solution is necessary for emissions reductions in a product system and cannot be replaced.
2. Has **substantiated impact** by describing how specific characteristics of the solution are essential to reduce emissions. To prove the cause-effect relationship, different types of evidence can be provided (e.g., sample data could be used to support an AE claim for a broader scope beyond the sample itself). For more complex solutions the cause-effect relationship should be shown with a detailed conceptual diagram with logical and sequential stages that traces the process by which measurable GHG effects occur.

Table 3: Definitions of significant decarbonization and substantiated impact of end-use and intermediary solutions

Type of impact	*Definition*
Significant decarbonization	The solution achieves measurable (i) GHG emissions reductions outside the company's organizational boundary, quantified against a reference scenario as outlined in Section 4, or (ii) lower emissions than would occur in its absence; and in either case, these are significant: 1. The end-use solution achieves significant GHG emissions reductions when quantified against a reference scenario (as outlined in Section 4.6). 2. The intermediary solution is an essential component of a climate solution (i.e., an end-use solution that has passed Gate 1, Gate 2 and Gate 3, or for application in multiple end-use solutions, Gate 2 and Gate 3) and it cannot be replaced without compromising significant emissions reductions. *"Significant"* can refer to the scale of impact in absolute numbers, or to a reduction big enough to compensate for potential variations and uncertainty related to data and assumptions that underly the AE claim. The claiming party must assess, quantify or estimate the impact and justify its significance on a case-by-case basis.
Substantiated impact	The company must provide evidence that the GHG emissions reductions occur due to a cause-effect relationship between the solution and the emissions reduction.

3.4. Gate 1-3: An example validation claim

Below is an example of a claim that passes all three gates.

Note that this is an **intermediary solution**, which means that the company should show the link to specific end-use solutions through tracing and verification. If direct tracing is not possible, they may use data on average usage, deployment patterns or other evidence establishing a clear link between the intermediary and its end-use application. Any assumptions should be conservative, realistic, transparently disclosed and regularly assessed.

Table 4: Example validation claim eligibility

Solution and claiming party	Intermediary solution: carbon fiber sleeve for EVs (encases the rotor of the EV's permanent magnet motor) manufactured by Company A.		
Claim	AE from the use of the carbon fiber sleeve (intermediary solution) in EV (end-use solution). **Reference**: EV with aluminum sleeve, **FU**: total kilometers driven over the vehicle's lifetime		
Criteria	**Eligibility requirements**	**Company/solution's evaluation**	**Fulfilment of requirements**
Gate 1 Climate action	**1. Verify GHG emissions inventory**	GHG emissions inventory assessment and review statement.	✓
	2. Commit to 1.5°C pathway	SBTi target validation statement and targets published on company's website.	✓
	3. Monitor and report progress	Annual sustainability reports include changes in GHG inventory published on the company website.	✓
Company A can prove its climate action and is eligible to pass Gate 1.			
Gate 2 Latest Climate Science Alignment	Prove science-based mitigation potential	Using carbon fiber in EVs reduces weight, leading to energy savings during operation. The carbon fiber solution has mitigation potential in industry through energy efficiency (IPCC AR6).	✓
The carbon fiber sleeve solution is aligned with the latest climate science and is eligible to pass Gate 2.			
Gate 3 Contribution legitimacy	**1. Significant decarbonization impact**	The carbon fiber sleeve enables measurable GHG reductions in EVs compared to the standard aluminum sleeve, as confirmed by a validated LCA study XX published in YY Journal with an impact factor of AA. Based on our estimations (provided as supplementary evidence), the carbon fiber sleeve EV can reduce lifetime emissions by more than 10% compared to an aluminum-based EV. At scale, across the European market – including EVs for personal and commercial uses (e.g., ride-hailing fleets) – this could drive substantial emissions reductions.	✓
	2. Substantiated impact	With its high strength-to-weight ratio, the carbon fiber sleeve enhances the EV's energy efficiency. It reduces the vehicle's weight, improves the battery's performance and range, and lowers its capacity demand – ultimately cutting GHG emissions due to energy savings.	✓
The carbon fiber sleeve solution has a legitimate contribution to EVs and passes Gate 3.			
Company A and the carbon fiber sleeve solution pass Gate 1, Gate 2 and Gate 3 and the claim eligibility is validated.			

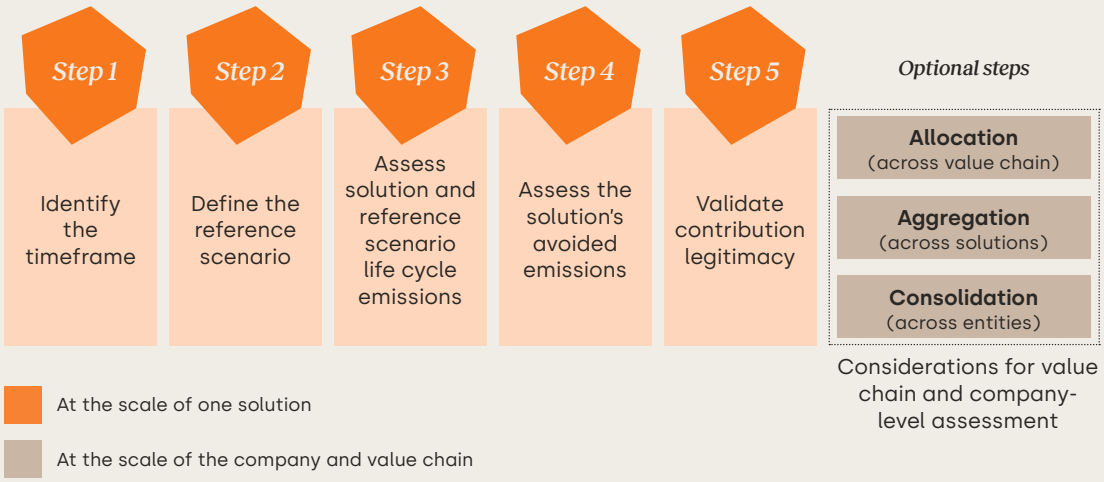
Assessing *avoided emissions*

04.

04. Assessing avoided emissions

Calculating AE for sold or installed base solutions requires a detailed step-by-step approach to ensure consistency in AE assessments undertaken by companies. This approach can be broken down into five steps, which are outlined below.

Figure 8: The five-step approach to calculating AE



4.1. Core principles

We have grounded the assessment of AE in core principles that ensure robust, transparent and conservative claims. We have aimed to align with the GHG Protocol's principles for GHG accounting and reporting:

- **Transparency** – disclose all the information needed to provide intended users with the basis for decision making, and for stakeholders involved to evaluate the robustness and reliability of the assessment.
- **Conservativeness** – consistently use moderate estimates and assumptions to assess AE. In case of doubt, lack of reliable data, or if there is room for interpretation of the Guidance, chose the scenario that leads to lower AE impact
- **Accuracy** – take efforts to transparently disclose and reduce uncertainty in the data and methodological aspects of the assessment. Where relevant include traceability and monitoring of data.
- **Relevance** – use data, methods and assumptions for the purpose of quantifying AE that are relevant to the assessment.
- **Completeness** – consider all relevant information which may affect the qualification and quantification of AE and complete the requirements set out for the assessment.
- **Consistency** – observe conformance to this Guidance when conducting the assessment to ensure internal consistency.

4.2. Overview of the five-step approach

AE quantification follows a five-step approach. The calculation starts at the level of each solution that has been sold or is in the installed base in the reporting timeframe:

Step 1: Identify the timeframe of the assessment. A company identifies whether the solution's AE should be calculated on a year-on-year basis or a forward-looking basis. The timeframe should be consistent with the reporting timeframe of the solution's emissions in the company's GHG inventory assessment.

Step 2: Define the reference scenario. The reference scenario depends largely on the context of sales, as it depends on the way solutions will be used and the alternative scenarios that would occur instead. The reference scenario should always represent the most likely alternative that the solution is replacing.

Step 3: Assess solution and reference scenario life cycle emissions. The company assesses life cycle emissions of the solution and of the reference scenario.

Step 4: Assess the solution's avoided emission. The company calculates the difference in emissions between the solution and the reference scenario, taking into consideration the solution's entire life cycle.

$$\Delta GHG_{AE} = \sum_{k=1}^{n} (Ref_{n-0} + \mathrm{Ref}_{n-1} \ldots) - (Sol_{n-0} + Sol_{n-1} \ldots)$$

Where:

ΔGHG_{AE}= AE in tCO2e during assessment timeframe
n = ending index year for assessment
Ref_n = GHG emissions that would occur in the absence of the solution, in tCO2e
Sol_n = GHG emissions in the solution scenario, in tCO2e
k = index year of assessment timeframe (solution sold or in installed based)

Step 5: Validate contribution legitimacy. The calculations carried out in Step 4 can validate the legitimacy of the solution's contribution following the eligibility criteria of Gate 3.

Additional steps relate to considerations for value chain and company-level assessment. AE are often consequences of interventions by various solutions as well as solutions providers and users. There are therefore instances where AE may be aggregated (e.g., there are various solutions on the entity level) or allocated (e.g., there are various solutions within the value chain).

4.2.1. Step 1: Identify the timeframe of the AE assessment

We recommend that companies align the AE assessment of a solution with the timeframe used to assess the company's GHG inventory, as per the guidance provided by the GHG Protocol Corporate Standard or ISO corporate and product carbon footprint standards.[13] They should follow one of two approaches:

- **Approach A: Year-on-year (YoY) AE assessment and reporting.** If a solution's emissions are assessed and reported annually in a company's GHG inventory (e.g., Scope 1 or Scope 3.13 "Downstream Leased Assets"), then it is recommended that AE are also assessed every year. For use phase emissions of sold solutions reported under Scope 3.11, it may be better to follow the YoY approach. For instance, when a company has precisely monitored the use of solutions sold during their lifespan, they are able to make assumptions that are closer to reality. The YoY approach is also useful for distributing the claim of AE over the lifetime of a solution, in particular for large decarbonizing projects with long lifespans.
- **Approach B: Forward-looking (FW-looking) AE assessment and reporting.** If a solution's full life cycle emissions are assessed and reported in the year of transaction in the company's GHG inventory (e.g., Scope 3.11 "Use of Sold Products"), then AE should also be assessed in the year of sale for the solution's entire life cycle. This option is intended for companies who do not precisely monitor the use of solutions sold during their lifetime and for those wishing to understand the solution's long-term implications. In cases where it is difficult to establish forward-looking scenarios where high uncertainty is involved or data is not available, approach A is preferential. The higher level of uncertainty and use of predictions involved in FW-looking assessments should be made transparent in AE reporting. This Guidance does not address FW-looking AE assessments driven by sales forecasts or market uptake of a solution, but rather cases of sold or installed based solutions where the useful life of the solution spans beyond the year of sale. We collaborate with investor coalition Project Frame who provide more detailed guidance on approaches to assessing projected AE based on commercial forecasts and not on sold products. We have released a guide where this is detailed further.[14]

The YoY and FW-looking approaches are theoretically equivalent

These approaches are different: the YoY approach accounts for realized AE that occurred in the previous or current year; while the FW-looking approach involves forecasting AE for products with a useful life longer than a year and reporting them all in the initial year of sale or lease. But if the same data and assumptions are applied to both, they should yield identical total results by the end of the assessment period.

Both approaches rely on assumptions. The YoY approach, though based on "realized' AE, relies on assumptions about how the solution is being used, and on uncertainties involved in the reference scenario. While this also applies to the FW-looking approach, it additionally relies on assumptions about the emissions of the solution during its entire life cycle which may be challenging to validate. For both approaches, transparent reporting should be completed in line with the guidelines for communicating and reporting, as well as tracing AE impact over time (see Sections 5 and 6).

Approach A: YoY AE

If the solution has a useful life that does not extend beyond the year of sale, or if it is delivered as a leased or contracted asset, the company should calculate and report its AE for each reporting year throughout the entire duration of the contract. This also applies to sold solutions or solutions in the company's installed base, especially those that the company monitors the use or operation of.

The YoY approach is consistent with the company's reporting of a leased solution's use phase emissions, which are also calculated and reported on an annual basis, either in Scope 3 "Leased assets" or in Scope 1 or Scope 2 (depending on the consolidation approach).

To assess YoY AE, the company should:

1. **Calculate the upstream and end of life emissions of the solution and the reference scenario** and distribute accordingly across their lifetime, as defined in the FU (see Section 4.2.3).
2. **Establish the use phase emissions of the solution and the reference scenario each year.** Any potential replacements during the contract should be taken into account when quantifying the number of solutions needed to fulfill the FU.
   - If a company with sold solutions chooses Approach A, the reported AE should also include the annual AE of solutions sold in previous reporting years that are still in use as part of the company's installed base during the reporting year in question.
3. **Assess annual AE** by calculating the difference in emissions between the reference solution and the solution. The production and end of life emissions should be distributed annually based on the lifetime as defined in the FU.

Approach A requires that a reference scenario is modeled, but unlike Approach B there is no need to forecast:

→ The future decarbonization of the energy mix, since the actual emissions factor can be updated for every year of calculation.

→ The solution's or reference solution's future performance, since its actual use is estimated each year.

Example: On-site recycling using Approach A (YoY)

A company has a contract to install and operate efficient on-site recycling solutions for 10 years. In this case, the company should:

1. Define the FU of the equipment solution and the reference scenario (including the evolution of the reference scenario over the lifetime of the solution) and allocate the upstream and end of life emissions to each year for the duration of their lifetime.
2. Assess and claim every year throughout the contract duration:
   - The actual emissions of the low-carbon recycling equipment during that year, based on the actual emissions factor of the energy (re-)used, e.g., in case of a heat recovery solution.
   - The emissions of the reference scenario in the given year. This should be based on the reference scenario established in the year of the transaction, using the actual energy-related emissions factor in the current year, and considering dynamic effects (e.g., the share of usage that actually replaces other activities).
3. Calculate the annual AE by comparing the emissions of the low-carbon recycling solution to the emissions of the reference scenario.

Approach B: FW-looking AE

If the solution's useful life spans beyond the year of sale, its AE should be calculated for its entire life cycle and reported in the year of sale.

This rule is consistent with a company's GHG inventory reporting of the use phase emissions of a solution, which are also calculated over the solution's entire lifetime and reported in the year of sale (in the Scope 3 "Use of Sold Products" category).

In this case, the company should:

1. **Establish a solution's future emissions** and assess the amount of GHG emissions the solution is likely to emit during its entire lifetime (see Section 4.6.1).
2. **Establish the emissions pathway in the reference scenario** and assess the amount of GHG emissions that would have been emitted during the reference scenario's entire lifetime.
3. **Assess the AE** by calculating the difference in emissions between the solution and the reference scenario, considering the solution's entire life cycle.

