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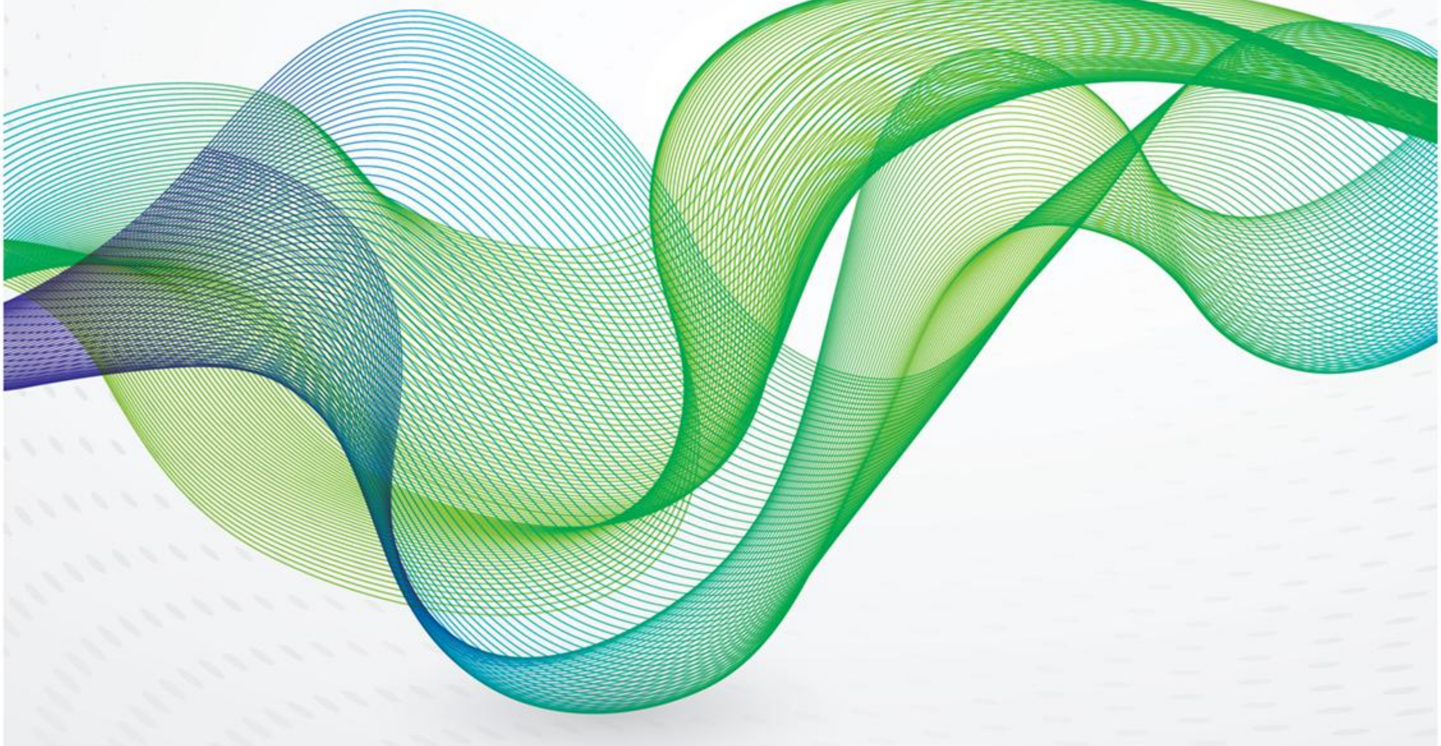
Avoided Emissions: Accounting for Carbon Beyond the Balance Sheet



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Executive summary

The scale of the challenge to reduce global emisisons is monumenal. Addressing it requires broad participation across society; equally important, those who contribute to a lower-carbon future should be enabled to communicate their contribution in a credible and transparent way.

To illustrate this challenge, imagine producing a more fuel-efficient vehicle, designing a higher-performance building insulation, or developing digital optimisation software, without any generally accepted way to communicate the associated fuel or energy saving caused by your initiative or technology. In such a context, the value of these improvements would remain largely invisible. A similar dilemma confronts carbon accounting, a fundamental and practical tool aimed at determining the emissions reduced globally.

While well-established frameworks exist to measure and report emissions reductions and removals, there is no widely accepted approach for quantifying or communicating the benefits of lower-carbon products and services whose impacts materialise elsewhere in the system. As a result, companies seeking to highlight their contributions may face allegations of greenwashing, not because the benefits are unreal but because there is no shared language or methodology to accurately capture them. Instead of encouraging broader participation for climate action and contributing towards a lower carbon future, the lack of sound methodological ways to recognise such benefits can discourage action and limit engagement.

In many cases, the entity that develops or supplies a lower-carbon product is not the one that ultimately uses it or captures the emissions benefit. Outdated approaches to carbon accounting struggle to reflect these complex market and commercial structures, often chilling potentially mitigation efforts due to different attribution and agency concerns.

This paper summarises the history of the concept of ‘avoided emissions’ (AE) and clarifies its role alongside – yet distinct from – inventory-based accounting, which has traditionally focused on summing emissions flows over a given time period. By articulating shared principles and robust approaches for quantifying, communicating, and interpreting avoided emissions, this work seeks to address these gaps and support more inclusive, credible and engaging participation regarding climate action and lower emissions globally, across sectors and geographies. Also, this is an open invitation for practitioners and researchers to think about how human, economic, environmental, and technological systems work all together and, as a result, can drive genuine transformations towards a more sustainable future.

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1. Introduction

Efforts to achieve net-zero emissions are relatively recent in corporate strategies, national policies, and global supply chains. As businesses, governments, and sectors set ambitious decarbonisation aspirations while facing mounting pressures on affordability, increasing energy demand, and broader geopolitical instability, the demand for transparency, credibility, and standardisation in carbon accounting has become more urgent than ever. Robust, reliable and durable measurement and reporting frameworks are essential for both tracking progress as well as informing investment, fostering innovation, and supporting strategic decision-making in the transition to low-carbon economies.

Decarbonisation, as the term suggests, is about reducing, removing, or avoiding carbon emissions that contribute to climate change. But the concept is bigger than that; it is an invitation to rethink how carbon is embedded in every activity we carry out, the services we rely on, and the products we consume. In the late 20th century, as scientific consensus grew around the impact of anthropogenic greenhouse gases (GHG) and their contributions to climate change, accounting became a key tool for setting reduction targets, informing climate policy, and supporting international agreements such as the Kyoto Protocol (1997) and the Paris Agreement (2015).

Sound, generally-accepted carbon accounting systems would ensure consistency and comparability across products, activities, firms, and systems, provide useful decision information, and help align incentives. The primary focus in carbon accounting to date has been on inventory accounting–how to sum emissions flows over a given time period. To truly drive the transition to a low-carbon, or even net-zero, future, another accounting approach is to develop standardised frameworks for quantifying **avoided emissions (AE). AE** represent GHG that are not emitted as a result of tangible infrastructure or physical assets (e.g., renewable power plants, carbon capture facilities, or electric vehicle fleets), or actions, decisions, or system changes (e.g., policy reforms, financial mechanisms, or digital optimisation) that replace or [permanently] prevent a higher-emitting alternative. Whereas inventory GHG accounting captures records of events that have already occurred, AE calculations often include forward projections or estimates.

AE help assess the climate relevance of corporate strategies and solutions, encouraging companies, investors, and regulators to drive system-wide changes that can yield not only emission-related benefits but also others such as economic, social, or environmental co-benefits. Two main approaches for calculating AE are i) assessing GHG and climate impacts using a consequential approach (capturing system-wide changes) or ii) an allocational approach (comparing life-cycle emissions to an equivalent alternative). Existing practices for estimating such impacts differ on key issues.

For instance, there is no generally-accepted framework for estimating and reporting comparative impacts. This limits companies' ability to assess their contributions to decarbonisation [1]. Therefore, standardised methods are needed to quantify AE and capture the mitigation potential of decisions [2] to i) allow contributors to quantify and communicate the benefits of their decisions; ii) incentivise decisions that lead to lower carbon outcomes; iii) identify and support innovation for technologies that enable responding to societal demands; and iv) increase accountability [3].

