Innovative Expansion of Greenhouse Gas Accounting Scenarios: "Avoided Emissions" Calculation

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Climate change has become the most urgent and severe challenge facing global sustainable development. In response to the temperature control targets proposed in the Paris Agreement, countries around the world have introduced carbon neutrality visions and initiated related actions. In the process of advancing climate goals, various socio-economic entities, starting from their own realities, are actively exploring emission reduction pathways by employing a range of measures. On one hand, most entities opt to reduce greenhouse gas emissions across all stages of their product's life cycle and value chain by optimizing their operational processes and strengthening supply chain management. On the other hand, some entities are leading the way by experimenting with product technology choices and business model innovations to externally guide and drive emission reductions within their life cycle or value chain systems. However, traditional greenhouse gas accounting methods have yet to consider the emission reduction impacts of the second approach. To scientifically measure the differences in emissions among various emission reduction pathways, the concept of "Avoided Emissions" has emerged, providing an additional analytical perspective for identifying and evaluating the effectiveness of climate actions taken by various socio-economic entities. This article aims to review the research and application progress of "Avoided Emissions," introduce its connotation, mechanisms, and characteristics, and focus on analyzing the mainstream methodologies and key considerations for calculating "Avoided Emissions." Additionally, it discusses the obstacles faced in calculating and disclosing "Avoided Emissions" and offers relevant recommendations.

The Definition, Mechanisms, and Characteristics of "Avoided Emissions"

In 2013, the World Resources Institute (WRI) introduced the concept of "Avoided Emissions" in a report, aiming to examine the role and contributions of organizations in climate governance from a broader systemic perspective. **WRI defines "Avoided Emissions" as "emission reductions that occur outside of a product's life cycle or value chain but as a result of the use of that product [1],**" highlighting that these reductions occur beyond the product's own system boundaries but are triggered by the application of the product or service. Other terms used to describe "Avoided Emissions" include Climate Positive, Net-positive Accounting, and Scope 4. In 2019, WRI published the "Estimating and Reporting Avoided Emissions" guidelines, providing a more systematic explanation of the definition, calculation, and disclosure of "Avoided Emissions." [2] These developments indicate that achieving systemic emission reductions beyond organizational boundaries through transformative innovations in technology, products, and business models has become a new trend in international carbon accounting standards and corporate practices. This trend is of great significance for guiding corporate strategic transformation, encouraging innovative emission reduction efforts, evaluating systemic emission reduction performance, and even promoting the low-carbon transition of the entire economic system.

From the perspective of emission reduction mechanisms, "Avoided Emissions" can be divided into two categories. The first category involves the direct substitution of high-carbon products/activities by low-carbon products/activities, such as the replacement of business travel with teleconferences, which reflects the substitution effect of the product. The second category involves the optimization effect of the product on external systems during its use, such as reducing carbon emissions from residents' travel through public transport-oriented building site selection or decreasing energy consumption in water supply systems through water-saving devices, which reflects the spillover effect of the product. Both types of emission reductions occur downstream of the product or service value chain and even at a broader societal system level, extending beyond organizational operational boundaries.

In terms of calculation boundaries, impact scope, and control mechanisms, "Avoided Emissions" exhibit notable differences from traditional greenhouse gas accounting. Specifically, "Avoided Emissions" focus on the emission reduction effects resulting from an organization's innovative activities beyond the lifecycle or value chain of its products. The primary focus is on the external carbon reductions achieved through the organization's products and services. Regarding impact scope and control mechanisms, "Avoided Emissions" represent systemic results of product use. Although organizations do not have direct control over these outcomes as they do over their own emissions, they can influence user behavior and optimize external systems through enhancements in product performance and innovations in service models. This, in turn, can affect carbon reduction at a broader societal level. Thus, from an organizational carbon management perspective, "Avoided Emissions" are aimed at fostering low-carbon transitions among stakeholders through product and business model innovations.

Approaches to Calculating Avoided Emissions and Essential Considerations

When discussing the quantification of greenhouse gas reduction contributions, the concept of Comparative Impacts is central. Comparative Impacts reflect the emission differences between a product or service and its alternatives under equivalent functions, highlighting the extent of a behavior's impact on climate change. According to the WRI's 2019 guide, "Estimating and Reporting Avoided Emissions, [3]" Comparative Impacts can be further categorized into Positive Impacts and Negative Impacts. Positive Impacts, often referred to as "Avoided Emissions," underscore the positive contribution of a product or service to climate action. Conversely, Negative Impacts represent additional emissions, emphasizing the challenges that remain in the reduction process. Currently, the industry commonly uses two evaluation approaches for calculating Comparative Impacts: the Attributional Approach and the Consequential Approach. These approaches provide static and dynamic perspectives on the comparative impacts of the subject's actions.