It should be noted that consistency with GHG inventory only applies to the timeframe of the reporting. The actual emissions calculated (e.g. in Scope 3.11 "Use of Sold Products'), can differ from the life cycle emissions of the use of the sold product in the AE assessment. The FU may differ because it is use-oriented in AE assessments, but production-oriented in GHG inventory accounting. For instance, an EV battery producer might report the total GHG emissions of the power consumption required for the total charge cycles of the sold battery under Scope 3.11. However, for the AE assessment – in accordance with Section 2.4 – the battery producer will estimate the power consumption based on the EV operation (e.g., power consumption required for the passenger-km driven throughout the EV lifetime). This number will likely be different than that reported in the GHG inventory Scope 3.11.

Example: Heat pump solution using Approach B (FW-looking)

A company produces and sells a heat pump to an end customer. The company should:

1. Assess the forecasted life cycle emissions of the heat pump during its entire lifetime (production, use, end of life, etc.).
2. Assess the forecasted life cycle emissions of the most likely alternative that the solution is replacing, in this case an average boiler, based on the lifetime as defined in the FU (see Section 4.5). For consumables or products with a useful lifetime of <1 year, the lifetime may not be defined in the FU.
3. Estimate and report the AE impact over the solution's lifetime at the time of the transaction.

For both solution emissions and reference scenario emissions, the company should:

→ consider dynamic effects, such as forecasted electricity decarbonization and yield degradation of the heat pump and boiler.

→ include direct rebound effects (e.g., a potential increase in the use of heating solutions).

→ use reasonable and sourced assumptions about the lifetime and usage of the heat pump and boiler (e.g., the average customer's learning curve to optimize settings).

How to determine which approach is more suitable for a given solution?

The following three examples illustrate different types of solutions and the considerations companies may have for choosing either a YoY or a FW-looking approach to assess AE.

Example: Choosing an approach – electric bicycles

Company A sells electric bicycles that facilitate a shift towards cycling in the city. It tracks its year-on-year bicycle sales and reports its Scope 3.11 "Use of Sold Products" emissions (i.e., the energy use during the use phase of the sold bicycles) at the time of sale over the bicycles' entire life cycle. These factors lead the company to favor Approach B (FW-looking) when reporting its AE.

In addition, the company does not collect data on how its sold products are actually used, which makes Approach A (YoY) irrelevant and confirms the use of Approach B (FW-looking).

The company could put in place a service that leases bicycles on a trip-by-trip basis, so they could track the products' use. It would then be preferable to follow Approach A (YoY) and report AE on a yearly basis. This would also be the approach they would follow when reporting their in-use emissions (charging the electric bicycles) within their Scope 3.10 "Downstream Leased Assets" emissions.

Example: Choosing an approach – railway installation

A railway transport company is building a new railway line. When the line is commissioned, a provisional plan for its use is made available, as well as the wider behavioral shift that is expected from it. Using certain assumptions, the company could estimate its AE over the lifetime of the line.

But it prefers to follow Approach A (YoY) because:

→ Approach A is consistent with the timeframe for reporting its GHG inventory. The company will calculate emissions from the use and maintenance of the line operation in its GHG inventory.

→ Data will be available for an annual calculation, making it more precise. Approach B would rely on projections about the line's operation, which are uncertain at the time of its commissioning.

Example: Choosing an approach – livestock feed supplement

As we saw in Section 2.4, a feed supplement that reduces enteric emissions is an end-use solution, but also part of the broader system of cattle farming. Since feed is consumed instantly and does not have a useful lifetime, its AE are assessed at the system level by comparing emissions from cattle fed with the supplement versus those without it.

If the cattle is farmed for meat production, AE could be calculated per kilogram of output, depending on the chosen FU (e.g., per kilogram of carcass weight or per kilogram of boneless beef). This comparison provides a clear measure of how the feed supplement contributes to reducing emissions per unit of beef produced.

In this case, Approach A (YoY) is most suitable, as methane emission reductions can be estimated on an annual basis.

4.2.2. Step 2: Define the reference scenario

The reference scenario is the most likely hypothetical scenario in which the AE solution is not used. The reference scenario always depends on the context of the market in which the solution is used. For instance, a bike sold to someone that wishes to replace an old bike is not likely to avoid emissions, whereas a bike used to replace short-distance car trips will avoid emissions.

To ensure credibility and to avoid overstating the impact of a solution put in place, the reference scenario should represent the most likely alternative to the AE solution and should be as specific and conservative as possible. It should be representative of a specific industry or region and clearly defined in the scope of the assessment. The reference scenario should always fulfil the same function as the solution.

The reference scenario is hypothetical, so cannot be proven. There is no one correct answer – it is an estimate. To determine the most likely alternative, companies should use recognized and well-documented assumptions, such as market data of an average solution, new sales data on existing stock in case of replacements of functional existing solutions, regulations, industry- and customer-specific knowledge, etc.

Example: Defining the reference scenario – heat pumps

In the context of the sales of heat pumps replacing old boilers, the reference scenario could be the average heating solutions sold that year in a given market. If no information is available for the full range of solutions and their representativeness in the market, the reference scenario should be based on the most widely used solutions (i.e., the top 25% of the market share in new sales (excluding installed base).

The most likely reference scenario in Country A could be a weighted average between all heating solutions (heat pumps, gas boilers, heating networks, electric radiators, etc.) sold in a given year. The weights should be taken from country statistics on the sales of heating equipment in the consumer market.

How do we define the reference scenario?

The reference scenario should always represent the most likely alternative for the solution and be as accurate as possible. In the context of a particular customer, it should be the specific alternative the customer would have chosen instead.

The choice of the reference scenario should start with determining whether there is a "new" or "existing" demand situation, followed by deciding whether it concerns an "improvement" or a "replacement".

a) "New demand" situation

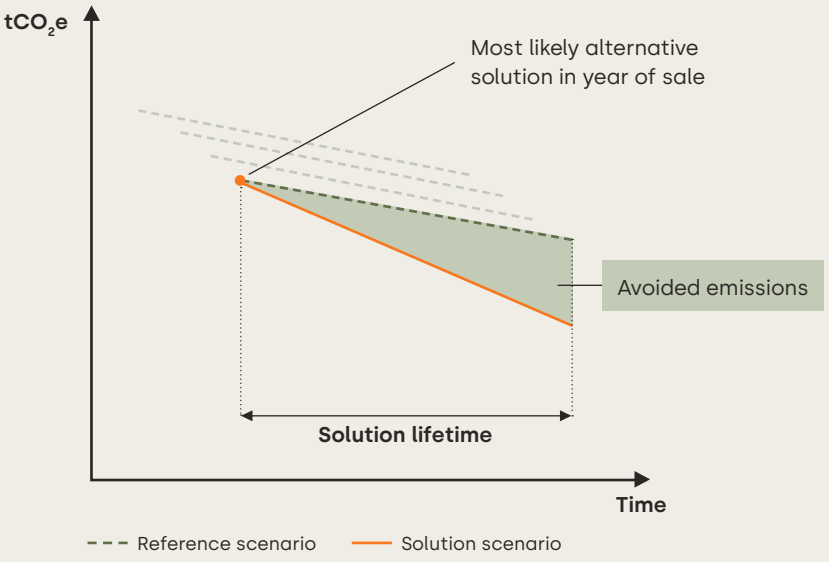
If a solution is used to fulfill a demand triggered by a growth in the customer's needs, no previous situation exists, and it is therefore considered a new demand.

In this context, the reference scenario should be the expected situation based on the new sales in the market in the year of sale for solutions with the same function (see Figure 9).

For example: Company A builds a new, low-carbon building. The reference is the average building of the same category, in the same region, being built in the same year.

If in doubt about whether a solution meets a new or an existing demand, the reference scenario should be defined following the "new demand' requirements.

Figure 9: An example of new demand solutions with no previous reference situation



b) "Existing demand' situation

If the solution meets an existing demand, it can be considered able to replace or improve an existing system. In this context, the emissions in the existing system are not zero.

There can be two distinct cases for the improvement or replacement of an existing solution: those that are influenced by exogenous factors such as regulation, and those that are not. This has consequences for the definition of the reference scenario.

Improvement not imposed by exogenous factors

If the improvement is not imposed by exogenous factors (such as regulation), the most likely reference scenario is the average market solution that provides (i) the same kind of improvement (functional unit) as the AE solution, or, in exceptional cases, (ii) the continued use of the previous system without the improvement. The latter should only be used with clear justification, as it assumes that no action would have been taken without the specific AE solution, implying the solution itself triggered the change.

For example: Company A insulates homes and performs a thermal renovation on a building. The reference situation could be (i) the average thermal insulation solution available on the market or (ii) the continued use of the non-improved building over time – if it is well justified that no other action would have been taken without the intervention of Company A's specific solution.

In cases like this, it might be difficult to determine the end-of-life date of a solution. However, a solution cannot claim AE indefinitely. For such cases, AE can be claimed:

→ for a pre-defined period of time (e.g., 5-10 years), or;

→ until the moment that actual market data show that buildings in the same region have been thermally renovated, or;

→ the reference scenario changes from the previous situation to a new situation where most buildings are thermally renovated (see example below).

Improvement imposed by exogenous factors

If the improvement is imposed by exogenous factors (such as regulation), the most likely reference scenario should be the average market solution that performs the kind of improvement mandated by the regulation.

For example: Company A insulates homes. It performs a thermal renovation to improve an inefficient building as required by regulation. The reference situation is the improvement delivered by the average thermal renovation solution applied to such buildings in line with the new regulation.

Note that AE cannot be claimed after a trigger event takes place. For instance, if a regulation imposes that all buildings should be thermally renovated by 2030, then AE cannot be claimed after 2030 and may need to be recalculated. For a more detailed explanation of trigger events see Section 5.1.2.

Replacement not imposed by exogenous factors

If the replacement is not imposed by regulation, the most likely reference scenario should be the average market solution based on the current sales of solutions to replace the existing one in the year of sale.

For example: Company A installs a heat pump to replace an old, non-functional fuel boiler that needed replacement in a private house. The reference situation is the average heating solution that is sold in the reporting year for this type of building.

Replacement imposed by exogenous factors

If the replacement is imposed by regulation, the most likely reference should be the average solution aligned to the new regulation chosen to replace the existing one in the year of sale.

Note: Some replacements, whether imposed by legislation or not, can occur before the previous equipment's end of life. In this case, the reference scenario would ideally be the use of the existing equipment until its expected end of life (with clear justification that no other action would have been taken in the year of replacement), and then a replacement by another solution that would likely be sold at the reference solution's end of life. For simplification purposes, this Guidance considers that all replacements occur at the end of life of the previous equipment (Figure 10). This is conservative, as it minimizes the amount of AE.

Should companies wish to factor in an early displacement of a functional solution, they may do so as long as it is clearly justified and explained in the calculation process. When a solution replaces existing technologies before they reach their end of life, the reference should include not only the new sales but also the existing stock of technologies.

Figure 10: **An example of solutions replacing existing alternative**

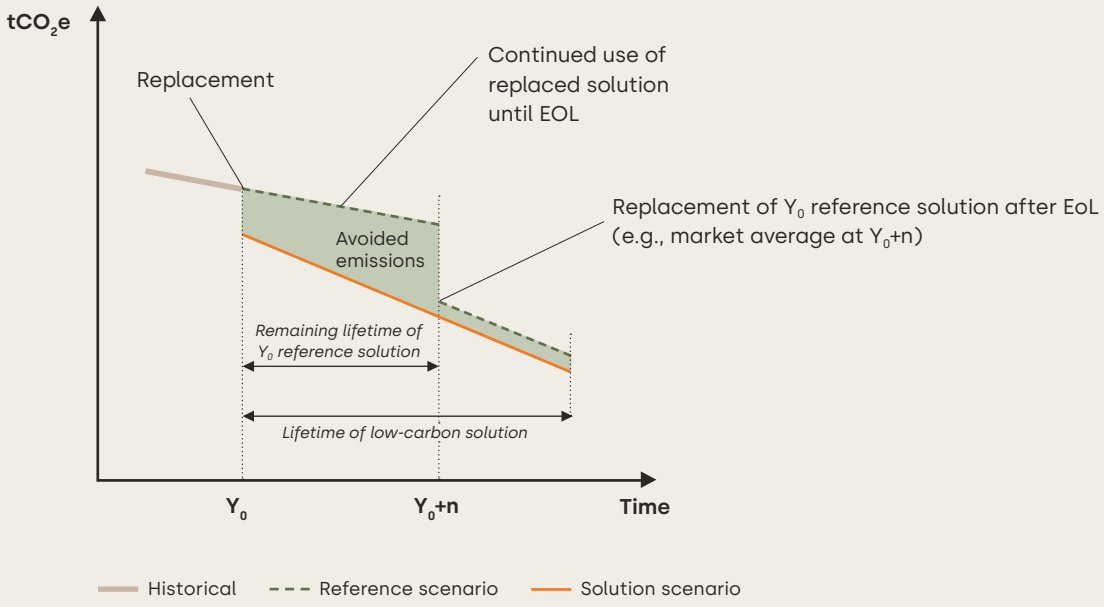
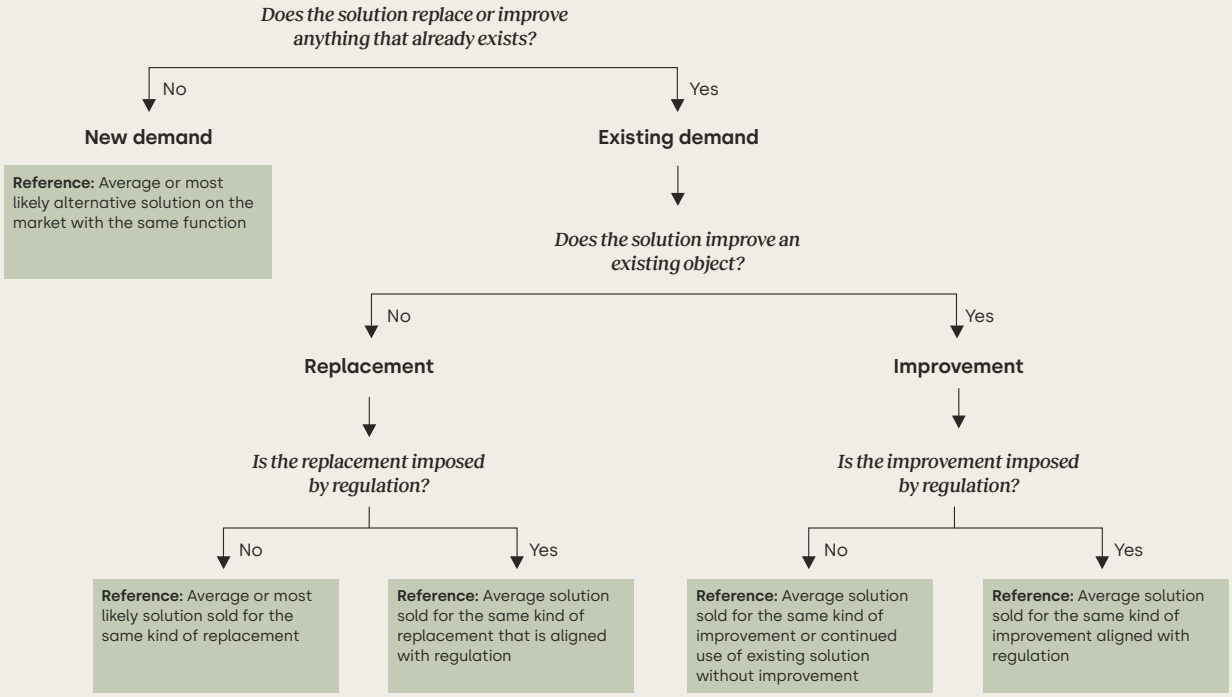


Figure 11: **Determining which reference to use in the AE assessment**



The role of regulation

When the reference scenario is the average solution on the market (i.e., "new demand' solutions, and "existing demand' solutions when replacing an existing solution at end of life), regulation is one of the key factors determining the average solution. Regulation should therefore always be considered for the reference scenario definition.