Unlocking the potential of carbon accounting as a strategic lever of innovation and fundamental pillar of climate leadership is at the core of AE. This study builds on a comprehensive literature review and expert interviews to explore the practical and real-world dimensions and potential of AE in the context of carbon accounting. While it does not provide an exhaustive analysis or methodological detail—available in the works of leading researchers and organisations cited herein—it seeks to contribute to the ongoing discussion on AE by delving into its practical implications for decision-makers and stakeholders. The aim is to support current efforts toward establishing a more coherent and enabling environment that aligns collective action and corporate innovation with global climate goals.

2. Understanding Avoided Emissions

2.1 Historical Context

The first efforts in carbon accounting can be traced back to the Kyoto Protocol (1997), which drew attention to GHG emissions at the national level. At that time, companies lacked standardised methods for measuring and reporting their emissions, and there were no mandatory regulatory systems for GHG reporting. In 1998, the World Resources Institute (WRI) and members of the World Business Council for Sustainable Development (WBCSD), a business-led sustainability trade association, launched what became the 'GHG Protocol'—a multi-stakeholder initiative to produce a framework for assessing a company's inventory of emissions in its value chain and coining the terms Scopes 1, 2 and 3 emissions. Over time, the GHG Protocol became foundational to other corporate climate frameworks such as the Carbon Disclosure Project (CDP), the Science Based Targets initiative (SBTi), and national climate-related financial disclosures, among others. Meanwhile, ISO standards such as 14064 and 14067 formalised quantification and verification methods for corporate and product emissions, and the CDP initiated widespread corporate emissions disclosure questionnaires to build comparative absolute emissions data.

The concept of avoided emissions (AE) originated in project-level carbon accounting under the Clean Development Mechanism (CDM) commencing in 1997 and evolving along with national emissions trading systems, where projects in non-Annexe I countries earned Certified Emission Reductions (CERs) by implementing activities that reduced or avoided emissions relative to a baseline scenario [4]. The CDM, along with the Joint Implementation Mechanism, introduced the use of counterfactual baselines and verified reductions to measure climate benefits. Building on this foundation, as carbon crediting evolved, it relied on quantifiable, permanent, additional verified emission reductions, creating financial incentives for mitigation, while corporate carbon reporting focused on measuring and disclosing a company's own emissions to promote transparency and track progress over time. AE functions as a conceptual bridge, extending the logic of the CDM to prevent emissions across value chains, and complements both crediting mechanisms and corporate reporting frameworks.

As attention shifted from compliance mechanisms to corporate climate strategy in the 2010s, initiatives such as Global e-Sustainability Initiative (GeSI) Boston Consulting Group (BCG), WRI, SBTi, the Institute of Life Cycle Assessment, and Mission Innovation (MI), among others, emerged to help shape a forward-looking narrative around technological innovation and science-based decarbonisation pathways. The International Energy Agency (IEA) further contributed by providing technology roadmaps, scenario modelling, and life-cycle emission factors, which are essential in AE calculations.

In 2023, WBCSD published its *Guidance on Avoided Emissions*, a structured framework for companies in some sectors to measure, report, and communicate AE consistently across many sectors and activities, followed by a version 2.0 in 2025 [3], which met certain eligibility criteria. It also provided reporting templates and alignment tools for standardisation. Parallel efforts—such as the GHG Protocol's 2024 consultation on *Beyond Value Chain Mitigation* and emerging debates on "Scope 4" emissions—signal a broader shift toward integrating AE into mainstream carbon accounting, transforming AE from a project-level accounting concept into a strategic tool for evaluating systemic decarbonisation impact beyond corporate boundaries.

In September 2025, ISO and the GHG Protocol formally announced a strategic partnership to harmonise their GHG portfolios and co-develop new standards for emissions accounting and reporting [5]. This partnership aims to reduce fragmentation in carbon accounting, improve consistency across jurisdictions and sectors, simplify reporting burdens, and foster greater alignment with disclosure regimes and policy instruments [6]. Although AE is not addressed explicitly in this context, harmonising standards and integrating corporate and project accounting are essential for the whole carbon accounting community. Consultations on AE accounting have also been included for public comment.

Standardising AE approaches across sectors, activities, products, and processes—while strengthening integration between the mentioned corporate accounting frameworks and innovation-oriented methodologies (e.g., WBCSD guidance, IEA scenarios)—is essential to ensure consistency and comparability in AE calculations. Improving data transparency, enhancing measurement, monitoring, reporting and verification practices, and aligning carbon accounting reporting with existing disclosure mechanisms (e.g., CDP, ISSB) is fundamental for AE's wider adoption and recognition, as well as supporting decarbonisation efforts (Annexe 1: Timeline of Avoided Emissions Concepts and Key Institutional Contributions).

2.2 Traditional Carbon Accounting

GHG accounting—or carbon accounting—refers to the standardised quantification, allocation and reporting of emissions. It enables organisations to assess their carbon footprint, identify reduction opportunities, and align with disclosure and target-setting frameworks that support global decarbonisation [7]. The GHG Protocol presents emission scopes that establish carbon accounting boundaries for direct emissions from corporate-owned or controlled sources (scope 1), indirect emissions from purchased electricity, heat, or cooling (scope 2), and all other indirect emissions across the value chain (scope 3). One benefit of this model is that its structure estimates a corporate carbon inventory, which can help identify decarbonisation opportunities. Scopes 1-3 are backwards-looking and focus on what has already been emitted.

This inventory-based approach is particularly relevant given the highly concentrated nature of industrial emissions as reported by the CDP's Carbon Majors in their analysis of GHG emitters from 1988 to 2022. In this context, rigorous and consistent corporate GHG accounting is essential to assess a firm's emissions performance. Corporate activities are central to developing and integrating products, services, and technologies that contribute to broader, system-level emissions reductions. These enabling or consequential impacts are often not captured within conventional corporate inventories. As a result, scope-based accounting can misrepresent the climate relevance of certain activities, particularly when emissions reductions occur outside organisational boundaries or are realised by downstream actors.

To illustrate, consider an energy provider supplying natural gas to a power generator that replaces coal with gas: under conventional carbon accounting, the gas supplier may report higher emissions, even though natural gas has approximately 50% lower lifecycle GHG emissions than coal. Similarly, a carbon capture and storage (CCS) operator capturing CO_2 on behalf of a separately owned and operated coal-fired power plant may report emissions even though it sequesters more CO_2 than it emits. These examples highlight that corporate inventory accounting is central to understanding firm-level emissions flows over a given period, and AE can enable consistent reporting of emission reductions and avoidance of such activities.

As carbon accounting frameworks evolve—ranging from corporate disclosure mechanisms to cooperative approaches under Article 6 of the Paris Agreement—ensuring coherence and integrity becomes increasingly critical. For these frameworks to meet their objective, they require **fairness and equity** to recognise diverse contexts, enable **multiple technological pathways** to lower emissions, and avoid imposing homogenous assumptions that disadvantage producers in different regions and sectors. Additionally, **inclusivity and transparency** are necessary for broad participation and credibility [9]. The accounting systems must be accessible and foster a collaborative environment to ensure coherence and avoid fragmentation or exclusion; they must also be scientific and policy-sound to maintain trust and consistency, as well as flexible, as market effects might influence behavioural change. In this dynamic and constantly transforming area, collective engagement and participation are paramount.

As science, policy, businesses, and society increasingly acknowledge the urgent need for transformative, cooperative approaches to sustain global economies, carbon accounting –largely retrospective– should open up to a forward-looking approach and look beyond corporate boundaries. Therefore, AE offers a complementary framework for assessing the broader mitigation potential of products and technologies [10], positioning businesses not only as emitters but also as contributors to systemic decarbonisation and innovation [11].

2.3 Conceptual Foundation of Avoided Emissions

2.3.1 What Are (and Are Not) Avoided Emissions?

In a nutshell, AE refers to GHG emissions that would have occurred under a business-as-usual (BAU) or dominant-practice scenario but are **prevented by** a cleaner alternative. AE capture a "lower-carbon" impact that may arise beyond a company's direct or indirect value chain (i.e. outside Scopes 1–3). In this context, the lower-carbon alternative—hereafter referred to as a "solution"—may take the form of a product, service, policy, or decision that enables emissions avoidance [12], [13]. There are two types of solutions:

1. Intermediary solutions. Inputs that require further processing, transformation, or inclusion in another solution before being used by the end-consumer. They are not consumed in their current form (e.g., wind turbine blades, batteries, or EV chargers).
2. End-use solutions. Goods and services consumed by the end-user in their current form, without further processing (e.g., EVs, heat pumps, solar panels, animal feed ingredients to reduce enteric emissions, grid optimisation software).