The Attributional Approach seeks to quantify the greenhouse gas emissions associated with a specific product or service throughout its lifecycle, focusing on the product's micro-level attributes. To estimate Comparative Impacts, this method initially establishes the functional unit of the assessment and reference objects, such as "passenger transport service per kilometer." The Attributional Approach then calculates the greenhouse gas emissions for each lifecycle stage—from raw material extraction, production, and transportation to use and final disposal—for both the assessment and reference objects. The comparative impact is determined by the difference between the emissions inventories of the two objects. A lower emission value for the assessment object compared to the reference object signifies a positive comparative impact or "avoided emissions" benefit.

FORMULA 1: CALCULATION OF COMPARATIVE IMPACT UNDER THE ATTRIBUTIONAL APPROACH

Comparative Impact of Greenhouse Gas Emissions = **Greenhouse Gas Emissions of the Reference Object** − **Greenhouse Gas Emissions of the Evaluated Object**

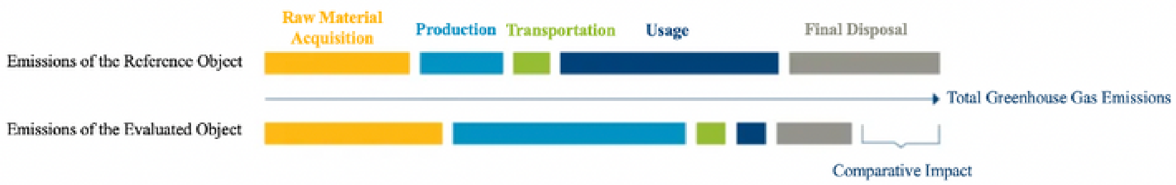

Figure 1: Logical Framework for Calculating Comparative Impact under the Attributional Approach

This method further extrapolates the total "avoided emissions" to the usage phase based on the projected sales volume of the product. The Attributional Approach is valued for its straightforward calculation logic and relatively accessible data, rendering it a fundamental tool for environmental impact assessment at the product level across various industries. However, it is constrained by its focus on the product's own attributes, neglecting the effects of decisions on external social systems. This limitation may lead to an underestimation of the broader emission reduction contributions of a company within its value chain and society as a whole.

The Attributional Approach is designed to assess changes in macro-level environmental impacts resulting from specific decision-making behaviors, with a focus on causality and marginal effects. This method involves defining a baseline scenario and a reduction decision scenario to estimate the comparative impact of the reduction decision by analyzing the difference in greenhouse gas emissions between these two scenarios. Specifically, the Attributional Approach starts by assuming that entities operate under usual conditions and constructs a baseline scenario that accounts for the evolution of external factors. This baseline serves as a reference for evaluating the impact of reduction decisions. Subsequently, the method establishes a reduction decision scenario (such as improving energy efficiency) and simulates the resulting emission changes in the external system due to the decision-making behavior. It is important to note that the external system considered in this approach encompasses not only the upstream and downstream value chains of the entities but also broader socio-economic factors, including the national energy system, industrial layout, and consumption patterns. The difference in emissions between the baseline scenario and the reduction decision scenario reflects the comparative impact of the decision. If emissions in the decision scenario are lower than those in the baseline scenario, the positive emission difference quantitatively represents the "avoided emissions" potential of the decision, indicating the entity's contribution to emission reduction at the system level.

Unlike the Attributional Approach, which focuses on the product's performance, this approach incorporates the external effects of reduction behaviors, providing a unique advantage in evaluating decisions with structural impacts, such as energy substitution, technological innovation, and business model changes. However, this approach faces challenges related to system boundary identification, baseline scenario setting, and key parameter assumptions, and demands high data acquisition and modeling analysis capabilities, which can limit its practical application.

FORMULA 2: CALCULATION OF COMPARATIVE IMPACT UNDER THE ATTRIBUTIONAL APPROACH

Comparative Impact of Greenhouse Gas Emissions = **Greenhouse Gas Emissions Under the Baseline Scenario** − **Greenhouse Gas Emissions Under the Emission Reduction Policy Scenario**

The methods for calculating related emission reductions have become increasingly sophisticated, with several authoritative standards providing systematic guidance for companies. Internationally, standards such as the GHG Protocol, ISO 14069, and the French regulatory method have defined and provided reference methods for "avoided emissions." [4] Additionally, international organizations like the Net Zero Initiative and Carbone 4 have developed relevant guidelines that further detail calculation processes and disclosure requirements. Although these standards differ slightly in their calculation boundaries, they share a common approach: quantifying reduction benefits by comparing the emissions of innovative reduction schemes with those of conventional schemes. When setting up calculation scenarios, existing standards generally require the definition of two types of scenarios: one representing the target scenario with the deployment of innovative reduction schemes, and the other representing the conventional scenario lacking such schemes. "Avoided emissions" are then reflected as the difference in emission levels between these two scenarios. In configuring the conventional scenario, relevant entities should carefully assess the potential competitive paths and market substitution effects of the innovative scheme, while taking into account industry characteristics, technology maturity, and other factors.