For example:

- → In Country X, a new environmental regulation for new buildings will directly influence what the "average new building" is in Country X.
- → Similarly, in Country Y, a law stating car manufacturers must not exceed an average carbon intensity for the vehicles they sell will directly influence what the "average new car" is in Country Y.
- → A law introduced in Country Z that imposes a minimum rate of refurbished electronic equipment sold on the market will directly influence what the "average new smartphone" is in Country Z.

The role of the market

The context and state of the market plays a major role in determining how big a decarbonization impact a solution can be expected to have. The solution's expected impact is negligible when (i) the market is oversaturated by similar solutions, (ii) the demand for a solution is low or (iii) the evidence shows that the uptake of the solution in a certain market might be challenging. This would also be reflected in the assessment of the solution's contribution legitimacy in Gate 3. To maximize the potential for decarbonization impact, prioritize innovative solutions and markets where the most likely reference scenario suggests that the solution may achieve the highest AE impact.

Ensuring consistency: Use a fixed reference scenario

Once defined, the reference scenario should remain fixed for the year of sale or initial lease/useful lifetime. Here, "fixed" refers only to the specific technology or technology mix representing the most likely alternative at the time of sale. It does not apply to other aspects, such as changes in the emissions of the technology mix, which can dynamically change (e.g., the electricity grid mix used by a specific technology/technology mix may evolve over time) or to future sales, where each year requires a newly calculated assessment and claim. A fixed scenario should be linked to the year of sale because in the absence of the solution, the most likely alternative would have been adopted instead and operated for its full lifetime – locking in its associated emissions.

The fixed reference scenario will apply throughout the contract period or the usable life of the solution, including any necessary operational start up time.

The company should use the fixed reference solution for steps 1 and 2 of the assessment:

1. **Identifying the timeframe** of the AE assessment, for both the FW-looking and YoY approaches.
2. **Defining the reference scenario** for the new demand situation or existing demand situation replacing technologies at their end of life.

This ensures consistency for the reference scenario between FW-looking and YoY approaches (see simplified example in Section 4.5.2) and prevents more favorable comparisons that could arise from forecasts in FW-looking assessments.

4.2.3. Step 3: Assess the life cycle emissions of the solution and the reference scenario

Definition of scope and boundaries

Companies should calculate AE based on the solution and reference scenarios' entire life cycles (i.e., emissions from transport, production, use, end of life, etc.), to the extent needed to reliably establish the difference between the two cases. System boundaries need to be clearly defined (see Section 4), including the complete life cycle and capturing all relevant emissions sources and reductions. The timeframe used to assess AE should not exceed the timeframe associated with the solution's life cycle.

Example: a fixed reference scenario in practice

In 2024, Company A sells a heat pump solution in a specific market. The reference scenario for the next unit sold in that market in 2024 consists of 90% gas boilers and 10% heat pumps. This technology mix (90% gas boilers and 10% heat pumps) serves as the fixed reference scenario for all solutions sold in 2024. Company A will therefore calculate the full life cycle emissions of both the sold solution (heat pump) and the reference scenario (90% gas boilers and 10% heat pumps).

However, emissions from the grid mix or the natural gas consumed by either the solution or the reference can remain dynamic. The most likely alternative may also change over time. For this reason, the reference scenario should ideally be reassessed for future years. For example, in 2025, if the most likely alternative shifts to 80% gas boilers and 20% heat pumps, this updated mix should then serve as the reference for all heat pumps sold in 2025.

Figure 12: Example: Replacing a gas boiler with a heat pump in an existing building (not imposed by regulation).

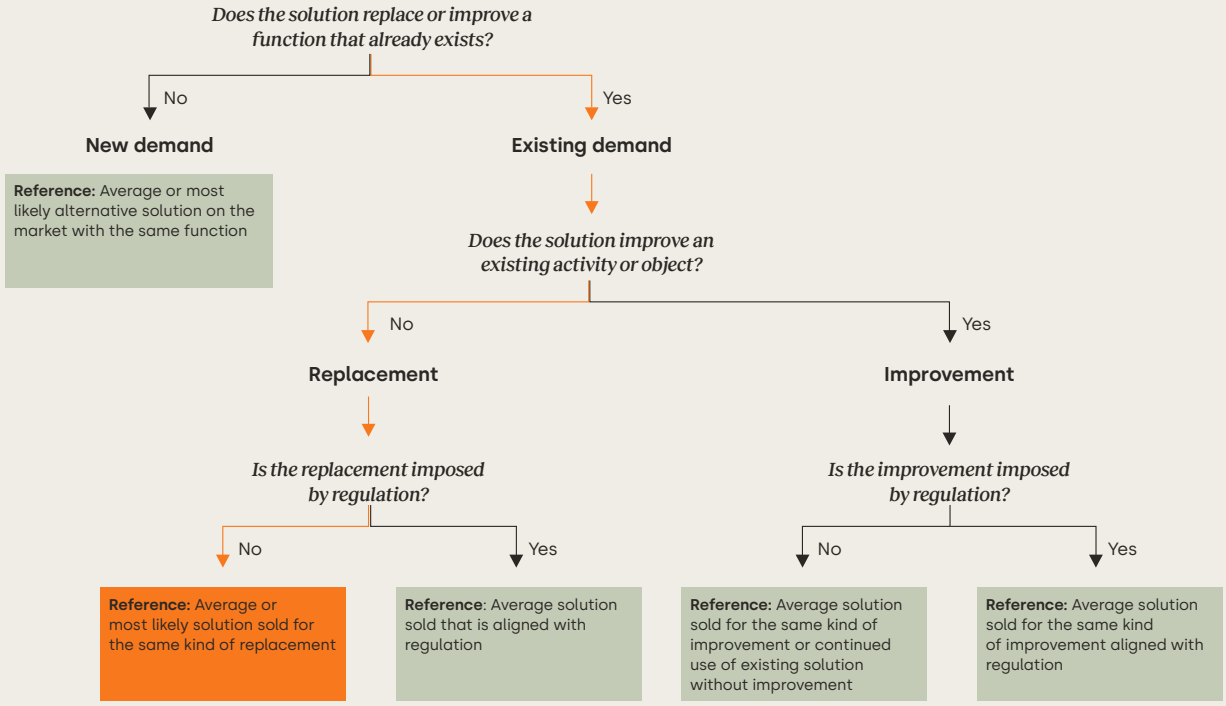
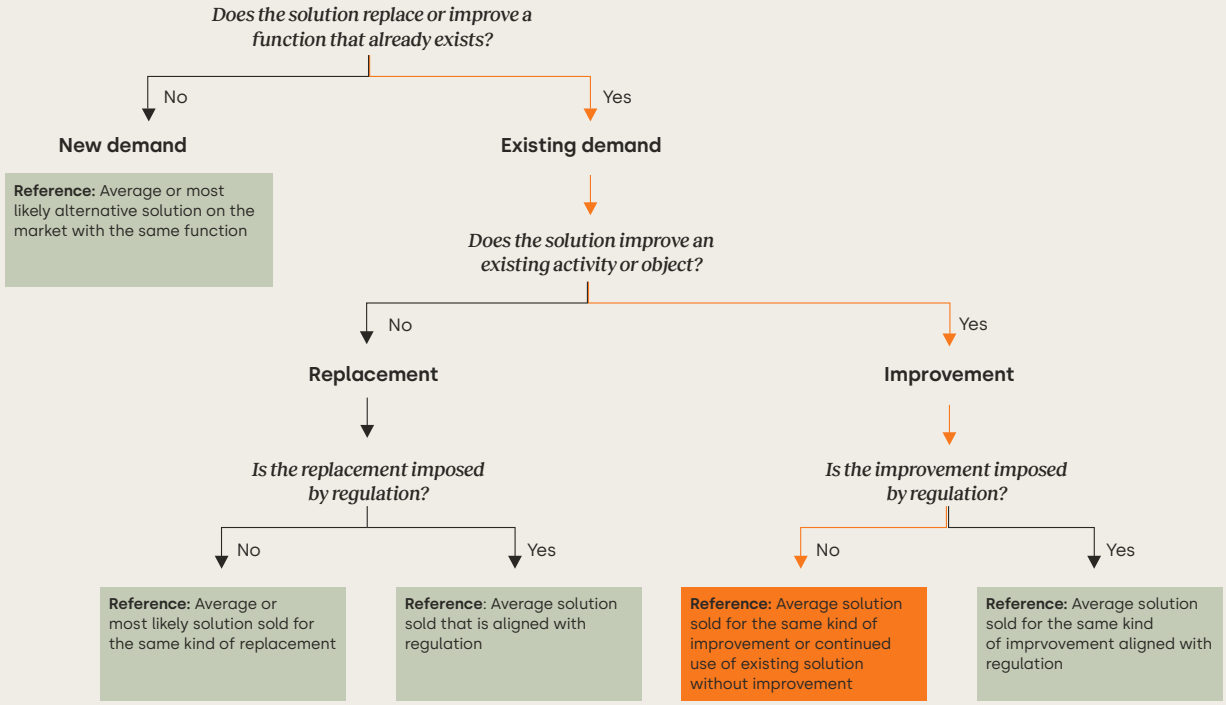


Figure 13: Example: Converting a thermal car into an electric car. The improvement is not imposed by regulation



Example: Defining the FU of a heat pump solution

The definition of the FU of a heat pump solution with a lifetime of 10 years could be: "Providing heating for an average residential house in the Netherlands for 10 years". The reference scenario is assumed to be 80% gas boilers and 20% oil boilers. The required quantities of the solution and the reference to fulfill the FU depend on their lifetimes, as seen in the different cases below.

Table 5: **Example FU definition including lifetime**

Case	*Lifespan (years)*	*Required to fulfill the FU*
1. Same lifetimes for solution and reference		
Heat pump solution	10	1 heat pump
Gas boiler reference	10	1 gas boiler (times 80%)
Oil boiler reference	10	1 oil boiler (times 20%)
2. Different lifetimes for solution and reference		
Heat pump solution	10	1 heat pump
Gas boiler reference	15	10/15=0.67 gas boilers (times 80%)
Oil boiler reference	12	10/12=0.83 oil boilers (times 20%)

Definition of lifetime in the FU

The FU (functional unit) is a measure that defines the function a solution fulfils, making it possible to compare the solution to a reference scenario. In order to fulfil the function, the lifetime of the solution often needs to be taken into account, and thus should be specified.

For solutions with a useful life of one year or less (e.g., food products), the duration is less relevant – however this information should be included in the FU definition or reported separately in a transparent manner.

Note that "lifetime" refers to the useful life of a solution. Companies should define this in a realistic and conservative way based on best available science, rules, data and statistics (see Section on data below). For FW-looking assessments, companies should adopt the most conservative option between the actual and the manufacturer-recommended lifetime of the solution.

Example: Defining a solution's lifetime

For a project that includes a set of solutions such as retrofitting a building to increase its energy efficiency with efficient lighting, appliances, insulation and new windows, there are solutions with various lifetimes involved. Assuming a FU such as "kWh of energy consumed per m2 area, for a residential building in the Netherlands, over 10 years", the lifetimes of the different interventions can be scaled to the FU.

For instance, if an appliance has a lifetime of seven years, then 10/7=1.43 appliances are needed to fulfill the FU. If windows have a lifespan of 30 years, then 10/30=0.33 windows are needed to fulfill the FU.

Not all solutions have a usage lifetime. For instance, animal feed is directly consumed by animals. Nonetheless, the same logic applies: as long as an appropriate FU is defined, then the required quantity of feed to fulfill the FU can be defined.

Attributional and consequential approaches

An AE assessment builds on the lifecycle inventories of both low-carbon solutions and reference scenarios to assess the changes in the market from introducing or selling the solutions. Companies can use two common modeling approaches to calculate the life cycle GHG emissions of a solution and its reference: the attributional and the consequential approach (Table 6).

Either approach can be adopted, and they can be adopted jointly. Companies should state the reasons behind the choice in their AE assessment. The underlying inventories for each approach are built differently: attributional inventories use activity and average data, whereas consequential inventories often use marginal data.

Various components of the AE assessment – such as the scope definition, the assessment of the life cycle emissions of the solution, the reference scenario and the underlying data – can be determined using either an attributional or a consequential approach. Some components are more often addressed using attributional (e.g., assessing GHG lifecycle emissions for the solution), while others can be defined using either approach. A consequential framing may become progressively integrated (e.g., comparing solution and reference scenario, assessing rebound or side effects). Consequential approaches can introduce additional uncertainty due to the wide array of considerations they inherently involve.

Calculation consistency between the scenarios and with GHG inventory

The emissions calculations should be consistent between the reference scenario and the solution delivered by a company. To achieve this, companies must use the same FU for each, and account for the full life cycle GHG emissions for both the solution and the reference scenario. Companies should also use emission factors that account for the solution's entire life cycle (i.e., from cradle to grave), and not only for direct emissions related to the solution's operating phase.

Companies should ensure consistency between the AE and the generated inventory emissions they declare. To claim AE associated with the introduction of a decarbonizing solution, a company should account for the carbon footprint of that solution in its separate GHG inventory.

Table 6: Definitions of the attributional and consequential approaches

Key characters	*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 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

Data in lifecycle emissions assessment

Types of data

The data (primary and secondary[15]) for AE calculations can be differentiated based on the company's operational or financial control and its access to information. This applies to end-use and intermediary solutions as well as the reference scenario.