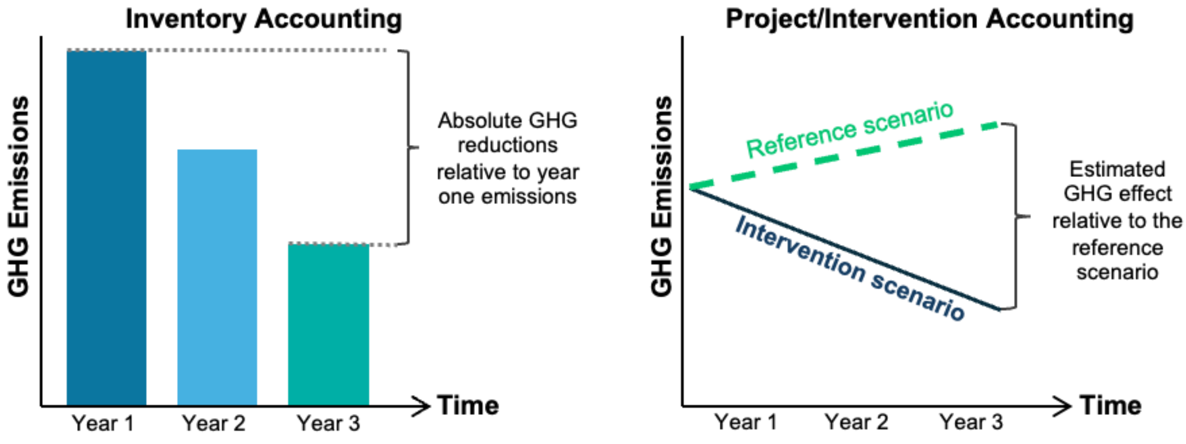
There are also two types of GHG accounting methods: 1) **allocational methods**[1] that quantitatively assign emissions and removals to an accounting subject; they do not account for any changes outside of the accounting boundary over time; 2) **consequential methods** that quantitatively attribute emissions avoidance and enhanced removal impacts by capturing the effects a company has on the broader system over time [14].

AE follow consequential logic. Its quantification is the hypothetical difference in emissions between a counterfactual baseline (*what would have occurred otherwise*) and the alternative scenario. While inventory accounting records past and present emissions, intervention accounting projects potential future impacts (Figure 1). However, the results from AE accounting must align with allocational accounting frameworks when integrated into reporting systems to ensure consistency, coherence and compliance with disclosure standards [14].

AE differ fundamentally from reduced or removed emissions, which typically are linked to inventories or offset crediting and cannot be used for offsetting purposes [15]. Offsets are claims to compensate for emissions elsewhere through reductions or removals in other projects, geographies, or sectors. Thus, emission reductions occur when a company or system lowers its emissions relative to a historical baseline (e.g., through fuel switching or energy efficiency improvements). At the same time, removals involve capturing and durably storing atmospheric carbon (e.g., reforestation, direct air capture).

[1] Gillenwater (2023) proposes using "allocational" instead of "attributional" to emphasise that this approach assigns emissions within a system rather than implying causation. The term "attribution" can misleadingly suggest that a specific actor or intervention causes emissions, while the intent is to allocate portions of total emissions to entities such as companies, facilities, or countries.

Figure 1: Comparison between the inventory accounting (emission reporting within a company's value chain) and the project/intervention accounting (emission changes between reference and intervention scenarios)



Source: Adapted from the GHG Protocol

An important point is that recognising the distinction between AE and inventory emissions is essential to ensure conceptual integrity, because AE may not reduce an entity's own Scopes 1–3 emissions, nor replace the need for removals to achieve a net-zero balance. There is a frequent confusion about AE, particularly through the informal notion of *Scope 4*, a non-official category used in voluntary disclosures to signal broader climate contributions [16].

Some argue that *Scope 4* is not equivalent to the GHG Protocol's Scopes 1–3 and that treating Scope 4 as AE gives the impression that they are capable of offsetting Scopes 1–3. If misused, it can lead to inflated reported reductions and undermine legitimacy from inventory accounting [17]. *Scope 4* is not included in mandatory or standardised reporting regimes and relies on interpretative estimations; therefore, it should be regarded not as an accounting category but as a strategic governance tool to communicate forward-looking climate intent and systemic impact [16].

2.3.2 Principles and Architecture of Avoided Emissions Accounting

The decision usefulness of AE estimates depend on a coherent methodological architecture that ensures comparability. The AE architecture is grounded in a set of guiding principles that underpin sound GHG accounting practices and key design parameters that define how AE are identified and quantified. Together, these elements provide the foundation for robust and trustworthy AE assessments.

AE accounting integrity and comparability rely on a set of principles to ensure methodological rigour. These principles serve as the foundation for consistency and comparability across interventions [2], [3], [10], [18]–[20] (Figure 2).

The operationalisation of these guiding principles depends on methodological design choices and their suitability for the type of calculation that AE aim to provide. As core elements of AE architecture, they influence *what* is assessed, *how* boundaries are set, and *which* scenarios are compared. When translated into parameters, they shape how principles are applied in practice and, in turn, may affect the interpretive value and practicality of AE results.

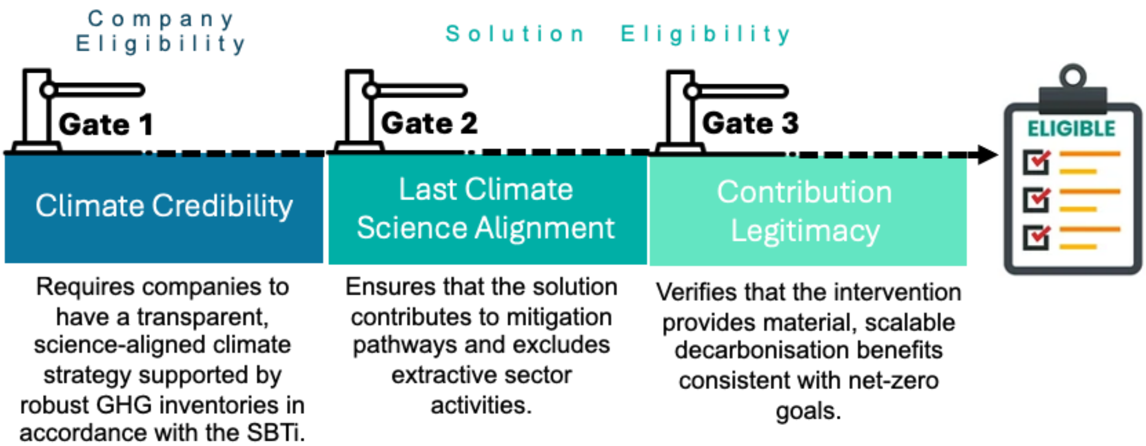
Figure 2: Guiding principles for AE accounting for methodological rigour and representation that allows consistency and comparability between projects/interventions

Relevance	AE assessments must address decision-making needs by providing information that is meaningful and applicable to stakeholders. Approaches and methodologies should reflect the solution's mitigation value in its real-world context.
Completeness	All significant emission sources and activities within defined boundaries must be included. Exclusions should be disclosed and justified to avoid selective reporting and ensure fair representation of the assessed portfolio.
Consistency	Accounting approaches, boundaries, and calculation methods must be applied consistently across time and projects to enable meaningful comparison. Any methodological changes should be documented and communicated transparently.
Transparency	All assumptions, data sources, and methodological choices must be clearly disclosed to create a verifiable audit trail. It ensures that results are interpretable, reproducible, and open to scrutiny.
Accuracy	Quantification must minimise bias and uncertainty by applying the most reliable data available and, where doubt exists, adopting conservative assumptions to prevent overestimation of avoided emissions.
Precision	AE calculations should employ the most probable and well-supported reference scenario to estimate emissions differentials, thereby improving the robustness and interpretive clarity of the results.
Representativeness	Both the solution and reference scenarios should reflect realistic technological, temporal, and geographical conditions. It prevents distorted conclusions about a project's mitigation potential and ensures fair attribution of systemic impacts.

The first parameter to consider is **eligibility**, which establishes whether a product, technology, or intervention qualifies as AE. A solution is eligible if it demonstrably prevents GHG emissions relative to a plausible baseline scenario, ensuring genuine climate contributions rather than broad portfolio effects [3], [15].