This approach aligns with the Attributional Approach for calculating "avoided emissions," emphasizing a systematic examination of value chain reduction effects from the marginal impact of decisions. In preparing calculation parameters, companies must comprehensively gather activity level data and emission factors for both the target and conventional scenarios. Activity level data should consider both the anticipated market scale of the innovative scheme and key technical parameters during the usage phase and end-of-life.

In the calculation process, it is crucial to address three key issues to thoroughly evaluate the direct substitution effects of low-carbon products and the external optimization effects during their usage phase: selecting reference products, determining substitution ratios, and defining assessment periods. **Selection of Reference Products:** The choice of reference product is pivotal in determining the relative emission reductions of the innovative product. It is essential to ensure that the reference product is comparably aligned with the innovative product in terms of functionality, performance, market presence, and technological maturity. For newly developed low-carbon products, the reference product is typically the high-carbon counterpart that is being replaced or phased out. For upgraded products, the reference product may be a previous version of the same product. In all cases, the selection of reference products should be based on a thorough techno-economic analysis, with a preference for high-substitutability products that hold a significant market share in the target market. **Substitution Ratio and Functional Equivalence:** The degree to which the innovative product can effectively substitute the reference product directly influences its emission reduction potential. During the R&D phase, when the product is not yet commercially available at scale, substitution ratios can be qualitatively estimated using technology roadmaps, expert opinions, and other methods. Once the product enters the market, actual sales data should be used for dynamic adjustment. Additionally, converting the unit usage of the innovative product into equivalent functional units of the reference product is crucial for ensuring comparability. This requires a systematic definition of functional units, including key attributes such as product function, usage intensity, and lifespan. **Definition of Assessment Periods:** Calculating "avoided emissions" necessitates a precise definition of the lifecycle stages to be included in the assessment and establishing the assessment period based on the expected lifespan of the product. For short-lived consumer goods, the assessment should focus on primary stages such as production, use, and disposal. For long-lived capital goods, such as buildings and infrastructure, a comprehensive evaluation across the entire lifecycle is required for long-term assessment.

Challenges and Suggestions for Avoided Emissions Calculations

The calculation and disclosure of "avoided emissions" is a cutting-edge topic in the field of greenhouse gas management and plays a crucial role in advancing societal low-carbon transformation. However, its standardized development still faces several pressing challenges. Firstly, existing guidelines for calculating "avoided emissions" lack sufficient detail and operability, with no unified regulations for key aspects such as system boundaries and scenario assumptions. This leads to inconsistencies in calculation methods among different entities and results in non-comparable disclosure outcomes. Secondly, calculating "avoided emissions" imposes high demands on data management and analytical capabilities. Unlike traditional greenhouse gas accounting, "avoided emissions" requires extensive data on product lifecycles and external value chain emissions, which often lack standardized collection channels and reporting mechanisms. This results in variable data quality and necessitates substantial resources for data cleaning, integration, and computation. Thirdly, the flexibility of "avoided emissions" calculation rules may lead some organizations to exploit the subjectivity of scenario settings to selectively disclose favorable emission reduction metrics, potentially exaggerating product benefits and misleading the public, which risks undermining credibility and contributing to "greenwashing." Finally, while significant resources are required for calculating "avoided emissions," there is currently a lack of empirical evidence supporting the extent to which these calculations can generate environmental reputation premiums and competitive advantages for businesses, and whether these benefits justify the high calculation costs.

Currently, China should tailor its approach to its developmental stage, carefully manage the pace of achieving carbon peaking and carbon neutrality, and actively explore practices related to "avoided emissions" calculations. The objective should be to establish a path that is both practical and effective within the context of national conditions. In terms of calculating "avoided emissions," it is recommended to adopt a trial-and-error approach guided by pioneering examples. It is crucial to encourage industries, enterprises, and products with strong foundational conditions and significant emission reduction potential to follow international practices and lead in practical calculations. This will help identify and promote replicable practices, laying the groundwork for broader adoption of "avoided emissions" calculations and building experience. Looking ahead, as calculation capabilities advance and data foundations are strengthened, there is a need to develop a unified national standard for "avoided emissions" calculations.

Authoritative standards organizations should spearhead this effort by creating detailed, actionable guidelines for critical parameters such as system boundaries, activity level data, emission factors, and scenario settings, thereby reinforcing the methodological framework.

REFERENCES:

[1] World Resource Institution (2013). Do We Need a Standard to Calculate "Avoided Emissions"?. https://www.wri.org/insights/do-we-need-standard-calculate-avoided-emissions

[2] WRI (2019). Estimating and Reporting Avoided Emissions. https://ghgprotocol.org/estimating-and-reporting-avoided-emissions

[3] WRI (2019). Estimating and Reporting Avoided Emissions. https://ghgprotocol.org/estimating-and-reporting-avoided-emissions

[4] Global Climate Initiatives. Scope 4, avoided emissions, what are we talking about?. https://globalclimateinitiatives.com/en/scope-4-emissions-evitees-de-quoi-parle-t-on/

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