The recommended options are:

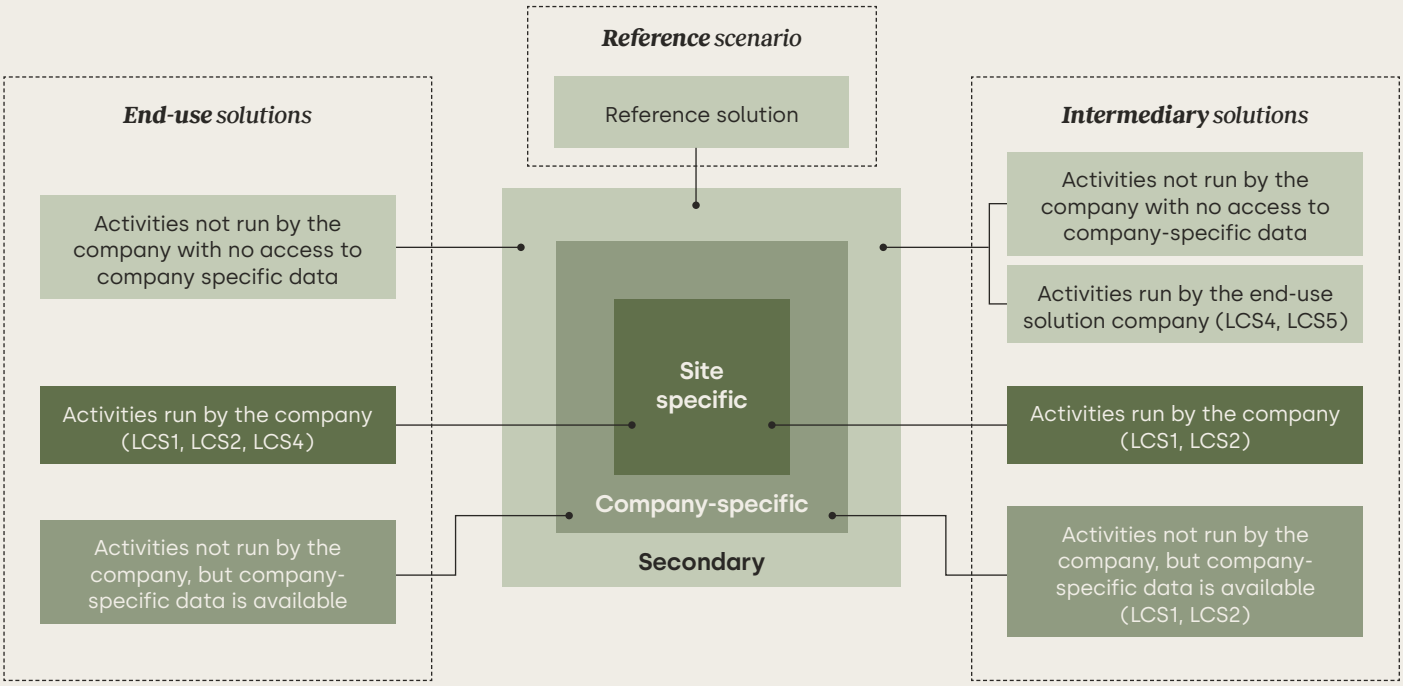
- → For activities inside a company's financial or operational control – **primary data**, which can be **site- or company-specific**;
- → For activities outside a company's financial or operational control
  - – where information is available – **company-specific data** (supplier or stakeholder);
  - – where information is not available – **secondary data**;

Prioritize primary over secondary data whenever possible. For example, for asset-heavy equipment, the solution provider often knows the specific machinery that is replaced and can use site-specific data for both the reference and solution scenarios. Ensure the data quality of the solution scenario is not lower than that of the reference scenario for existing solutions.

Good practice recommendations for data collection, quality and management

- → **Refer to existing standards**: Use product-specific standards (e.g., ISO 22526 for biobased plastics), product category rules (PCR), product environmental footprint (PEF) category rules (PEFCR) for data collection, data quality indicators and requirements, if applicable.
- → **Supply chain collaboration**: Aim for overall alignment, collaboration and primary data exchange between stakeholders in your supply chain.
- → **Improve key data points or assumptions**: Seek higher quality data, such as site-specific or actual measurements, to replace previously used data points or assumptions with lower data quality or high impact.
- → **Align assumptions**: Use the same foundational assumptions (e.g., IEA STEPS) for both scenarios to avoid biases.
- → **Document transparently**: Thoroughly report data sources, key assumptions, limitations and data gaps and how they affect the assessment.
- → **Use proxies**: Use proxies based on validated assumptions if data is missing and choose conservative values when various options are available.

Figure 14: Recommended data types based on solution type



Note: Life-cycle stage (LCS) LCS1: raw materials acquisition & pre-processing; LCS2: manufacturing; LCS3: distribution; LCS4: Use; LCS5: end-of-life.

- → **Use consistent secondary data sources**: Ensure consistent secondary data in both the solution and reference scenarios.
- → **Validate key assumptions**: Confirm and regularly update key assumptions, especially those that have a significant impact on AE calculations.
- → **Review data**:
  - Conduct a yearly evaluation of updated data, from the same or new sources, to identify significant changes from the original assessment.
  - Continuously verify data related to baselines, rebound effects and side effects and update the AE assessment as needed, especially for FW-looking assessments.
- → **Track trigger events**: Monitor major events (e.g., policy changes, shifts in delivery model, consumer behavior, market mix) that could affect assumptions or data, and reassess AE evaluations if needed.
- → **Scenario assessment**: Evaluate scenarios that include high/low rebound effect as well as high/low levels of uncertainty alongside the expected or most likely scenario.

Table 7: Data sources (illustrative and non-exhaustive list)

Type	*Source*
Primary data	Meter and sensor readings, purchase records, utility bills, engineering models, direct monitoring, material/product balances, stoichiometry or other methods of obtaining data from specific processes in the value chain e.g., directly from suppliers, primary customer and market data (collected directly by own market research or customer surveys)
Secondary data	→ Life cycle databases as per GHG Protocol list → Secondary customer and market data representing averages instead of company-specific data. Examples include: – Consumer behavior data (e.g., product use phase, recycling patterns or electronics disposal) gathered from broader surveys or studies conducted by third parties – Sales, market share and distribution data such as product sales and market penetration figures from retailers or analytics firms → Journals (International Journal of Life Cycle Assessment, Journal of Industrial Ecology, Journal of Cleaner Production, Journal of Environmental Science & Technology, Nature, Resources Conservation & Recycling, Environmental Innovation & Societal Transitions) → External studies conducted by credible organizations (e.g., Label Energie Positive et Reduction Carbone, Green Building Councils, Fédération des Services Energie Environnement, International Energy Agency) → Regulations and standards (U.S. Environmental Protection Agency, UK Department for Business, Energy & Industrial Strategy, Réglement environnementale 2020, International Standards Organisation, Association Française de Normalisation, American Society of Heating, Refrigerating and Air-Conditioning Engineers, European Committee for Standardization) → The Net Zero Initiative's standardized references and avoidance factors in the Guidance on Avoided Emissions v1.0.
Trends, projections, policy scenarios etc.	→ EU Reference Scenario 2020 (European Commission) → Table of Solutions (Project Drawdown) → POTEnCIA scenarios (European Commission) → EA's Global Energy and Climate Model → IRENA's Renewable energy roadmaps → Data (FAOSTAT)

4.2.4. Step 4: Assess AE

AE are assessed by calculating the difference in emissions between the reference scenario and the solution, taking the solution's entire life cycle into consideration, as defined in the FU.

Addressing the evolution of AE over time

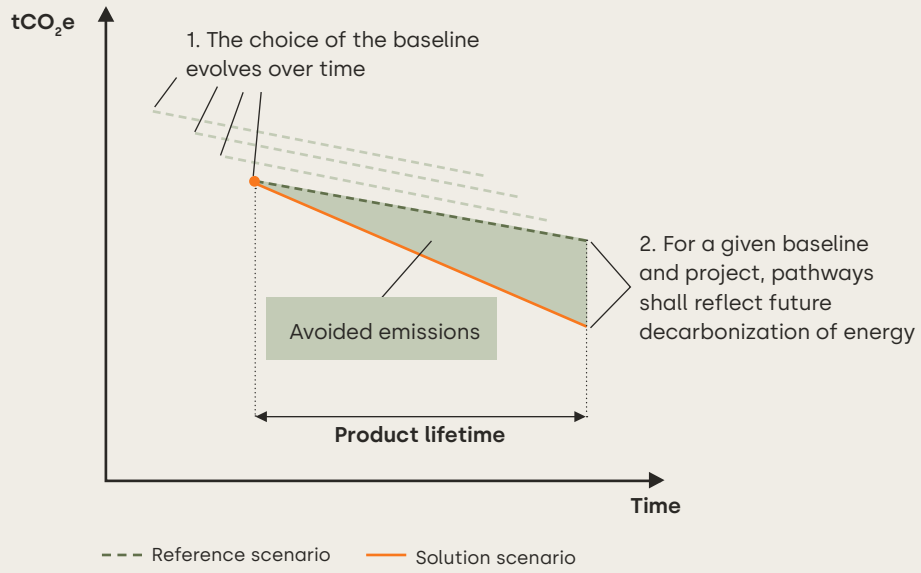
AE assessments incorporate the hypothetical behavior of various market actors and can involve estimations over several years. This dynamism must be accounted for. Reference and solution scenarios should consider the potential evolution of the underlying data and assumptions over time, in relation to different aspects.

In most cases, the emissions of both a reference scenario and solution evolve over time due to changes in the energy mix (e.g., the actual or predicted decarbonization of the energy consumed over a solution's lifetime) or other factors such as technological efficiency improvements in machinery, buildings or transport. In the case of FW-looking AE assessment, a company should incorporate trend scenarios (e.g., IEA STEPS to best assess the expected decarbonization of the energy sector for both the reference scenario and the solution[16]) or well-documented hypotheses to define forward-looking scenarios within different sectors.

The situation will depend on the year of sale, especially for references reflecting the state of the market in a given year.

To assess AE, there are various time-related concepts that come into play when choosing an approach and defining a reference scenario. The following example illustrates how different results can be calculated in a FW-looking or YoY approach as a consequence of the fixed and dynamic aspects of a reference scenario.

Figure 15: An example of a solution where the reference is the average solution that improves in the market over time (schematic)



Example: comparing a FW-looking and a YoY assessment of AE for a heat pump solution.

As a first step, the scope of the solution should be defined:

- → **Assessment goal:** Communicating AE assessment results to potential investors.
- → **Type of solution:** Heat pump.
- → **Function and FU:** Providing heating for an average residential house for 10 years.
- → **Reference scenario (2024):** Most likely reference solutions for heating are 90% gas boilers and 10% heat pumps, based on new sales.
- → **System boundary:** To provide heating for an average residential house over 10 years, the system includes all processes related to the production, use and operation, and end of life of the solution and reference scenario.

Example: comparing a FW-looking and a YoY assessment of AE for a heat pump solution (cont'd)

Additional information to be considered in the assessment:

- → **Year of sale:** 2024
- → **Lifespan:** 10 years for both the heat pump and gas boiler
- → **Geographical scope:** Netherlands
- → **Assumptions:**
  - The solution is operational for the full year 2024 (relevant for the YoY approach).
  - The solution is replacing old technologies that have reached their end of life i.e., this is an existing demand situation, replacement case.
  - A heat pump consumes 1000 kWh of electricity per year; a gas boiler consumes 1000 m^3 natural gas per year (illustrative data).

The reference scenario for 2024 should remain fixed for all solutions sold in 2024.

Table 8: Forecasted evolution of emission factors of the power grid and natural gas per year (hypothetical values).

GHG emissions per year	*2024*	*2025*	*2026*	*2027*	*2028*	*2029*	*2030*	*2031*	*2032*	*2033*	*Total*
Power grid $kgCO_2eq$/ 1000 kWh	1.6	1.5	1.3	1.2	1	0.9	0.8	0.7	0.6	0.4	10
Natural gas $kgCO_2eq$/ 1000 m^3	2.1	2.1	2.1	2.1	2.0	2.0	2.0	1.9	1.9	1.8	20

If the annual consumption of electricity for the heat pump and natural gas for the boiler remain constant at 1,000 kWh and 1,000 m^3, respectively, then the total projected emissions over their lifetimes amount to 10 kg CO_2 eq. for the heat pump and 20 kg CO_2 eq. for the gas boiler (sum of all years).

The assessment of the total emissions for the FW-looking approach is presented in Table 9. Production and end of life treatment values are hypothetical.

Table 9: Calculation of emissions for the heat pump and gas boiler using FW-looking approach

Approach	*Technology*	*Production (GHG emissions in kg CO2 eq.)*	*Use/operation (GHG emissions in kg CO2 eq.)*	*EoL (GHG emissions in kg CO2 eq.)*	*Total emissions (10y)*
FW	Gas boiler	8	20 (over 10 years)	5	8+20+5=33
	Heat pump	10	10 (over 10 years)	5	10+10+5=25

The assessment of the total emissions for the YoY approach is presented in Table 10. Production and end of life treatment values are hypothetical.

These numbers are fictive for the purposes of this example. Assumptions made for AE assessments should be based on credible data

Example: comparing a FW-looking and a YoY assessment of AE for a heat pump solution (cont'd)

Table 10: Calculation of emissions for the heat pump and gas boiler using YoY approach

Approach	*Technology*	*Production (GHG emissions in kg CO_2 eq.)*	*Use/operation (GHG emissions in kg CO_2 eq.)*	*EoL (GHG emissions in kg CO_2 eq.)*	*Yearly emissions - 2024 (production and EoL are spread over 10 years)*
YoY	Gas boiler	8	2.2*	5	8/10+2.2+5/10= 0.8+2.2+0.5=3.5
	Heat pump	10	1.5*	5	10/10+1.5+5/10= 1+1.5+0.5=3.0

*Assuming that the values in the use phase have been realized and they are more representative than the forecasted values in Table 8.

The most likely reference solution in 2024 (90% gas boiler and 10% heat pumps) remains fixed for the full lifespan of solutions sold in 2024, as defined in the FU.

A new reference should be calculated for solutions sold in 2025, as the 90% gas boilers and 10% heat pumps distribution for 2024 may no longer accurately reflect the most likely alternative scenario. Additionally, for the new year, projected emission factors for energy consumption can be updated if more accurate data becomes available, with projections extending until 2034. Table 11 shows the calculation of the AE.

Table 11: AE results for the heat pump solution using the FW and YoY approaches

FW—looking assessment|2024-2033 (total)	*YoY assessment|2024*
Emissions $reference_{total}$ – Emissions $solution_{total}$	Emissions $reference_{yearly}$ – Emissions $solution_{yearly}$
(33*0.9+25*0.1)-25 = 32.2-25 = 7.2 kg CO_2 eq.	(3.5*0.9+2.5*0.1)-3.0 = 3.45-2.5 = 0.95 kg CO_2 eq.

The difference between the FW-looking result (7.2 kg CO_2 eq.) and the YoY result (0.95 kg CO_2 eq.) - which would roughly total 9.5 kg CO_2 eq. over 10 years, without accounting for potential variations in the yearly assessments - can be attributed to the use of more accurate data and verified assumptions in the YoY assessment.

Recalculating the solution and reference scenario

As discussed, AE assessments can include several assumptions. Various factors – such as structural changes in the reporting organization, the discovery of errors or an improvement in data collection – can prompt the need for AE to be recalculated.[17]

When this happens, both approaches require recalculation:

1. YoY: Recalculate any relevant years already assessed up to that point.
2. FW-looking: Recalculate the base year, any relevant years assessed up to that point, and the forward-looking impact.

Evaluating assumptions and data used over time will help a company:

- → Incorporate assumptions and data that are most accurate and up to date with the latest science and practices;
- → Verify whether the reference scenario initially defined accurately represents reality;
- → Identify interdependencies between the solution and the expected decarbonization impact;
- → Regularly update the reference scenario to represent the latest market conditions or policies, so that solutions sold in later years do not use outdated reference scenarios.