The WBCSD (2025) defines a three-gate eligibility framework to safeguard claim integrity (Figure 3):

Figure 3: Eligibility framework to safeguard AE claim integrity



Source: Modified from WBCSD (2025)

Eligibility also entails transparent disclosure of climate targets and alignment with recognised frameworks such as the UN Race to Zero criteria, SBTi Net Zero Standard requirements, 1.5º Business Playbook, IEA Net Zero 2050 Scenarios, Net Zero Initiative, and ISO guidance to Net Zero. In addition, exclusion criteria are essential to maintaining methodological integrity: AE claims should not involve fossil fuel-related activities, military or nuclear applications, or interventions associated with significant social or environmental adverse effects. At the same time, excluding entire sectors limits the recognition of certain technologies or projects that could plausibly deliver avoided emissions in transitional contexts. This remains an active area of debate, as current AE frameworks prioritise an integrity-first principle to safeguard credibility and prevent fragmented or misleading claims. Incorporating feedback from external stakeholders such as NGOs and academia helps ensure that AE assessments reflect a holistic understanding of sustainability, rather than serving as a narrow or reputational instrument only [3], [16].

Additionality is a cornerstone principle to ensure that reported climate benefits reflect genuine, causal mitigation effects. An intervention is deemed *additional* if its outcomes differ meaningfully from the counterfactual scenario, indicating that emissions avoidance would not have occurred without it [21]. In this sense, additionality safeguards the integrity of AE accounting by preventing the misallocation of AE claims [22]. Although sometimes framed as a theoretical construct, additionality is a well-established principle applied across climate policy, mitigation assessment, and sustainability frameworks to distinguish genuine, causal impacts from outcomes that would have occurred under BAU conditions. In the context of AE, additionality ensures that claimed benefits reflect transformative contributions rather than the continuation or re-labelling of existing practices or BAU.

From an analytical perspective, additionality testing can draw on well-established frameworks used in carbon crediting systems and financial assessments. The World Bank (2016) and the Gold Standard (2025) identify several complementary approaches: financial additionality, which verifies that an intervention would not be viable without external incentives; barrier analysis, which identifies technological, regulatory, or economic obstacles that the intervention uniquely overcomes; and the common practice test, which ensures the activity goes beyond standard or mandated practices. Combined, these tests help confirm that the intervention truly prevents emissions beyond business-as-usual conditions.

These methods align with broader criteria of *causality*, *materiality*, and *conservatism*, adapted from financial and climate accounting [23], [25]. Incorporating such principles enhances credibility by ensuring that AE estimates are both significant and plausible. Recent proposals also advocate *risk-adjusted valuation* or *discounting approaches* to reflect uncertainties associated with technology adoption, policy change, or market dynamics [26].

Ultimately, additionality must be assessed not only at the project level but also at the systemic scale. Practitioners must differentiate between the *substitution effect* –when a solution replaces an existing higher-emission activity– and *incremental convenience* effects –where usage does not necessarily displace prior emissions sources (e.g., increased participation in online events that do not offset actual travel). Upholding stringent additionality criteria ensures that AE claims reflect tangible mitigation outcomes, preserving both environmental integrity and decision-useful reliability.

The robustness of AE estimates relies heavily on how **system boundaries** are defined and justified. Boundaries delineate the scope of activities, processes, and interactions that directly or indirectly influence emissions outcomes [11]. Establishing these limits is fundamental for mapping causal chains, ensuring methodological consistency, and preventing double-counting. ISO standards provide a solid methodological foundation to define system boundaries. Broader system boundaries, extending beyond direct value chains, can better capture indirect and market-mediated effects, but also introduce higher uncertainty due to increased data complexity. The longer the causal chain, the harder to quantify and secure access to reliable data.

A well-established boundary enhances methodological coherence and comparability across projects. However, defining boundaries requires balancing inclusiveness with precision: overly narrow scopes risk omitting relevant effects, while overly broad ones may dilute analytical reliability. Besides, boundaries should not constrain alternative mitigation pathways or favour specific technologies [9], but ensure fairness and actual sustainability impacts. The Gold Standard (2025) emphasises the need for justified non-jurisdictional boundaries when climatic or topographical factors significantly influence the intervention outcomes. Therefore, boundary setting in AE is both a methodological and ethical act that requires clear documentation, conservative assumptions, and representativeness.

The **baseline** defines the counterfactual condition against which AE are quantified—that is, what emissions *would have occurred* in the absence of the proposed intervention. Often described as the BAU or market-average case, the baseline can draw upon historical performance data, modelled projections, or sectoral benchmarks. Baselines are rarely static, as they are defined by technological progress, policy changes, and market dynamics that continuously shift what BAU means, requiring regular reassessment to maintain relevance [11].

Establishing a credible counterfactual is one of the most persistent methodological challenges in AE quantification. Baseline assumptions shape the magnitude of claimed reductions: optimistic or inflated baselines can lead to overstated benefits, while overly conservative ones may obscure real impacts. This creates a risk of *baseline manipulation* or *optimism bias*, undermining comparability, integrity, and public trust [16], [27].

Guidance from international mechanisms, such as the UN Article 6.4 framework, provides tools and more than 100 methodologies for deriving reference scenarios, acknowledging the need for contextual differentiation across sectors, regions, and temporal horizons [3]. Nevertheless, the counterfactual nature of AE remains a source of epistemic uncertainty resting on assumptions about future developments that are inherently unknowable. Consequently, transparency in assumptions, periodic updates, and the use of standardised benchmarks are not only good practice but essential safeguards to ensure that an AE claim is based on real climate benefits rather than a product of modelling choices [9], [14].

On the other hand, future or **intervention scenarios** describe the emissions pathway expected under the adoption of a solution and provide the analytical counterpart to the counterfactual baseline. Their robustness depends on demonstrating that observed differences are causally related to the intervention rather than to exogenous trends [14], [27]. Future or emerging solutions are uncertain; therefore, projections must include realistic assumptions about market penetration, adoption rates, and enabling infrastructure. Stephens and Thieme [11] emphasise that assumptions about future decarbonisation trajectories, technology clusters, and the probability of success should be transparent and tested through sensitivity analysis. In addition, guidance from WBCSD and NZI [3] suggests integrating LCA with models of dynamic policy and market developments. Intervention scenarios must balance plausibility and ambition, capturing meaningful mitigation potential while avoiding over-optimistic assumptions that could compromise the integrity of AE claims. Ensuring comparability between scenarios requires consistent system boundaries, functional units, and temporal frames, since these parameters define the scope of the intervention and its assessment [11].

The guiding principles and architectural parameters outlined above provide a foundation for credible AE assessments, emphasising transparency, consistency, and contextual relevance. However, the robustness of any AE claim ultimately depends on how these principles are applied in practice and safeguarded against methodological and ethical pitfalls. The following section explores key risks and the safeguards necessary to uphold the integrity of AE accounting.

2.3.3 Ensuring Integrity in Avoided Emissions Accounting: Risks and Safeguards

While valuable for accounting for potential climate benefits, AE face several risks. Recognising them is essential to prevent unintended effects and maintain credibility. As Broekhoff et al. [27] note, some project types inherently pose lower risks and are easier to meet quality criteria, while others require greater scrutiny and caution. The risks are interwoven across the AE architecture and require a thorough examination and evaluation.

While Scope 3 accounting permits multiple counting to reflect value-chain emissions exposure, AE claims are often interpreted as distinct mitigation contributions; in line with Article 6 integrity principles, avoiding double-counting—through clear boundaries and, where relevant, corresponding adjustments—is essential to ensure that each avoided tonne is claimed only once and remains policy-credible within an inventory concept. However, outside inventory statements may be made by all contributing parties in the value chain, like Scope 3.

Double-counting arises when the same avoided ton of GHG emissions is claimed more than once, inflating the reported mitigation effect. This occurs especially when multiple actors participate in value chains across jurisdictions or between corporate and national inventories. According to Broekhoff et al. [27], there are three main forms of how double-counting can happen: *double issuance* (multiple credits issued for one avoided tonne of CO_2), *double use* (two entities using the same credit toward their goals), and *double claiming* (when a government or another entity also claims project-level reductions).

The reliance of AE estimates on counterfactual scenarios exacerbates this risk because, without clearly defined system boundaries and allocation rules, producers, users, and policy-makers may inadvertently overlap claims [16]. An example that illustrates this concept is at the national level, where mitigation outcomes sold in one jurisdiction are simultaneously claimed by another under the Paris Agreement. This is a risk recognised in negotiations around Article 6, which introduces "*corresponding adjustments*" to ensure each ton is counted only once [28]. The challenge with complex supply chains is that it makes accurate horizontal attribution [2] difficult, as each stakeholder's share of AE may be uncertain or inconsistently reported [29].