While a YoY assessment can better reflect reality regarding emission factors, it still relies on several assumptions. These include and are not limited to:

- → The lifespan of the solution and reference technologies (over which upstream production and end of life emissions may be distributed)
- → End of life emissions, which may occur in the future.
- → Aspects of the annual energy consumption for both the solution and its reference scenario.
- → Factors influencing the use phase (especially if they are not being monitored), such as consumer behavior, technology performance degradation, and other relevant parameters.

To balance short-term flexibility with long-term consistency, we recommended evaluating assumptions and data used, and potentially recalculating, at regular time intervals:

- → **Recommended:** Yearly recalculation of baselines using latest available data or actual measurements instead of assumptions, for example through traceability and monitoring of a solution's performance.
- → **Required:** Recalculation every two to three years and no later than five years, even for solutions with long lifespans.

4.2.5. Step 5: Validate contribution legitimacy

Using the calculations carried out in Step 4, a company should (re-)confirm Gate 3 eligibility for its solution(s) by validating the contribution legitimacy quantitatively. Take the following steps:

1. Show the significant decarbonization impact: Report the actual GHG emissions of the solution and the reference scenario, as well as the AE. This is to show the reductions against the reference scenario.
2. Explain why the impact is significant: Refer to the absolute number of AE or indicate to what extent the AE exceed the variation in results stemming from an uncertainty analysis.
3. For intermediary solutions, quantify their share of the total emission reductions (achieved by the end-use solution) to ensure that their contribution remains significant.
4. Confirm the substantiated impact by showing the cause-effect pathway between the solution and AE through the underlying calculation and data model.

4.3. Optional - Considerations for value chain and company-level assessment

After assessing AE at solution level, it is possible to:

a. Assess AE at a *value chain level.* This entails partitioning the total AE through allocation across the different value chain actors involved in the solution.

b. Assess AE at a product *portfolio level.* This entails adding the AE of various solutions in a company portfolio through aggregation.

c. Assess AE at an *entity level.* Add multiple solutions from multiple business units or company entities through consolidation into a specific entity level, such as across subsidiaries.

This section is presented separately from the core assessment guidance due to the current limitations in methodologies, data and alignment in allocating, aggregating, and consolidating AE. Widely accepted methodologies are scarce at the time of publication of this Guidance, and, particularly, allocating AE across various value chain actors involves high levels of uncertainty. The risk of arbitrary choices, inconsistent assumptions and cherry-picking is difficult to mitigate without clear and widely tested and accepted approaches. As such, allocation should be approached with caution, and results should be interpreted carefully and shared transparently.

AE at the level of the company portfolio are the aggregate of the AE of all products and services sold in a given time period. Before aggregating the results, it may be useful in some use cases to apply allocation to avoid accounting multiple times for the same AE. The guidance below outlines under which conditions AE can be allocated and aggregated across a company's portfolio. If the solutions target completely distinct emission reductions, the AE of different solutions may be added together. However, if two solutions target the same emission reductions, the effect of the first solution on the addressable emissions must be calculated first, as the second solution will only impact the remaining emissions. Without considering this, double counting will occur. In this way the emissions are allocated between two solutions, which allows stakeholders to aggregate them afterwards if needed.

For example:

→ Company A has a solution that optimizes the energy demand of residential buildings and another targeting office buildings. These solutions do not overlap due to distinct end-use applications.

→ Company B has a solution that reduces traffic flow and another that optimizes the electricity use of EV charging infrastructure in the same city. These cannot simply be added together, as the reference scenario of the EV charging infrastructure optimization solution must consider the reduction of traffic flow.

The recommended guidelines on value chain allocation, portfolio-level aggregation, and entity-level consolidation will help create an overview of a company's total AE. Depending on the use case, it is helpful to align with the financial analysis of the solutions or reporting boundary of the organization. Please note that companies should communicate the percentage of sales associated with AE claims to make clear the share of AE solutions in the overall company portfolio.

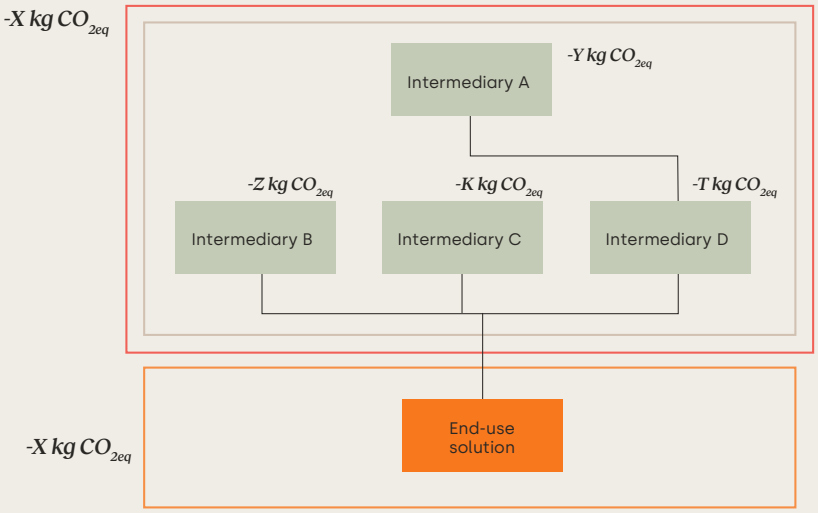
4.3.1. Value chain allocation

"Allocation" is when the total AE generated by intermediary solutions (which correspond to the AE of the end-use solution) are distributed across each intermediary solution contributing to the end-use solution. The total of the AE allocated to each intermediary solution cannot be greater than the AE of the end-use solution (see Figure 14 below: $Z+K+T+Y \leq X$).

As discussed, AE assessments are hypothetical and inherently carry a high level of uncertainty. The use of allocation may increase this uncertainty. However, if the same AE are accounted for multiple times by different stakeholders, this could lead to inconsistencies and risk greenwashing. The purpose of allocation in the AE context is to ensure that the total AE reflects the collective value chain effort to show contributions from multiple components.

To account for the additional uncertainty introduced by any allocation method, unallocated data should be reported, the allocation approach should be communicated transparently along with any AE claim, it should be aligned between relevant stakeholders, and based on robust and relevant data. Allocation may provide supplementary insights for stakeholders. Therefore, as an optional disclosure that is identifiable as allocated AE, AE may be calculated using the allocation approach specified in this section. This optional disclosure enables organizations to develop expertise with allocation methodologies while enhancing transparency for key stakeholders (e.g., corporate decision-makers, investors, financial planners).

Figure 16: Allocation of AE across intermediary solutions that contribute to an end-use solution



Before applying allocation, companies should follow these practices to maintain accuracy and integrity:

- → **System boundary definition**: Establish clear boundaries for AE calculations, specifying the inclusion of the solution's entire life cycle and capturing all relevant emissions sources and reductions.
- → **Transparency**: Provide a detailed system boundary diagram and clarify the solution's contribution to, or relationship with, the total AE in the end-use solution. This should include all relevant components, to prevent double counting and enhance credibility.
- → **Collaboration with component providers**: Engage with other value chain actors and funders to align on claims, ensure traceability and standardize monitoring methods for transparent and coordinated AE accounting. When performing allocation, it is generally good practice to harmonize allocation approaches with other actors across the value chain.

Where industry or sector guidelines on the value chain allocation of AE are being developed in the future, we recommend contributing to them. This enables convergence within sectors and alignment with best practices.

Where these guidelines do not exist, apply the following allocation hierarchy to prioritize accuracy and avoid cherry-picking.

1. **Exact contribution**: If it is possible to quantify the exact contribution of an intermediary, the company should use this value. For example, if a fleet management system uses Internet of Things-based traffic routing to optimize vehicle paths, and data shows that this reduces total fleet mileage by 5% over a sustained period under consistent operating conditions, the provider of the routing solution can claim that specific share of AE. (There are various ways to calculate attribution, such as smart devices in industry or machinery).

   This approach also applies when an intermediary can justify why 100% of the reduction is directly attributable to its solution. For example, a software provider develops and operates an energy management system that automatically shuts off idle industrial equipment when not in use. Before the system's deployment, the equipment ran continuously, consuming significant electricity. After implementation, monitoring shows that all reductions in electricity use are directly attributable to the software's control (with no other changes to operations or equipment).
2. **Other relationships**: In cases where other relationships (e.g., economic relationships) can justify a proportional allocation of AE, the company should use these. For example, if the cost or value of a component is proportionally significant to the overall end-use solution, this relationship can help guide the split of emissions. Other approaches may include: i) induced emissions; ii) weight; iii) other physical parameters.
3. **Equal split**: If the number of intermediaries contributing to the end-use solution is known, the AE should be equally split across the intermediaries unless more accurate data is available.

The "exact contribution" approach is the only method that can provide a potentially accurate allocation, although it tends to be challenging to implement. Any other approach will lead to arbitrary choices and opportunities for "cherry-picking" – but these other approaches can be considered helpful insofar as they help companies who are new to allocation to learn and develop towards the exact contribution approach.

4.3.2. Company-level aggregation

The aggregation of AE across intermediary and end-use solutions can be challenging at the company level. Five archetype conditions for aggregation could occur. Each comes with specific rules to enhance transparent accounting and prevent double counting:

1. **Different end-use solutions with distinct AE: sum up**
   Aggregating end-use solutions with distinct AE to a total is only permissible based on Section 4.8.
2. **Distinct markets sell the same end-use solution: sum up under condition**
   The aggregation of AE of the end-use solution for distinct markets can take place following the calculation of the AE with a consistent assessment in line with the Guidance. For example, extrapolating the end-use solutions sold in different markets to another market is not possible.
3. **Intermediary and end-use solutions addressing the same AE: do not sum up**
   Avoid aggregating intermediary solutions with end-use solutions that address the same AE. This prevents double counting and an overstatement of total AE.
4. **Multiple intermediary solutions: sum up under condition**
   Depending on the use case, it is possible to aggregate an intermediary solution's AE. Follow best practices on necessary conditions and be transparent about other relevant intermediaries to prevent double counting, especially if an intermediary solution contributes to multiple end-use solutions.
5. **Solutions that already exist and solutions under development: do not sum up**
   Although existing solutions and solutions under development may address different AE, the high uncertainty over whether the latter will be sold in the market means these different types of solutions should not be aggregated. This will allow for transparency over time.

Example: Aggregating across solutions

Company A has two different business units (BU) that produce different AE solutions for different markets in year X:

→ BU 1: EV battery (intermediary solution) sold to EV customers and used by BU 2.

→ BU 2: EV (end-use solution) sold in Germany, France and Japan.

In line with the example in section 2.4, no allocation is applied between the EV battery and the EV.

Aggregated AE for Company A in year X:

BU 1 Total AE

EV battery sold to EV customers – sum up the AE from the end-use solutions in which the EV battery is used by EV customers in the same market (archetype 2).

EV used by BU 2 – do not sum up the AE from the intermediary and end-use solutions, since they contribute to the same AE and no allocation was applied between them (archetype 3).

BU 2 Total AE

EV sold to EV customers – sum up AE of EVs sold in the different countries under the condition that they are based on distinct AE of EVs sold in each market (archetype 2).

Table 16: Illustrative numerical example of aggregated AE

Business unit	*Solution*	*Market*	*avoided emissions (tons of CO_2eq.)*	*Aggregated avoided emissions (tons of CO_2eq.)*	*Note*
BU 1	EV battery	EV customer 1 market 1	200.000		
BU 1	EV battery	EV customer 2 market 1	300.000		
BU 1	*EV battery*	*Market 1*		*500.000*	
BU 1	EV battery	EV customer 3 market 2	100.000		
BU 1	*EV battery*	*Market 2*		*100.000*	
BU 1	EV battery	BU 2 EVs	200.000	*0*	Not included in aggregation
BU 1	***EV battery***	***Sub-total***		***600.000***	***Distinct AE for distinct markets so can be summed***
BU 2	EV	EV customers Germany	400.000		
BU 2	EV	EV customers France	500.000		
BU 2	EV	EV customers Japan	100.000		
BU 2	***EV***	***Sub-total***		***1.000.000***	***Distinct AE for distinct markets so can be summed***

4.3.3. Entity-level consolidation

After aggregating solutions at company level, companies can take the step to consolidate the AE across different entities e.g. parent company and subsidiaries. Companies should follow methodological approaches from existing standards, such as the GHG Protocol and Partnership for Carbon Accounting Financials (PCAF), when consolidating AE.[18] In general, the principle is to follow financial statement consolidation to the extent possible. Note that these standards serve different audiences (corporates and financials) and address different aspects of consolidation. Existing concepts from these standards can be used as a basis for consolidation of AE solutions across company and financial portfolios – for example, operational boundary and organizational boundary to aggregate GHG emissions at entity level from the GHG Protocol, and attribution of emissions depending on the asset class from PCAF.

Communicating and *reporting avoided emissions*

05.

05. Communicating and *reporting avoided emissions*

It is important to standardize the reporting of AE claims. Doing so will improve comparability and consistency, and minimize the risk of misstatement. Companies calculating AE in line with this Guidance should report and communicate AE in accordance with the principles set out in this section.

5.1. Guidelines for external reporting

The guiding principle for AE reporting is transparency. Transparent reporting will stimulate learning, enable continuous improvement and refine best practices.

To achieve this, companies reporting on AE must comply with the following requirements:

1. **AE should always be reported separately** from:
   - GHG inventory footprints.
   - Carbon sinks.
   - Financial contributions to transition (like offsets or carbon credits) outside of the organizational boundary.
2. **AE should not be used to claim a company's or solution's carbon neutrality,** Net Zero emissions or any other claims implying a company's or solution's overall absence of impact or positive impact on the climate.
3. **Companies should provide key information** when communicating and reporting at a solution level, namely:
   a. A description and definition of the scope, including the system boundary.
   b. The selected approach for the timeframe identification.
   c. The life cycle GHG emissions of the solution(s) and reference scenario(s) on which the AE are based.
4. **Companies should specify whether they used the FW-looking or YoY approach** to quantify AE. In the case of FW-looking, they must transparently communicate that this goes beyond one year and the timeframe of the assessment.
5. **Companies should communicate a quantitative estimate or qualitative description of the uncertainty** of the results. This includes listing key assumptions and limitations associated with the calculations, including for the reference scenarios, and providing sources for the underlying data.
6. **Any reported and communicated AE must comply with the three eligibility criteria gates.** Companies who make AE claims externally must provide evidence of compliance with each gate.
7. **Companies must specify the percentage of total revenue the AE solutions represent** when AE are communicated externally.
8. **Companies should list all other known key components or the link between intermediary and end-use solutions** that are essential to realizing the AE.
9. **Companies should state if their AE impact has been reviewed by a third party** or not.
10. **Companies should publicly communicate any identified negative side effects of the solution(s)** in terms of environmental trade- offs and sustainability goals beyond GHG impact. The company must provide a description of the actions undertaken to mitigate these effects.
11. **Companies should state whether they have identified potential rebound effects** and if they have been included in the assessment or not. If these effects have been identified, companies must describe their nature and the actions undertaken to mitigate them.
12. **Companies should report on the context of recalculation** where there have been significant changes, and on the chosen policy for recalculation. Reporting on original and recalculated figures supports transparency.
13. **In their sustainability report, companies should report on AE in a separate section** from their GHG inventory emissions. In the case of a FW-looking assessment, the cumulative AE should be supported by an annual breakdown.

5.1.1. Additional considerations for reporting

Beyond the reporting guidelines above, companies should internally track (and are encouraged to communicate) the following calculation details:

1. The rationale behind the chosen reference scenario(s) (e.g., most likely alternative solution, new/existing demand, improvement/ replacement, led by legislation).
2. Their use of attributional and consequential approaches.
3. Sources and key hypotheses used to define and calculate the life cycle GHG emissions of the reference scenario and solution, including the FU, lifespan and boundary.

4. A qualitative and quantitative assessment of the data quality (see Section 4.5).
5. If applied, the range of AE results based on the outcomes of uncertainty and sensitivity analyses.
6. Any potential materiality threshold used in the calculation process.

5.1.2. Updates to reporting

When reporting on AE, especially using the YoY approach, companies should consider updates following certain conditions. This is in addition to recalculation of AE on an annual basis (best practice) or based on the availability of more specific or updated data and assumptions (see Section 4.5 and Section 4.6.2).

The conditions to update reporting include structural changes in the reporting organization, changes to calculation methodologies and changes in the activities in the GHG inventory underlying the solution. In general, companies should recalculate in line with company policy or when a significance threshold of 10% or more is triggered.

Where significant changes happen in the middle of the year, companies should recalculate the solution and reference AE for the entire year instead of only part of the year. The recalculation is different for the two approaches:

→ FW-looking: recalculation of all years back to the lifetime base year.

→ YoY: recalculation of AE for the year prior to the change.

In all cases, companies should report on significant changes compared to the previous reporting period.

For independent review purposes and in line with the GHG Protocol, companies should define an AE recalculation policy and have quality procedures in place.

5.1.3. Third-party review

To enhance the credibility and transparency of claims, we recommend conducting a third-party review of AE assessments, especially in the case of external reporting. This should follow the ISO 14071[19] standard as it describes the key aspects of a critical review process and reviewer competencies. These include:

→ Scope of the review.

→ Reviewer qualifications (selecting reviewer, reviewer agreement, replacing reviewer).

→ Process of the review (general process, type of review).

→ Validity of critical review statement and report.

→ Review report.

→ Revision of an existing review e.g. in case of recalculation.

→ Template for review report, reviewer independence and competencies.

The below indicates recommended content for review alongside the process. Depending on the level of third-party review, this content will need to undergo more detailed evaluation by the reviewer.

Recommended content to be critically reviewed:

→ Purpose of AE assessment.

→ Proof for eligibility assessment (three gates), including negative side effects and potential rebound effects.

→ Definition of the system boundary, including FU.

→ Explanation of AE assessment approach: FW-looking or YoY, attributional or consequential life cycle accounting.

→ Definition of and rationale for reference scenario.

→ Main assumptions used for the AE assessment, e.g. lifetime, emission factors.

→ Data quality assessment, including DQR, data collection and data validation process.

→ Sensitivity analysis results.

→ Uncertainty analysis results.

→ Range of AE results based on the outcomes of the sensitivity and uncertainty analyses.

→ Draft text for external reporting and KPIs that will be reported in line with Guidance template.

→ Calculations and calculation model.

→ Materiality threshold used for calculations.

→ Explanation of aggregation principle followed (if applied).

→ Rationale for allocation approach (if applied).

5.2. Communicating AE

Below is a suggestion for how companies could communicate AE in line with the above guidelines. Please refer to the WBCSD Avoided Emissions Implementation Hub[20] for the full technical template that can serve as a basis for reporting.

Figure 16: Recommended communications template for AE reporting

Description of the solution The solution and reference scenario and life cycle GHG emissions (when communicating at a solution level): The context and overview of the solutions in scope and definition of reference scenario (when communicating at an entity level): Consider aspects like context, contribution to change, total system description, stakeholders, region/market, time period, greenfield/brownfield, solution implementation and actions for systems engagement to ensure the solution is implemented.	**Core principles** ☐ We comply with the three eligibility gates ☐ We report AE separately from our GHG inventory and do not net or compensate AE and inventory emissions ☐ We don't claim climate neutrality through the use of AE ☐ We assessed the potential negative side effects of our solution(s) in terms of environmental trade-offs and sustainability goals beyond GHG impact ☐ We assessed and shared the potential rebound effects of our solution(s)
AE assessment The function and FU of the solution: Solution system boundaries: Approach: ☐ Year-on-year (20XX) ☐ Forward-looking (20XX – 20XX) CO_2 eq. avoided (split by solution type in different markets) → Absolute CO_2 eq. avoided (metric tons): → Intensity-based CO_2 eq. avoided / FU (e.g. MJ, km, tons of production): → Intensity-based CO_2 eq. avoided / net revenue Total lifecycle CO_2 eq. breakdown by solution and reference scenario: % of AE linked to end-use or intermediary solutions: % of revenue from solution / total net revenue (at the entity or BU level only): Carbon credits claimed for solution (if applicable):	**Methodology & data** Data quality score: OR Qualitative description of data quality hierarchy: Key assumptions and limitations of the solution and reference scenario: Description of potential negative side effects and rebound effects, and description of actions to mitigate these: Baseline recalculation and explanation (as applicable): Solution's effect on Scope 3 downstream categories:
Eligibility Assessment Gate 1 (Climate Action Credibility): Gate 2 (Climate Science Alignment): Gate 3 (Contribution Legitimacy):	Our approach to defining and calculating AE has been independently verified: ☐ Yes ☐ No

Tracing and monitoring *avoided emissions*

06.

06. Tracing and monitoring *avoided emissions*

Traceability and monitoring of AE over time is crucial for reporting and validating AE claims. There are various tools and technologies that can support AE assessments in this way, especially across the value chain and in the use phase.

6.1. Why does traceability and monitoring matter?

Traceability and monitoring improves accuracy and credibility in assessments, provides information on the effectiveness of climate action strategies and enables collaboration among value chain actors.

Traceability refers to the ability to identify, trace, and measure attributes, distribution, location and application of products, parts and materials. Doing so helps to ensure the reliability of sustainability information.[21] In light of this guidance, this means tracing the connection between the provider and user of the climate solution and the realized GHG emissions.

Monitoring refers to the systematic and periodic analysis especially of data but also methodological aspects used in an AE assessment.

Some incentives to invest in traceability include:

- → **Financial opportunities:** companies who lead the way in sustainability and decarbonization with credibility can access more financing opportunities, especially in the context of increasing scrutiny.
- → **Regulatory compliance:** monitoring key performance indicators related to AE reporting can enhance third-party reviews or increase the efficiency of auditing, which are required to meet certain regulations.
- → **Consumer engagement:** encourage and enable impact- and data-driven got-to-market strategies and sustainable procurement/ consumption choices

The relevance of traceability and monitoring in AE assessments

Traceability and monitoring relate to specific methodological aspects outlined in the Guidance, namely:

- → FW-looking and YoY approaches: Traceability and monitoring can help validate or improve key parameters, assumptions and data. Examples include product use, energy consumption, lifespan, maintenance needs, rebound effects, consumer behavior, emission factors and LCI datasets. Where significant variations occur compared to the initial data used, the AE should be recalculated.
- → Validation of a solution's actual or realized impact: Continuous monitoring will help measure and validate actual use and prove the direct cause-effect relationship between the solution's introduction, uptake, and usage, and its realized AE.
- → Gauging impact-oriented decision-making: Capturing and managing data from the use phase of climate solutions can improve data quality at this stage of the assessment. Monitoring the use phase is essential given that consumer behavior and potential rebound effects can significantly affect the impact of climate solutions. Climate impact can only be strategically optimized when interdependencies between value chain interventions and use phase implications are clear.

6.2. Tools for traceability and monitoring

Companies face practical and regulatory challenges when implementing traceability and monitoring. They must choose the right technologies to track different metrics, and align with different actors related to a solution's value chain.

Examples of technologies that can enhance traceability and monitoring

Data collection/sensing

- → Satellite technologies and drones can provide constant monitoring in agro-environmental or infrastructure value chains to collect granular data on land use.
- → Smart devices – such as sensors – can provide real-time and specific tracking. For example, the ECOFACT platform (ECO-innovative Energy FACTory Management System) uses sensors to gather data in a factory to monitor energy-related KPIs in real-time.
- → Sustainability certification schemes can certify operators against sustainability standards and can collect on-the-ground data in auditing cycles.
- → Consumer surveys and market research groups can support in substantiating a solution's AE impact (cf. Gate 3), validating assumptions, and leveraging climate action in consumer engagement.

Data management and processing

- → AI-based data analysis platforms can process large volumes of real-time information to generate key indicators on emissions and solution performance.
- → Life Cycle Assessment software can evaluate environmental impacts across various parts of the value chain.

Data sharing with upstream and downstream actors

- → Industry associations as well as multi-client studies can provide data for a specific solution type or for parts of the value chain with data gaps or low data quality.
- → Internet of Things devices can collect data for use by multiple value chain actors. These devices use blockchain technology for secure and traceable record keeping, which supports the verification of the data. For example, the Digital Product Passport (DPP) initiative enables sharing of key product information among various value chain actors (industrial, consumer, R&D and financial).
- → Collaborative platforms where stakeholders share real-time data on product performance and end-use in federated/ decentralized data governance models
- → New business models which nudge and financially incentivize downstream actors to share data with upstream manufacturers.

Some examples of good practices in traceability and monitoring:

- → Promoting industry-wide collaboration and value chain data exchange to ensure common practice and harmonization of solutions' climate-related data and assumptions that are used in AE assessments.
- → Documentation and detailed referencing of data sources, data processing steps, calculations and results so that the assessment is transparent and reproducible by other practitioners.
- → Active support (in the form of resources and commitment) from senior management of solution provider companies and companies in the value chain, to ensure this topic is prioritized.
- → Where it is not possible to obtain (live) data from the supply chain, lab-based tests can be used as proxy input data if they are representative of industrial level processes.
- → Where it is not possible to obtain primary data from the use phase, consumer data collection mechanisms can be used, such as surveys and market research groups. Internet of Things or smart technologies can also track the emissions of certain appliances.
- → Where value chain actors produce data, companies may allow access to raw, unprocessed data alongside the processed data so that other actors can clearly interpret or incorporate the data in their calculations.

Traceability of primary use phase data may be a major challenge for solution providers whose solutions can be used in multiple end-use applications with a variety of use patterns. In some situations, the use stage also depends on human behavior, which is complex to capture reliably, especially over the lifetime of a product and in reference scenario modelling.

Even if use phase and end of life data generated by downstream actors is available, there is often no incentive to share this consistently with a wide array of potentially relevant upstream actors. There is therefore a significant opportunity for two-way data flow between relevant value chain actors.

Leveraging *avoided emissions*

07.

07. Leveraging *avoided emissions*

Companies, investors and policymakers each have an important role to play in leveraging AE. With the right focus and action, these actors can support each other and society in the path towards a 1.5°C future.

How companies can leverage AE

AE can demonstrate how a company's solutions are contributing to decarbonization and therefore highlight growth opportunities linked to climate action. AE can also be used as a powerful tool to innovate and scale solutions, especially in markets where they have highest decarbonizing potential.

There are three main ways to leverage AE:

- → **Innovate and scale up:** Transform business models to deliver innovative climate change solutions and scale up solutions.
- → **Mobilize resources:** Identify profitable opportunities aligned with Net Zero goals and access capital from financial actors using these metrics to inform their investment decisions.
- → **Engage with systems actors:** Report AE to demonstrate climate-aligned values to investors, customers and employees, which can drive collaborative efforts towards Net Zero goals.

Different teams benefit from the concept of AE in different ways:

- → R&D can use AE insights in stage-gate processes and product development decisions.
- → Procurement can use AE as a metric to select lower-emission suppliers and solutions, and capture system-change opportunities in sourcing decisions.
- → Finance and Investor Relations can use a new solution's AE to raise capital through sustainability-linked loans, green bonds, in consolidated entity-level finance strategy.
- → Marketing and Communications teams can incorporate AE in the company narrative to showcase the sustainability benefits of its products and services.

How investors can leverage AE

AE gives investors and financial actors a way to move beyond looking only GHG emissions and associated *risks* – and quantify instead the Net Zero aligned *opportunities* of current and future investment decisions.

The role of financial institutions in decarbonizing the economy is essential to achieving Net Zero goals. Financial institutions can leverage AE as part of this by:

- → **Measuring private actors' contributions to decarbonization.** A new, forward-looking metric like AE can help meaningfully evaluate an investment's contribution to Net Zero targets and pathways.
- → **Integrating AE into the investment process.** Investors can use AE in the screening and due diligence phase to identify an investee's decarbonizing potential, assess their commitment to Net Zero and anticipate regulatory or business risks related to climate.
- → **Using AE to steer engagement and stewardship.** An AE metric can start a conversation and help financial actors guide companies towards decarbonization and scaling up climate solutions.

We work with financial institutions to consolidate and develop guidance on how to strengthen the ties between real economy and finance actors in intervention-based impact assessment:

- → Avoided Emissions & Sustainable Finance, 2024
- → Avoided Emissions & Climate investing, 2025

How policymakers can leverage AE

AE offer a powerful tool to guide governmental action towards accelerating decarbonization efforts. In particular, AE offer a system perspective of a solution's impact that can support understanding of resource efficiency.

Governing bodies can leverage AE assessments at two complementary levels:

- → **Robust national planning** could usefully involve using metrics – such as AE – that complement those focused on GHG emissions reductions. National planning is an opportunity for countries to take a strategic look at their investments and policy environment and scale projects that unlock private finance. AE can help identify the most relevant decarbonizing solutions in a given area, or which areas to prioritize for selected decarbonizing solutions.
- → **Policy mechanisms** could be supported by AE, to speed up decarbonization efforts from companies and through innovation. AE-based incentivization mechanisms and regulations could be made dynamic – for example, by being based on evolving market averages or identified best-in-class actors. Examples of applications of AE in public procurement or funding programs can be found in Europe (Innovation Fund), China, Japan, and the US.

This Guidance can serve as a reference to inform actions by public authorities and align them with best practice. We hope this lays the foundations for additional work to support governing bodies in accelerating decarbonization efforts.

Implementing *the guidance*

08.

08. Implementing the *guidance*

We have created a set of resources to guide companies, investors and policymakers in putting this Guidance into practice. These resources can help you understand how to assess the emissions mitigation impact of real economy solutions. They are available on the Avoided Emissions Implementation Hub and outlined below.

Technical template

We developed this tool to summarize the key elements needed to calculate and communicate AE assessments in line with the Guidance. The template provides a high level of technical granularity, to support companies in assess and disclosing AE in a way that is transparent, consistent and robust.

Use case repository

The repository contains examples from WBCSD member companies who have put this Guidance into practice. Our aim is to establish best practice learnings from different sectors and encourage harmonization. To build the repository, WBCSD member companies submitted their use cases for evaluation by WBCSD experts. A review process was established to ensure that well defined, good practice use cases are first fully documented using the technical template. These are then, for publication, captured in the one pager format which is more concise and comprehensive for a wider audience. Most of the assessments published in the repository have not yet undergone third-party verification and are published as learning assets to help establish best practices and contribute to future harmonization efforts.