> To safeguard AE integrity in this context, AE frameworks must define clear boundaries, apply corresponding adjustments, and use interoperable registries to avoid double issuance. Projects should guarantee exclusive claims [27] to AE by verifying that accounting boundaries don't overlap, monitoring registrations, and legally attesting to ownership and transfer of claims.

Rebound effects, also known as induced effects, occur when an intervention indirectly triggers changes in production, consumption, or market behaviour that offset part of its intended emission benefits. These effects can manifest across sectors (e.g. through increased demand for a lower-carbon product due to reduced costs or through systemic shifts in supply chains that stimulate new emissions elsewhere). As such, they represent unintended feedback that reduces the net climate benefit of an intervention.

As Stephens and Thieme [11] emphasise, rebound effects are complex, context-specific, and difficult to quantify because they depend on behavioural, economic, and structural responses that unfold over time. Rather than attempting to precisely correct for these effects, credible AE accounting should clearly acknowledge their potential influence and communicate the scope and limitations of AE results, reinforcing their interpretation as indicative contributions rather than exact mitigation outcomes.

> To strengthen credibility, organisations should explicitly identify rebound risks and apply conservative adjustments or uncertainty buffers to avoid overstating climate benefits [16]. Similar to the buffer reserves used in carbon crediting schemes to insure against project reversals [27], a *virtual buffer* can serve as a safeguard in AE accounting, providing a margin of safety against unforeseen behavioural or systemic effects. Other safeguards could include applying discount factors or conducting sensitivity analyses, ensuring transparent documentation of data sources and limitations, and making rebound risks explicit in both project design and reporting.

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[2] **Horizontal attribution** is the process of assigning portions of a solution's avoided emissions to contributors along the solution's supply chain. The process can quickly become complicated due to changes in the capital structure of the supplier, independent of changes in the investor's ownership stake (Moreno and Ellsworth 2024).

Leakage—or displacement—refers to the unintended increase in emissions elsewhere caused by an intervention that, within its boundaries, appears to avoid emissions (e.g. a low-carbon product substitution in one market may reduce demand for higher-emitting alternatives locally but spur demand elsewhere, or supply chain shifts may enable higher emissions in adjacent geographies) [25], [30]. In the context of AE, leakage does not imply that the accounting is flawed; rather, it highlights an inherent limitation of boundary-based, counterfactual approaches. Recognising this limitation helps situate AE as an indicative tool for understanding contributions to a lower-carbon future, rather than as a precise measure of net global emissions outcomes.

Many AE methodologies stop at the direct intervention boundary and do not extend modelling to the marginal system or market responses [31]. To illustrate the omission of displacement effects, empirical studies of carbon pricing show that production, investment and energy-market channels can drive relocation of emissions across borders, eroding mitigation gains at the system level [32]. The lack of rigorous treatment of leakage erodes comparability, dilutes accountability, and exposes AE claims to reputational risk.

> To address this risk, AE frameworks should expand system boundaries to capture indirect and market-mediated impacts, and apply marginal system modelling rather than simple average scenarios [29]. Transparent disclosure of assumptions about displaced activity or market feedback, and conduct sensitivity analyses to test how varying levels of leakage affect results. Periodic review of actual intermediate and long-term market outcomes can help validate assumptions and adjust claims accordingly. When quantification is infeasible, conservative discount factors should be applied.

Greenwashing refers to situations in which the communication of climate-related information may be misleading and may not fully reflect an organisation's overall emissions profile or mitigation performance. Because AE calculations are interpretive, forward-looking, and not subject to mandatory reporting requirements, AE information may be presented selectively alongside, rather than in relation to, Scope 1–3 emissions [16]. For example, disclosures may emphasise lower-carbon products or activities within a portfolio without providing equivalent visibility to higher-emitting ones, so as not to affect the completeness and comparability of reported climate impacts [29].

The absence of standardised methodologies and limited third-party verification can lead to selective disclosures or ambiguous claims in voluntary climate reporting. The OECD [33] reports that only 37% of companies with GHG targets clearly disclosed key methodological assumptions, and assurance practices vary widely. In such contexts, AE-based claims may be more difficult to interpret and compare, potentially affecting stakeholder trust and increasing scrutiny from regulators and consumer protection authorities [34].

> To mitigate this risk, AE frameworks should require comprehensive disclosure of all relevant product portfolios and value-chain emissions (not just selected favourable ones). Clear documentation of assumptions, boundary definitions, and limitations, supported where possible by independent third-party verification and assurance, is fundamental. While existing standards such as the International Sustainability Standards Board (ISSB) and the SBTi do not provide guidance on AE, alignment with their principles on disclosure quality, governance, and emissions accounting can enhance the robustness and comparability of AE-related communications. Internal controls and governance processes further support the traceability and defensibility of AE claims.

2.3.4 Key Considerations when Assessing Avoided Emissions

Bringing principles into the practical dimension depends on various factors. Remember that, in general, carbon accounting is more than maths; therefore, when theory is translated into operational practice, we require a holistic, interdisciplinary approach to fully capture the complexity, nuances and details of reality. To assess AE, it is paramount to recognise, understand and integrate the following aspects:

Data. Consider that AE accounting relies on granular, high-quality, and timely data to describe baseline technologies, marginal emission factors, and life-cycle inventories [35]. Unfortunately, such data is rarely available at the necessary resolution, especially for marginal databases which depend on dynamic market and system conditions [36]. Data producers (corporations, statistical agencies, LCA databases) operate under differing conventions and confidentiality rules, leading to fragmented, incomparable datasets and methodological inconsistency [15]. Beyond availability, provenance and intent equally are critical: *who* collected the data, *for what* purpose, *how* and under what assumptions. Primary data offer the highest credibility but are often scarce; secondary or modelled data can fill gaps but must be transparently documented and validated [11]. Relying solely on corporate disclosures risks bias, yet excluding them entirely may yield lower quality estimates; hence the need for triangulation across multiple sources.

Activity data and emission factors remain central proxies for avoided emissions when direct measurement is infeasible [29]. However, the absence of standardised definitions for these factors challenges comparability and reproducibility. Persistent data asymmetries also shape participation: developing economies and SMEs often lack the infrastructure or access to high-quality datasets, risking exclusion from credible AE reporting [9]. Ultimately, AE data must evolve from static, retrospective to dynamic, forward-looking, enabling strategic planning and systemic insight rather than mere accounting. High-quality data is not just a technical requirement; it is the currency of credibility for AE claims.

PRACTICAL CONSIDERATIONS

- Prioritise primary and marginal data, cross-check multiple sources, and document assumptions clearly.
- Ensure traceability of data origin, time frame, methodological boundaries, and other metadata.
- Foster open, interoperable, and inclusive data infrastructures (especially for developing regions and SMEs).
- Regularly update datasets to reflect evolving science, technologies, and market realities.

Geographic and contextual specificity. The regional, policy, technological, and market environments in which an intervention is deployed materially affect its outcomes. As the WBCSD (2025) explains, purely statistical AE estimates based on average solution or solution-specific models. Nevertheless, many AE estimates rely on such practices, risking oversimplification and overgeneralisation.

Geography itself matters, since the impact of interventions (products, technologies, policies) applied in one site or country may differ significantly from that in another due to market, climate, regulatory, or social contexts [37]. Standards such as The Gold Standard [24], for instance, require that the “applicable area” is clearly justified, mainly when variation exists between national or sub-national levels. By contrast, regional perspectives, such as the BRICS Contact Group [9], argue that global worst-case defaults are inappropriate and that benchmarks should reflect sector- and region-specific feasibility, reinforcing fairness and contextual relevance. Without geographic and contextual specificity, AE claims risk being academically elegant but practically irrelevant and may undermine comparability, inequity and credibility across regions.

PRACTICAL CONSIDERATIONS

- Align geographic boundaries with relevant regulatory, infrastructure and market conditions, using region-specific data where possible.
- Define the deployment context clearly, including the solution’s region, scale, and an appropriate reference scenario or comparable product within the same boundary.

- Apply conservative assumptions and document uncertainty when data are limited to prevent overstating impacts.
- Ensure fairness and comparability by harmonising benchmarks with peers operating under similar geographic conditions.