In addition, to capture the transformative nature of AE, we worked with WBCSD member companies to develop use case design principles. While these are not binding, they helped in prioritizing solutions for AE assessment and establish the current state of corporate low-carbon solutions:

- → The environmental and social impact of solutions and final applications should comply with "do-no-significant harm" rules.
- → Solutions should clearly differentiate from business-as-usual and established technologies.
- → Companies should provide a change story that describes the systemic benefit of each solution.
- → Relevant stakeholders should be mapped and a plan for system-wide engagement should be drafted.
- → Solutions should be applied in markets where they have the highest decarbonizing potential.

Sector-specific guidance

To complement the cross-sectoral methodology we are developing AE guidance for specific sectors, starting with Agriculture & Food and Built Environment. Our aim is to take a structured approach to AE implementation which goes beyond individual company cases to:

- → Mobilize industry clusters to implement and scale low-carbon solutions.
- → Provide actionable guidance on the application of AE in corporate decision making.
- → Build evidence to standardize intervention-based GHG accounting globally and harmonize solution-specific assessments.

Each of the sectoral guidance documents provide additional detail tailored to sectoral contexts, offering solution-specific methodologies to support consistent, transparent, and credible avoided emissions assessments. The documents can be accessed via our **AE Implementation Hub** and contain two sections:

Technical methodology: this section focuses on assessing solutions or solution groups within each sector to specify and harmonize how to quantify AE, covering aspects such as reference scenario selection, system boundaries, cut-off criteria, data sources and sector-specific challenges (e.g., seasonal, climatic). These use cases illustrate how the principles of avoided emissions assessment set up in this Guidance can be applied across real-world solutions in a consistent and replicable manner.

Agriculture & Food Use Cases:

1. Feed additive for livestock: Reducing GHG emissions from dairy cows
2. Crop input innovations: Use of bio-stimulants to increase crop yield
3. Fertilizer use efficiency: Precision agriculture using variable rate technology (VRT)
4. Improved packaging systems: Reducing food loss and waste at retail
5. Diet shifts to plant-based products: Plant-based cream cheese

Built Environment Use Cases:

1. Thermal glazing: Triple-glazed windows
2. Mechanical ventilation with heat recovery (MVHR)
3. Concrete floor-slab design: (a) Material reduction and (b) use of low-carbon concrete
4. Advanced building management systems
5. Solar PV and battery storage in hybrid systems
6. Use of recycled concrete

Managerial section: for use as a playbook on how to leverage AE in corporate decision making, It addresses use in R&D prioritization, investor communications, marketing, and financial planning—helping companies align innovation strategies with decarbonization goals and broader environmental commitments

These sectoral documents are intended for use by practitioners, sustainability teams, R&D professionals, and business decision-makers across the value chain. They provide actionable insights to improve the robustness of avoided emissions claims, promote internal alignment, and support transparent external communication.

Limitations and *areas for future work*

09.

09. Limitations

It is important to acknowledge the limitations of the technical aspects of conducting AE assessments outlined in this Guidance. Many of these limitations exist because the field is still developing - and serve as inspiration for companies to inform future improvements by testing the Guidance and sharing their experiences.

Lack of harmonized reference scenarios and data

This Guidance provides a step-by-step approach to the calculation of AE and the definition of the reference scenario. However, it is not possible to provide precise references and reference scenarios companies should follow for each case. Assessments are therefore likely to have varying levels of data quality and rely heavily on assumptions and hypotheses.

To address these data availability challenges, it is important to align AE data across sectors or regions and to develop AE factors databases with standardized data points for key parameters and scenarios. Efforts in this area are essential to streamline assessments.

These efforts will reduce volatility in results over time and across different regions. They can also help make modelling choices, interpretation and accountability decisions more consistent. This will lead to better comparability between similar solutions, making the metric more useful for decision making. Ongoing developments in this area will benefit from further testing and validation with different types of solutions, to bring harmonization one step closer.

Challenges with traceability and monitoring schemes

Tracing and monitoring data makes AE assessments more accurate and credible – especially in regard to the use phase and the solution's actual impact. It can also help companies access more financial opportunities and streamlining efforts to comply with regulation. Despite these benefits, companies have yet to overcome the practical challenges of establishing traceability and monitoring schemes. We therefore encourage companies to adopt traceability and impact monitoring and have provided an overview of tools and resources to help.

No quantitative criteria for eligibility Gates 2 and 3

The Gate 2 (latest climate science alignment) and Gate 3 (contribution legitimacy) requirements call for qualitative analyses and evidence to prove a company's eligibility for AE assessment. We have not set quantitative thresholds for eligibility because they may not be relevant to the wide range of solutions the Guidance addresses. Quantitative thresholds could be more usefully defined at a sector or industry level, and we encourage initiatives to establish these.

No specific guidance on uncertainty analysis for AE

The guidelines for external reporting (Section 5.1) require that companies report on the uncertainty of their AE calculations based on quantitative or qualitative estimates. The Guidance does not provide instructions on carrying out the uncertainty analysis, but invites companies to list any key limitations and assumptions related to their calculations. We have flagged the inherent uncertainty of AE calculations throughout the Guidance, and outlined ways to minimize uncertainty around system boundaries, contribution legitimacy, allocation and data quality.

No conceptualization of added emissions

Given that AE assess the benefit of a solution compared to a reference scenario, it could be possible to symmetrically define the "added emissions", i.e., the negative impact of a solution compared to a reference scenario. Calculating added emissions could highlight situations where solutions increase emissions or maintain a carbon-intensive situation – for example, when a car manufacturer sells a car to customers who would have otherwise continued using public transport.

This Guidance does not include the concept of added emissions and focuses only on AE. To prevent greenwashing, companies must always communicate the percentage of their sales that have generated AE. This makes clear the percentage of sales that have not generated AE or for which AE were not repored, including sales that generated added emissions. That said, this does not reflect the numerical relationship between the amount of added and AE, as such emissions should not be distributed evenly over a company's portfolio. For this reason, we encourage companies to add wording around the sales KPI to ensure these nuances are reflected alongside the KPI.

Identifying impacts beyond AE

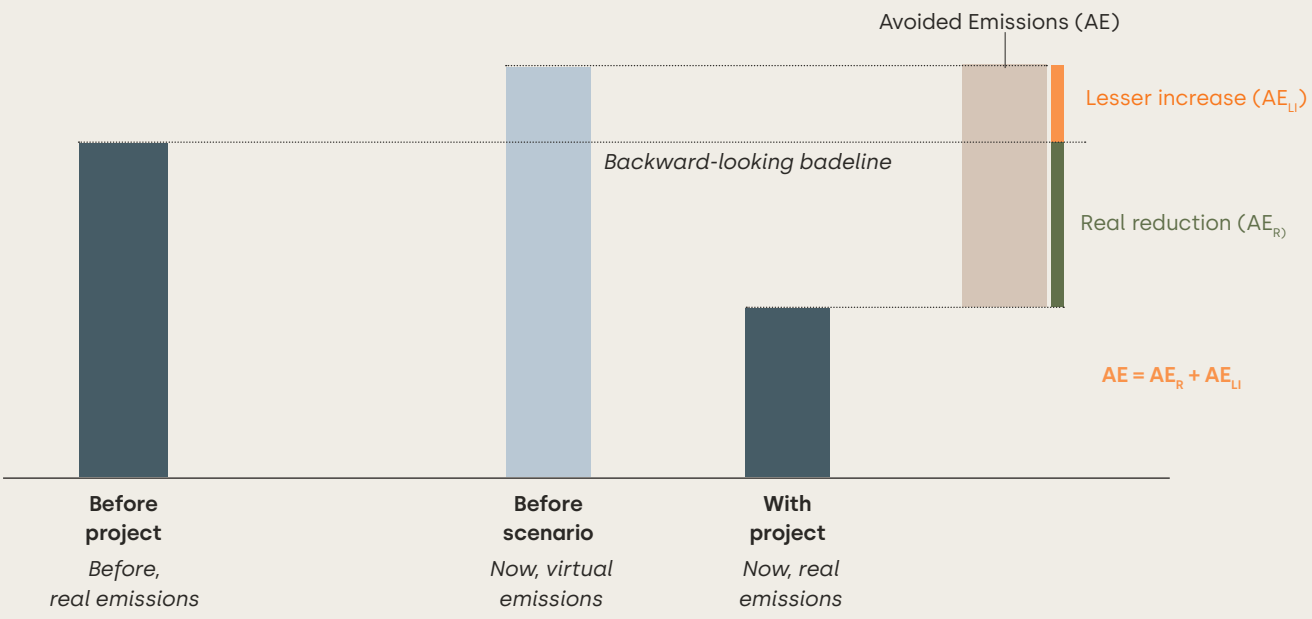
A solution may avoid emissions while also causing other effects – good or bad – such as added emissions, rebound or side effects, downstream impacts or systemic changes over time. Measuring these impacts is challenging because no robust guidance is currently available. Even so, companies should make efforts to assess consequences on a case-by-case basis, to ensure that a solution will not have any significant negative effects. Companies are required to report on these impacts and any corresponding mitigation plans, per the guidelines for external reporting (Section 5.1).

Distinguishing between real reductions of emissions and lesser increase of emissions

To calculate AE, the solution is compared to a reference scenario that would have occurred without the solution. This reference scenario is not the previous situation, but a hypothetical situation. AE are therefore not necessarily an actual emissions reduction compared to a previous situation.

However, from an atmospheric point of view, only actual, absolute GHG emissions reductions count. We recommend that companies state the percentage of the total amount of AE that are "avoided emissions reflecting a real reduction" (AER) compared to the previous situation, rather than a "avoided emissions reflecting a lesser increase" (AELI) over time.

Figure 17: AE can be made of "real reduction" (AER) or "lesser increase" (AELI)



FAQ

FAQ

Is this Guidance intended as a recommendation or a binding standard?

The Guidance is voluntary, sector-agnostic and globally applicable. It provides a standardized approach for assessing and disclosing AE in the absence of a global standard, though it does not itself constitute one. The main purpose of the Guidance is to guide companies in calculating and disclosing AE and support them in navigating the methodological challenges and complexities of AE calculations.

The Guidance includes requirements, recommendations and best practices to establish AE as a credible and robust metric in support of the Net Zero objective. To contribute to methodological convergence, we have structurally analyzed - and referred to as applicable - other intervention-based and impact accounting frameworks, as well as concurrent methodological advancements in the field of AE.

Why are managed phaseout (MPO) assets excluded, and on what basis are fossil fuel applications still considered?

The managed phaseout of high-emitting assets falls outside the scope of this Guidance, though we acknowledge its role in emissions reduction and global transition efforts.

We have instead prioritized innovative, scalable solutions that drive companies towards a 1.5°C future rather than merely mitigating climate risks. As part of this, we have emphasized the need to address the complexities of these solutions, including retirement dates, orderly transition scenarios, carbon lock-in risks, just transition considerations and viable pathways forward.

The Guidance excludes all types of solutions related to the exploration, extraction, mining and/or production, distribution and sales of fossil fuels. Fossil-derived efficiency solutions may be eligible if a company can provide robust evidence in alignment with the recommendations outlined in Section 3.2.2.

What's the rationale for aligning with 1.5°C pathways if they're no longer considered feasible?

At the time of writing this Guidance, debates over the feasibility of the 1.5°C limit have intensified as a result of climate data indicating that the average global temperature exceeded 1.5°C above its pre-industrial level in 2024 and potentially subsequent years. While this is a critical data point, it still only represents a single-year measurement and should not be confused with long-term climate trends, or used to justify abandoning climate targets. On the contrary, it highlights the urgency of accelerating climate mitigation efforts.

In this context, the 1.5°C aligned targets should not be seen as an absolute threshold but as a guiding reference for driving meaningful collective climate action. This Guidance therefore requires alignment with the 1.5°C pathway to prove climate action credibility.

What is the difference between offsets and AE?

There are many differences between carbon credits used for offsetting emissions and the AE of products and services:

- → Carbon credits do not always translate to a reduction or avoidance of GHG emissions. They can also indicate a removal of CO_2 from the atmosphere.
- → AE are rooted in a company's own climate action strategy and portfolio, whereas carbon credits and the underlying emission reduction activities are not necessarily related to a company's activities. Carbon credits therefore have less power to transform a company's business model and strengthen its role as a climate solution provider.
- → According to the definition of corporate "carbon neutrality" given by standards such as PAS 2060, carbon offsets can be used to claim, in certain conditions, a state of "carbon neutrality". AE, on the contrary, cannot be used to compensate or net out inventory emissions of solution providers, so they cannot be used to make a positive or Net Zero claim on company- or solution-level
- → In general, AE should be reported separately from any sold/tradeable offsetting credits to avoid double-counting. In practical applications, certificate schemes such as region-al credit systems or white certificates may be used to create tradeable certificates. In such cases, it should at least be clearly and transparently communicated what the share of sold/tradeable credits are that are related to any AE solution and claim, and what certification methodology has been followed.

What is the difference between corporate Net Zero (where AE are excluded) and contributions to global Net Zero (where AE are essential)?

The notion of corporate Net Zero is advocated by entities such as the Science Based Targets Initiative (SBTi) and Race to Zero. It is based on the idea that the definition of Net Zero at the global level (i.e., balancing emissions and removals) can be duplicated, as it is at the level of an organization. In this perspective, only two main indicators matter:

- → Corporate GHG emissions, which need to decrease following a 1.5°C pathway.

→ Carbon removals, either inside or outside the value chain, which need to match the residual corporate GHG emissions around 2050.

AE are therefore out of scope for corporate Net Zero (see Figure 21).

The notion of contributing to *global Net Zero* is advocated by the Net Zero Initiative, the UNFCCC "Climate Neutral Now" program, the French Environment Agency (ADEME), the Stockholm Environment Institute (SEI), Mission Innovation and others. It considers that the role of entities is to contribute to global Net Zero at the right level of ambition. In this broader perspective, organizations are just one part of a collective system aiming for Net Zero, rather than separate entities that need to reach Net Zero at their own scale. Four indicators qualify a company's contribution to global Net Zero:

1. Corporate GHG emissions, which need to decrease following a 1.5°C pathway.
2. Carbon removals, either inside or outside the value chain.
3. Contributing to the decarbonization of society through the financing of additional GHG reduction/avoidance projects outside the value chain, e.g., through the purchase of carbon credits.
4. Contributing to the decarbonization of society through offering solutions that avoid emissions, i.e., the decarbonization effect of solutions from the society point of view.

Each of the four indicators follows their own targets independently, and no netting is allowed between them.

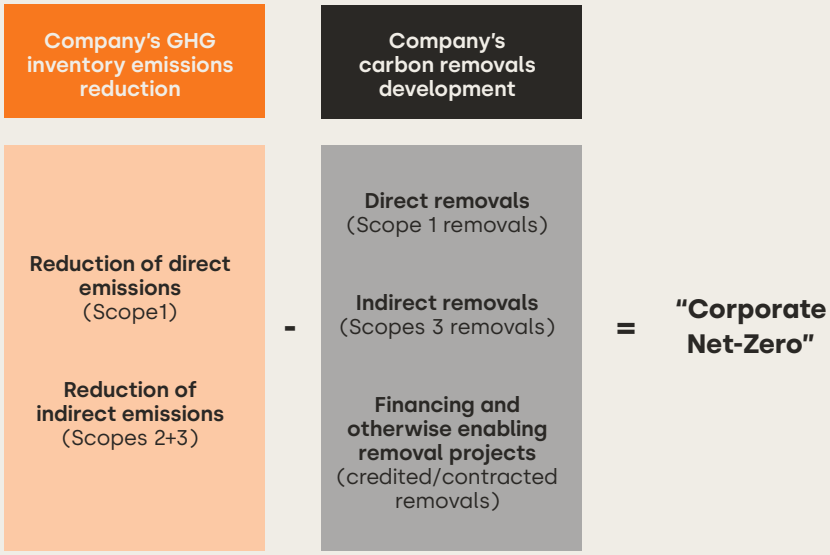
What is the difference between AE, Handprint and Scope 4?

Since the concept's inception, experts have attempted to describe "avoided emissions" using the terms "Handprint" or "Scope 4". We believe "Scope 4" to be misleading, as it places AE on the same level as companies' GHG inventory emissions and therefore implies forms of compensation or netting between AE and GHG inventories which this Guidance clearly advises against. While "Handprint" does create the necessary distinction, the concept has a more comprehensive scope including also non-climate impact categories. We strongly recommend the use of "avoided emissions" to ensure consistency and avoid any miscommunication.

Aren't AE just another greenwashing tool?

AE have long been used in a misleading way by some companies to divert attention from their GHG inventory emissions and focus only how their activities may have a positive impact on the planet. Some companies have even used AE to net their corporate GHG emissions and make abusive "Net Zero" or "carbon neutrality" claims on company or product levels.

Figure 18: High-level definition of corporate Net Zero



It has also been possible for companies to make dishonest assessments that maximize the volume of AE, either from the choice of an unrealistic reference scenarios or from deliberate 'cherry-picking' regarding the scope of assessment, timeframe or allocation.

Another common mistake has been assessing and reporting AE for products and services that either did not directly trigger a decarbonization impact or that were fundamentally incompatible with the 1.5°C global limit (even though they did allow for some decarbonization in specific instances).

Avoided emissions systems should be built on top of primary data, continuous validation and improvement of assumptions to monitor both the use-phase and end-of-life of companies' product or service. This requires more 'reflexive' data flows, i.e., from downstream towards upstream, that can inform corporate and investor climate strategies and increase resource efficiency across value chains. The harmonization of data structures and exchange protocols across value chains and organizations in line with privacy and data protection standards is needed to progress on this core pillar of effective, credible, and conservative use of avoided emissions in industry and finance.

When used correctly, AE are a valuable indicator of a company's contribution to the decarbonization of society.

Our intention with this Guidance has therefore been to:

→ Give clear rules on the eligibility, assessment and reporting of those AE to prevent any misuse of this indicator.

→ Highlight the importance of well-defined AE to assess a company's contribution to the decarbonization of its ecosystem in the context of contributing to global Net Zero.

Glossary

Added emissions	The additional GHG emissions when comparing the GHG impact of a solution to an alternative reference scenario in which the solution is not implemented.
Aggregation	Adding avoided emissions from various end-use and/or intermediary solutions within a company's portfolio into a single total.
Allocation	Partitioning the total avoided emissions of a solution across the different value chain actors involved in the solution.
Attributional approach	A method that estimates comparative GHG impacts as the difference in product GHG inventories (constructed using attributional LCA between the reference solution and assessed solution).
Avoided emissions (AE)	The estimated difference in full life cycle GHG emissions that result from a scenario with a solution in place, compared to a reference scenario without the solution when reference scenario emissions are higher (ISO 14064-1). This reduction occurs in other actors' direct emissions.
Avoided emissions reflecting a real reduction (AER)	The percentage of the total amount of avoided emissions that correspond to "real emissions reductions" compared to the previous situation.
Avoided emissions reflecting a lesser increase (AELI)	The percentage of the total amount of avoided emissions that correspond to a "lesser increase" of emissions over time.
Carbon reductions	Efforts to lower the amount of GHG emissions directly produced by a company (in their GHG inventory) compared to a previous measurement.
Carbon removals	The extraction of GHG emissions from the atmosphere.
Climate solutions	Activities, products or services that contribute to or enable climate mitigation to support decarbonization in line with credible 1.5˚C pathways towards Net Zero, or that contribute to climate adaptation. These solutions can be end-use or intermediary solutions, and must not extend the lifetime of fossil fuel-based assets or activities.
Component	A part (e.g. activity, material, process) of an intermediary or end-use solution. A component must have a clear and verifiable link to its intermediary or end-use solution through tracing and verification, demonstrating its role in enabling or contributing to avoided emissions.
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.
Consolidation	Adding the avoided emissions of solutions across multiple business units or company entities (e.g., subsidiaries) into a specific entity level (e.g., parent company).
Corporate Net Zero	Setting corporate Net Zero targets aligned with meeting societal climate goals means (1) achieving a scale of value chain emissions reductions consistent with the depth of abatement at the point of reaching global Net Zero in 1.5oC pathways and (2) neutralizing the impact of any residual emissions by permanently removing an equivalent volume of CO_2.
Direct emissions	GHG emissions from GHG sources owned or controlled by the organization (Scope 1).
Eligibility gates	The three criteria (climate action credibility, latest climate science alignment and contribution legitimacy) that companies should abide by to be able to claim avoided emissions in line with this Guidance.
Emissions reduction potential (ERP)	A methodology to quantify the forward-looking potential of a climate solution to reduce GHG emissions over a specified time horizon (that may or may not be equal to the useful life of the solution), compared to a baseline scenario.
End-use solution	A products or service consumed by the end-user in its current form, without further processing, transformation or inclusion in another solution.
Expected emissions reduction (EER)	A forward-looking umbrella metric used in climate finance to estimate potential emissions reduction of solutions or entities covering both fossil fuel and non-fossil fuel activities.

Forward-looking emissions assessment	An assessment approach to calculate avoided emissions for the solution's entire life cycle, thereby accounting for all future GHG emissions. It is intended for companies who assess and report the solution's emissions in the year of transaction, who do not precisely monitor the use of solutions sold, or who want to understand the long-term strategic implications of a given solution.
Functional unit (FU)	The quantification of the end-use solution's expected performance.
Global Net Zero	The condition in which anthropogenic GHG emissions are balanced by anthropogenic removals over a specified period and within specified boundaries. In this Guidance, we refer to Global Net Zero to describe the internationally agreed upon goal for mitigating global warming in the second half of the century. The IPCC concluded the need for Net Zero CO_2 by 2050 to remain consistent with a 1.5oC pathway.
Indirect emissions	GHG emissions resulting from the organization's activities but originating from GHG sources not owned or controlled by the organization (Scope 2 and 3).
Intermediary solution	An input into the production of other products or services that requires further processing, transformation or inclusion in another solution before use by the end-consumer. Products or services that enable other solutions are considered intermediary.
Intervention accounting	An accounting method that quantifies systemwide impacts of a specific action or intervention on GHG emissions and removals relative to a counterfactual reference scenario that represents the conditions most likely to occur in the absence of the action or intervention.
Inventory accounting	An accounting method for GHG emissions and removals over time within a defined inventory boundary relative to a historical base year.
Life cycle GHG emissions	The sum of greenhouse gas (GHG) emissions resulting from all stages of the life cycle of a product.
Products	Tangible goods consumed by an end consumer or used in the production of another good.
Rebound effect	The increased use of a solution as a consequence of its lower GHG emissions impact, which partly or fully cancels out the initial emissions savings intended by the solution.
Reference scenario	A reference case that represents the events or conditions most likely to occur in the absence of the assessed solution. In this Guidance, it is the scenario against which a solution is assessed to determine avoided emissions. "Reference scenario" may be used interchangeably with "Counterfactual" or "Baseline" scenario in other avoided emissions guidelines.
Services	Skills, time and efforts performed by people to satisfy a consumer need.
System boundary	Refers to the supply chain steps and related processes required to fulfill the functional unit.
Timeframe	The duration of specific period over which the avoided emissions are assessed. The start and end date that apply for the assessment should be specified.
Traceability	The ability to identify and trace the history, distribution, location and application of products, parts and materials, to ensure the reliability of sustainability claims.
Year-on-year (YoY) avoided emissions assessment	An assessment approach to calculate avoided emissions every year, i.e., at the end of the reporting year. It is intended for companies who assess and report the solution's emissions annually, companies who precisely monitor the use of solutions sold in a specific year, or for large decarbonizing projects with long lifespans. It allows for comparing changes in avoided emissions between two periods.

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Existing guidance on AE

This guidance was based on the WBCSD Guidance on Avoided Emissions (2023) and on the following key guidelines and frameworks:

- WRI (2019). **Estimating and reporting the comparative emissions impacts of products**.
- ILCA (2015). **Guidelines for Assessing the Contribution of Products to Avoided Greenhouse Gas Emissions**.
- Mission Innovation (2020). **The Avoided Emissions Framework (AEF)**.
- Carbone 4 (2022). **Net Zero Initiative – The Pillar B Guidance. Assessing and leveraging avoided emissions**.
- ISO (2019). ISO 14069 – Annex E on Avoided Emissions.
- ISO (2018) ISO 14067 - Greenhouse gases — Carbon footprint of products — Requirements and guidelines for quantification.
- Entreprises pour l'environnement (2017). **Émissions évitées. Les entreprises évaluent leurs solutions pour le climat.**
- WRI (2014). **GHG Protocol Policy and Action Standard.**
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- Exponential Roadmap Initiative (2022). **Framework for Natural Climate Solutions**
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- ENGIE, Saint-Gobain and SUEZ (2021). **Measuring The Contribution To Decarbonization Of Customers: The Need For Coherent Industry Standards.**

Additional sectoral guidance

- WBSCD and International Council of Chemical Associations (2013). **Addressing the avoided emissions challenge, Guidelines from the chemical industry for accounting for and reporting greenhouse gas (GHG) emissions avoided along the value chain based on comparative studies.**
- EIT Climate-KIC (2019). **Guidance on challenges to address for developing a methodology for contribution to GHGs mitigation in the recycling sector.**
- **A Methodology for Assessing the Environmental Effects Induced by ICT Services** – Part II: Multiple Services and Companies. In 7th International Conference on ICT for Sustainability (ICT4S2020), June 21–26, 2020, Bristol, United Kingdom. ACM, New York, NY, USA, 10 pages.
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- Project Frame (2024). Project Frame Methodology: Evaluating Greenhouse Gas Impact for Early-Stage Investments. Retrieved from: **https://static1.squarespace.com/static/60ad8a055e6bea2a5324c117/t/6786baa298a45a080d5af5df/1736882855764/2024+Project+Frame+Methodology.pdf.**

Endnotes

1 https://www.wbcsd.org/avoided-emissions-implementation-hub/

2 The recommended timeframe covers the most recent 12-month reporting period. If the inventory uses an earlier period, the company must provide assurance that there have been no significant changes to data, inventory boundaries, methods or other relevant factors since the calculation, in line with Section 5 of the GHG Protocol – A Corporate Accounting and Reporting standard.

3 The 1.5°C pathway describes the ambition of limiting the temperature rise at 1.5°C by reducing Scope 1 and 2 emissions, and limit it to well-below 2°C by reducing Scope 3 emissions

4 Covering a minimum of five years and a maximum of 10 years from the date of target publication

5 Examples include the United Nations Climate Change (UNFCCC) **Recognition and Accountability Framework**

6 See latest climate science definition above.

7 **Climate Change 2022**, Mitigation of Climate Change IPCC report

8 **EU Taxonomy** - Regulation (EU) 2020/852 of the European Parliament and of the Council of 18 June 2020 on the establishment of a framework to facilitate sustainable investment, and amending Regulation (EU) 2019/2088 (Text with EEA relevance)

9 Note that while transitional activities and direct fossil fuel applications may be included in this source, they are not covered by this Guidance and should be addressed separately from AE.

10 https://drawdown.org/solutions/table-of-solutions

11 Measurement system designed to assess the maturity level of a technology. Each technology project is evaluated according to the parameters defined for each technology level and is subsequently assigned a TRL rating based on its progress. There are nine TRLs, with TRL 1 representing the lowest level of maturity and TRL 9 the highest.

12 Peer reviewed journals, authoritative reports from trusted organizations like government agencies or international bodies, scientific literature, including published studies, research papers, or credible publications such as industry reports, academic articles, or white papers from recognized institutions.

13 https://ghgprotocol.org/corporate-standard; https://www.iso.org/standard/71206.html

14 https://www.wbcsd.org/resources/avoided-emissions-climate-investing-a-guide-for-investors-and-businesses/

15 Primary data are first-hand collected and therefore site-specific, company-specific or supply chain-specific. Secondary data are not first-hand collected but obtained from third-party databases or other external sources (see Table 7).

16 Since both solution and reference scenario will need to adapt the same FW-looking scenarios, this would effectively normalize any potential overstating.

17 Cf. Chapter 5 of GHG Protocol: A corporate accounting and reporting standard and Chapter 11 of the GHG Protocol for Project Accounting

18 Both the GHG Protocol and PCAF are refining their guidance on AE at the moment of publication of this Guidance. We aim to contribute to, build on, and harmonize the emerging landscape for AE standards in real economy and finance as closely as possible.

19 ISO 14071:2024, (Edition 1, 2024), Environmental management — Life cycle assessment — Critical review processes and reviewer competencies, https://www.iso.org/standard/86264.html

20 https://www.wbcsd.org/avoided-emissions-implementation-hub/

21 A Guide to Traceability: A Practical Approach to Advance Sustainability in Global Supply Chains (2014) United Nations Global Compact. https://unglobalcompact.org/library/791

Acknowledgements

This Guidance is the result of an iterative, consensus-based, multi-stakeholder process, incorporating feedback from an open consultation and several feedback rounds from sustainability leaders representing WBCSD member companies. We would like to thank all contributors, and particularly the member companies of the WBCSD Avoided Emissions program, for all the time and efforts they have put in the updates to the Guidance.

Independent Advisory Group

We would like to thank the members of the Independent Advisory Group that contributed to the update of this document:

- Atsushi Inaba – President, Japan Life Cycle Assessment Facilitation Centre
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- Michael Macrae - Director Scope 2 and Senior Advisor on Impact Accounting, WRI / GHG Protocol
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- Romain Poivet - Climate & Energy Engagement Lead, TC 207/ SC7/WG4 Convener - World Benchmarking Alliance, ISO
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The Independent Advisory Group provided feedback and expert input throughout the process of updating this document. Responsibility for the content lies with the authors. The recommendations and feedback expressed by the Independent Advisory Group members were considered as individual views and not as a reflection of the views of the respective organizations or employers.

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