The plausibility, measurability and credibility of AE claims vary by industry, technology maturity, and market structure. Most companies still rely on **sector-agnostic** methods because tailored guidance is limited (61% in a recent CDP sample) [15]. **Sector-specific** guidance, when available, reflects realistic operational and technological conditions [13].

Some sectors, particularly related to extractive industries such as oil and gas and mining, remain controversial because their core business models (new exploration and production) conflict with additionality, long-term decarbonisation objectives, and disclosure expectations; weak reporting and portfolio expansion risk undermine claim integrity despite any low-carbon offerings. However, parts of these sectors can develop genuine mitigation technologies, so exclusion should be balanced with eligibility gates that consider company strategy, investments, and demonstrated transition pathways [1], [9].

Innovation and methodological pluralism should be encouraged. The AE Implementation Hub, by the WBCSD, includes a repository of pilot use cases across various sectors to support companies in adopting and scaling low-carbon solutions. A single standard for all sectors is unrealistic, but sharing sectoral case studies can refine guiding principles and align efforts toward a common goal.

PRACTICAL CONSIDERATIONS

- Use sector-specific methods where possible; justify sector-agnostic choices.
- Update emission factors regularly (e.g., every 5 years in fast-changing sectors) and update AE estimates to reflect technology and market evolution.
- Apply eligibility gates for high-impact or controversial sectors based on transparent transition plans and records on sustainability compliance.
- Apply regional benchmarks to ensure fairness and realism.

The forward-looking nature of AE accounting must consider how time is treated in the baseline and intervention scenarios. Because AE estimates often project savings over extended periods, they are vulnerable to externalities and temporal uncertainty caused by technology obsolescence, regulatory shifts, changing user behaviour, or market upheaval, which can invalidate the initial assumptions [16]. For example, a product expected to displace emissions for 15 years may be replaced prematurely or repurposed differently, undermining the claimed benefit.

Temporal consistency also means aligning the functional units, time horizons, and update frequencies of scenarios. AE should ideally be reported annually, but cumulative lifetime impacts must also be considered, particularly for infrastructure or long-lived assets [11]. Furthermore, the validity period of emission factors, such as five years for recycling-sector models [38], reflects the need to refresh assumptions in dynamic markets. Whether for AE, removal credits, or decarbonisation pathways, the issue of permanence is critical, as temporary avoidance or storage may not yield equivalent long-term benefits [27].

PRACTICAL CONSIDERATIONS

- Align time horizons with the product or project lifespan, updating scenarios regularly to reflect technological, policy, and market changes.
- Report avoided emissions consistently, using clear functional units and both annual and cumulative lifetime metrics.

- Test robustness through sensitivity analysis, assessing impacts on assumptions, adoption rates, lifetime, sector decarbonisation, and regulatory shifts.
- Manage and communicate long-term uncertainty responsibility, applying conservative projections and ensuring solutions remain compatible with long-term decarbonisation pathways.

Uncertainty. It arises from variable data quality, model assumptions, system boundaries, and contextual differences. Reported emissions and AE estimates must contend with both *scientific uncertainty* (when the underlying processes are not fully understood) and *estimation uncertainty* (arising from models and parameters used) [18]. Rather than avoid it, practitioners should aim to understand, report, and manage it transparently.

Sources of uncertainty in AE include the accuracy of activity data and emission factors, the choice of baseline and intervention scenarios, attribution of causality across multi-actor systems, and the durability of claimed avoidance over time. In multi-stakeholder value chains, allocation uncertainty becomes especially salient, determining whether one entity's action is the proximate driver of AE or merely one of several contributing factors.

Credible AE frameworks integrate uncertainty by using conservative assumptions, performing sensitivity and scenario analyses, and communicating uncertainty ranges or qualitative confidence levels. Transparent treatment of uncertainty is the only way for AE claims to maintain alignment with the accuracy principle of rigorous GHG accounting and to resist being dismissed as speculative or marketing-oriented.

PRACTICAL CONSIDERATIONS

- Identify and disclose key uncertainties across the quantification process, describing and quantifying them transparently.
- Apply conservative assumptions and sensitivity analyses to test how results change under different parameters or scenarios.
- Clarify attribution and responsibility by defining causal boundaries and the firm's influence in complex, multi-actor systems.
- Strengthen methodological robustness through internal expertise and, where appropriate, third-party review of methods and assumptions.

Monitoring, reporting and verification (MRV). Traditional MRV frameworks, such as the GHG Protocol, primarily focus on measuring Scope 1–3 emissions, whereas AE introduces additional complexity. It requires tracking whether the deployment of a product or solution actually prevents emissions system-wide, rather than simply collecting data on a company's direct or indirect emissions [3]. This implies broader indicators of system behaviour, market uptake, and indirect effects.

MRV frameworks should ensure boundary alignment with the baseline–intervention model used in AE calculations. Expanding causal chains can increase uncertainty and reduce clarity, making verification more challenging. Transparency and traceability are equally vital because monitoring systems must document data sources, collection methods, assumptions, and functional units to enable independent verification and replication [19], [35].

Since AE often involves multiple actors and complex value chains, verification mechanisms should also prioritise accessibility and inclusivity, ensuring that smaller entities and actors are not excluded due to cost or capacity barriers [9]. Furthermore, AE reporting must remain clearly separated from corporate GHG inventories, avoiding misleading substitution or netting against direct emissions. In the AE context, MRV should include periodic reviews, ex-post validation, and adaptive updates to reflect real-world performance and prevent overstatement of benefits.

PRACTICAL CONSIDERATIONS

- Align monitoring boundaries with AE baselines and interventions, ensuring transparent and traceable data, assumptions, and methods.
- Maintain integrity and credibility through independent verification, interoperable systems, and clear separation of AE from corporate GHG inventories.
- Ensure accessible and efficient MRV by using cost-effective, digital, and inclusive verification approaches.

3. The Methodological Landscape of Carbon Accounting for Avoided Emissions

Although the concept of AE has gained significant traction in recent years, the ambition to measure climate impact rather than merely inventory emissions has been developing for over two decades. During this time, the carbon accounting landscape has evolved rapidly. Current approaches differ widely in how they define baselines, allocate responsibility, and model counterfactuals, leading to inconsistent results. Establishing a unified framework is essential for credibility and comparability. Yet, challenges in commensuration persist, as the proliferation of proprietary methodologies reveals the absence of a clear, preferred approach despite repeated collaborative efforts [17].

Several initiatives are advancing this agenda. These efforts are largely voluntary and led by private, non-governmental organisations, rather than by public regulators or formal policy mandates. WBCSD's Avoided Emissions Guidance, developed in partnership with the Net Zero Initiative, has expanded to include standardisation, implementation, and financing, supported by sector-specific guidance, pilot cases, and collaborations with policymakers and financial institutions [3]. Alongside ISO's life cycle–based standards and SBTi's net-zero work, these initiatives operate outside binding regulatory frameworks and do not constitute official inventory or compliance accounting, but they nevertheless represent an important step toward harmonised, credible AE accounting. A wide range of methodologies focus on AE quantification. O'Keeffe and Brander [5] present a comprehensive analysis of the methodologies published since 2005.

Experts emphasise the importance of integrating scientific rigour as the methodological backbone and aligning with policy frameworks to ensure AE makes tangible, measurable contributions, particularly given the methods' flexibility, fragmentation, and limited specificity. Lessons from established carbon accounting systems can help strengthen and guide AE's continued development.

AE should be seen as a complementary tool within the broader carbon accounting toolbox. Carbon accounting has evolved into a diverse landscape of methods and tools, all sharing the core objective of managing carbon to achieve real climate and sustainability outcomes. Yet, debates persist over whether these approaches collectively deliver the intended impact. A harmonised toolbox approach would enable consistency in practice and facilitate integration of emerging methods.

In the face of rising GHG emissions and the urgency for action, carbon accounting methodologies must prioritise *practicality over perfection*. Methodologies should be viewed as dynamic, evolving tools that are transparent, credible, and continuously improving through shared learning and practice. Collaboration among stakeholders is vital to creating a coherent, inclusive methodological landscape for AE. Despite efforts, progress remains fragmented. Strengthening coordination among scientific, corporate, and policy actors is essential and urgent – and already happening. It is important to note that **striving for "good" rather than "perfect"** methods and frameworks enables timely implementation, collective refinement, and the scaling of solutions that deliver tangible and measurable climate benefits.

4. The role of AE in Delivering Strategic Climate Action

AE transformative benefits can be found across multiple sectors. In **renewable energy and grid services**, AE arises from displacing fossil-based generation through solar, wind, storage, and flexibility solutions. Yet, outcomes depend on grid carbon intensity and temporal patterns of generation, making location- and time-specific marginal grid modelling essential to avoid overstating benefits [37]. In **mobility**, electrification, modal shifts, and sustainable aviation fuels (SAF) offer major AE potential. Still, impacts hinge on grid carbon intensity, battery supply chains, and behavioural persistence. EVs and SAFs can reduce emissions only when powered or produced with low-carbon energy and without triggering increased demand or resource strain (e.g., minerals or land use). AE in this sector must be assessed through full lifecycle and marginal analyses to ensure genuine climate alignment.

In **industrial materials**, such as green steel, low-carbon cement, and bio-based polymers, substituting carbon-intensive products can multiply system impacts upstream. However, real substitution, market dynamics, and policy incentives determine whether emissions are truly avoided or merely shifted. Rebound effects—like increased total production—must be anticipated [39]. The **circular economy**—through reuse, remanufacturing, and repair—offers AE by reducing the need for new production. Benefits depend on lifetime extension, substitution effects, and market uptake, varying by product and boundary [40]. Systemic shifts in business models and supportive policies are key to realising these gains. **Digital technologies** (AI, IoT, data optimisation) enable AE by improving efficiency and dematerialising processes across sectors. Studies such as *SMARTer2030* highlight significant potential but also high uncertainty due to allocation and rebound effects. The substantial energy and water footprints of data centres must be incorporated in claims [41].

Annexe 2 presents twenty-five methodologies, frameworks and incentives commonly used for AE analysis across sectors, including energy, ICT, AFOLU, finance, transport, industry, and policy.

AE can capture the enabling effects of technologies and systems that indirectly drive emissions reductions. These effects are often divided into **primary enabling effects**—immediate reductions relative to business-as-usual—and **secondary enabling effects**, which occur over longer timeframes or through wider adoption [11].

AE also complement national accounting and foster innovation if used strategically. Policymakers and institutions are advancing several pragmatic pathways:

- **Use AE as an innovation and transition indicator** rather than as NDC crediting or a compliance instrument. Used this way, AE helps governments and investors prioritise R&D portfolios, industrial policies, and international cooperation to accelerate technology diffusion and market transformation [42], [43]. They can also guide strategic planning for regions or sectors seeking to align economic diversification with climate objectives.
- **Integrate AE into finance and procurement** as part of the eligibility criteria for innovation grants, blended finance, and procurement contracts. Institutions can allocate resources toward projects with demonstrable system-level benefits while avoiding premature crediting. Lessons from carbon finance, such as third-party verification, permanence safeguards, and transparent registries, can strengthen the AE accounting practices.
- **Developing AE literacy** across government, business, and civil society is essential for scaling applications. It entails the ability to interpret AE metrics critically, communicate their meaning effectively, and apply them responsibly in planning and reporting. AE literacy supports transparency, informed dialogue, and trust, enabling stakeholders to identify real mitigation opportunities and avoid overstated or misleading claims.
- **Targeted pilots** could explore how AE estimates might be converted into authorised mitigation outcomes under Article 6, using conservative methodologies and corresponding adjustments. These early experiments would need rigorous verification, traceability, and host-country consent, but they can test how AE frameworks interact with compliance mechanisms and inform future integration of AE approaches into cooperative climate mechanisms.

5. Future directions and recommendations

We have explored and discussed key aspects of AE, which can play an increasingly strategic role within the carbon accounting landscape if it evolves with methodological integrity and contextual sensitivity. Future development should prioritise transparency and application of consistent principles across emerging frameworks. Harmonising definitions, boundaries, and verification practices to bridge AE within established accounting systems while opening up space for innovation. Methodologies must remain dynamic, allowing for iteration as data quality, digital tools, and sectoral understanding improve. A "*good enough but transparent*" approach, rather than methodological perfection, will help maintain practicality without compromising credibility.

To realise AE's potential, greater institutional coordination and governance reform are essential. The current patchwork of initiatives —GHG Protocol, ISO, WBCSD, NZI, IEA AEF, Mission Innovation, and others— illustrates both progress and fragmentation. Future efforts should focus on creating interoperable standards and transparent reporting mechanisms that account for diverse contexts across regions and sectors. Integrating AE into broader policy and finance frameworks, such as transition planning, green procurement, and innovation funding, can transform it from a voluntary reporting exercise into a catalyst for systemic decarbonisation and industrial transformation.

Finally, the next phase of AE's development depends on collaboration, literacy and coordinated interoperable uptake across contributors based on systems thinking. Building capacity across governments, industry, and academia will allow actors to interpret and use AE responsibly, fostering shared learning and continuous improvement. Cross-sector partnerships can pilot credible approaches, test data systems, and align AE with just transition principles to ensure that climate innovation delivers equitable benefits. By cultivating trust, transparency, and cooperation, AE can move from a "marginal" tool towards a mature, enabling framework that complements carbon accounting and strengthens the collective pursuit of net-zero and sustainability.

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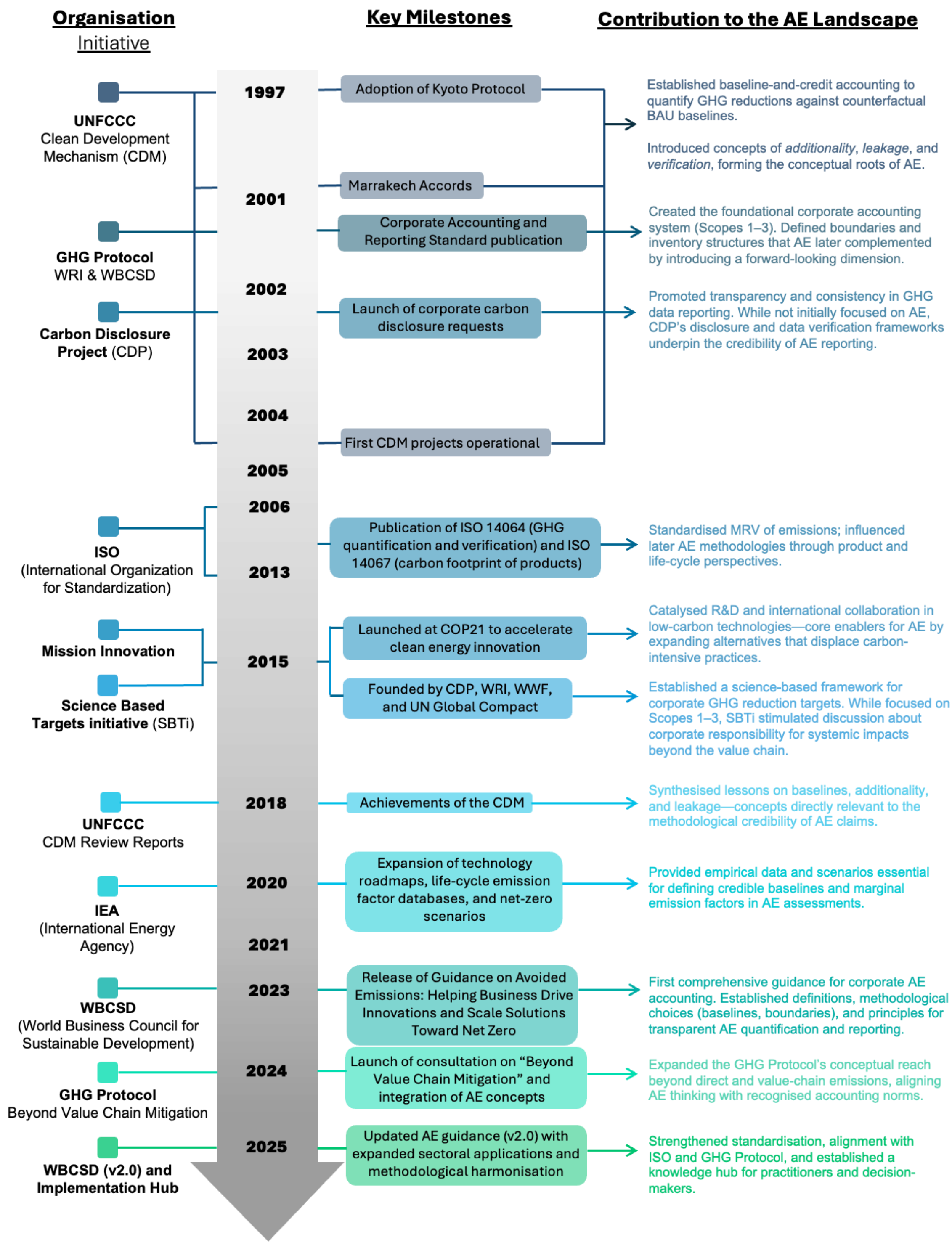
ANNEXE 1

Timeline of Avoided Emissions (AE) Concepts and Key Institutional Contributions



ANNEXE 2

Avoided Emissions (AE) Methodologies, Frameworks, and Incentives

This annexe presents a table that compiles methodologies, frameworks, standards, and incentive mechanisms developed globally to assess, quantify, or promote avoided emissions (AE). These initiatives' sources are a diverse set of institutions, including international organisations, standardisation bodies, private-sector alliances, and corporate actors. Collectively, they reflect the evolution of AE accounting as a complementary dimension to conventional carbon accounting and mitigation reporting.

The table provides a structured overview of the main efforts shaping the measurement verification and integration of AE into corporate strategies, project assessment, and policy framework. It intends to serve as a reference point for researchers and practitioners interested in understanding the diversity and interconnections among AE methodologies across sectors and scales.

The selection process combined systematic desk research and targeted expert sources. The initial reference list was derived from leading initiatives recognised in the literature and industry practice. To broaden the scope and ensure cross-sectoral coverage, additional sources were identified through keyword-based searches ("avoided emissions", "comparative impact", "enabling impact", "scope 4", "net avoided GHG"), review of major registries and reporting frameworks, and examination of sectoral and policy-specific methodologies.

Each entry was categorised according to eight analytical dimensions:

1. **Name**
2. **Year** (of publication or latest revision)
3. **Type** (methodology, framework, incentive, standard, or registry)
4. **Sector** (main domain of application)
5. **Sector focus** (whether the approach is agnostic across sectors or specific to a domain)
6. **Scale** (e.g., product, project, organisational, or policy level)
7. **Purpose** (primary intent or use case)
8. **Source**

The entries are organised alphabetically.

#	Name	Year	Type	Sector	Sector Focus	Scale	Purpose	Source
1	ACR – Avoided Conversion of Grasslands and Shrublands (ACoGS)	2013 / upd. 2024	Methodology	AFOLU	Specific	Project	Quantifies emissions avoided by preventing grassland/shrubland conversion to cropland (soil C preservation).	ACR methodologies
2	ADEME – Environmental assessment of the direct and indirect effects of digital technology on use-cases	2025	Framework / Study	ICT	Specific	Use-case / project	Evaluates direct & indirect environmental impacts of digital technologies across sectors.	ADEME report
3	AIOTI – IoT & Edge Computing Carbon Footprint Measurement Methodology	2024	Methodology	ICT	Specific	Solution / project	Defines criteria to measure carbon footprint & avoided emissions of IoT / Edge solutions.	AIOTI PDF
4	Carbon Trust – Avoided Emissions Framework (AEF)	2020	Framework / Methodology	Multi-sector	Agnostic	Product / portfolio	Guides organisations to assess avoided emissions from low-carbon solutions vs BAU.	Carbon Trust AEF
5	CDM (UNFCCC) – Approved baseline & monitoring methodologies	2005 – present	Registry / Methodology set	Multi-sector	Specific	Project / program	Defines baselines & monitoring to quantify GHG reductions (often avoided emissions).	CDM methodologies
6	CDP – Climate disclosure questionnaire (avoidance guidance)	2023	Reporting / Framework	Multi-sector	Agnostic	Organisation / product	Corporate disclosure platform referencing avoided-emission guidance (WBCSD, AEF).	CDP guidance
7	EGDC – Net Carbon Impact Assessment Methodology for ICT Solutions	2024	Methodology	ICT	Specific	Solution / project	Measures net carbon impact (incl. avoided emissions) of ICT solutions vs no-ICT.	EGDC PDF
8	EU Innovation Fund – GHG Emission Avoidance Methodology	2021–23	Methodology / Policy incentive	Energy & Industry	Specific	Project	Standardises GHG avoidance calculations for funding eligibility & monitoring.	EU Innovation Fund Methodology

9	ETSI ES 204 087 – Enabling Net Zero Transition	2025	Standard / Methodology	ICT	Specific	Solution / project	Specifies how ICT use affects GHG emissions of other sectors (avoided + induced).	ETSI standard
10	GHG Protocol – Product Life-Cycle & Comparative Impacts Guidance	2011 / 2019	Standard / Methodology	Multi-sector	Agnostic	Product / life-cycle	Life-cycle accounting for products; comparative approach for avoided emissions.	WRI Product Standard
11	Gold Standard – Avoided Emissions Methodologies (e.g., food waste, diesel genset phase-out)	2020–24	Methodology / Standard	Multi-sector	Specific	Project	Verifies avoided emissions from activities such as food-waste reduction or renewables.	Gold Standard methods
12	GSMA – Sustainability Assessment Framework	2020	Framework	ICT / Telecom	Specific	Industry / organisation	Benchmarks operators' sustainability, incl. climate & avoided-impact dimensions.	GSMA Framework
13	ICE (Intercontinental Exchange) – Avoided Emissions Dataset & Methodology	2022–24	Dataset / Methodology	Finance	Agnostic	Portfolio / investment	Estimates avoided emissions exposure of listed firms & funds for investors.	ICE Climate Data
14	IEA – Avoided Emissions Analytical Framework	2021–24	Framework / Model	Energy & Transport	Specific	Sector / scenario	Models avoided emissions from tech deployment (e.g., EVs vs ICE baseline).	IEA Net Zero Reports
15	ISO 14060 Family (14064, 14067, 14068 etc.)	2010s–2023	Standards family	Multi-sector	Agnostic	Org / product / project	International GHG quantification & reporting standards supporting comparative claims.	ISO Catalogue
16	Mizuho / GX League – Corporate Avoided Emissions Reporting Practices	2023–24	Guidance / Case study	Finance / Corporate	Agnostic	Portfolio / organisation	Shows how financial institutions and companies report and benchmark avoided emissions.	GX League Case
17	Mission Innovation – 1.5 °C Compatibility & Avoided Emissions Framework	2020–24	Framework	Energy / Innovation	Specific	Programme / portfolio	Evaluates how clean-energy innovations avoid emissions vs baseline techs.	Mission Innovation

18	Net Zero Initiative (Carbone 4) – Pillar B2: Solutions Contribution to Decarbonisation	2022	Framework / Toolbox	Multi-sector	Agnostic	Organisation / solution	Helps firms quantify decarbonisation impact (avoided emissions) of solutions.	Carbone 4 Guide PDF
19	Quantis / Avoided Emissions Platform (AEP)	2025	Platform / Methodology	Multi-sector	Agnostic	Product / portfolio	Provides harmonised "Scope 4" factors for common climate solutions.	Avoided Emissions Platform
20	SBTi – Corporate Net-Zero Standard	2021 / upd. 2024	Standard / Framework	Multi-sector	Agnostic	Organisation	Defines criteria for science-based net-zero targets (alignment with 1.5 °C).	SBTi Net Zero
21	UNFCCC / CDM – Project Baseline Methodologies (CDM Catalogue)	2005 → present	Registry / Methodologies	Multi-sector	Specific	Project / program	Provides standard rules for quantifying reductions (avoided vs baseline scenarios).	UNFCCC CDM Catalogue
22	Verra (VCS / VMR) – Avoided Emissions Methodologies (e.g., VMR0009 Biomass Wastes)	2010s–2024	Registry / Methodology	Multi-sector	Specific	Project / program	Quantifies avoided emissions from waste, biomass, AFOLU or energy projects.	Verra Methodologies
23	Voltalia – Corporate Avoided Emissions Calculation Method	2023	Corporate Methodology	Energy	Specific	Project / portfolio	Demonstrates corporate-level calculation of avoided emissions (vs fossil baseline).	Voltalia Method
24	WBCSD – Guidance on Avoided Emissions v2.0	2025	Guidance / Methodology	Multi-sector	Agnostic	Product / corporate	Harmonised approach for estimating & disclosing avoided emissions from solutions.	WBCSD Guidance
25	WRI – Estimating and Reporting the Comparative Emissions Impacts of Products	2019	Methodology / Working Paper	Multi-sector	Agnostic	Product	Framework for estimating comparative GHG impacts (incl. avoided emissions).	WRI Paper