EDITORIAL

The most important GHG accounting concept you may not have heard of: the attributional-consequential distinction

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ABSTRACT

There are two major types of GHG accounting, attributional methods and consequential methods. Often practitioners are not aware of the distinction and use an inappropriate method for a given purpose. Attributional methods are inventories of emissions and removals within a defined inventory boundary and are appropriate for allocating carbon budgets and setting reduction targets. However, attributional methods can lead to actions that unintentionally increase emissions as they only provide information on emissions/removals within the inventory boundary. Consequential methods aim to provide information on the system-wide or global change caused by actions and are the appropriate method for informing decisions aimed at reducing emissions.

Introduction

Too often environmental professionals, policy-makers, and standard-setters fail to distinguish between two major types of GHG accounting methods [1] – which are appropriate for fundamentally different purposes. Using the wrong type of method can lead to bad decisions for climate change mitigation [2], and unfortunately, this happens all too often.

Many GHG accounting practitioners will be familiar with "attributional" type methods, which create inventories of emissions—for example, corporate GHG inventories [3], national GHG inventories [4], and traditional product life cycle assessments [5]. Often practitioners mistakenly assume that attributional is the only type of method and try to use such methods to answer questions that they cannot and should not be used to answer – like how much a mitigation action reduces emissions.

A fundamentally different type of GHG accounting method is "consequential", which aims to quantify the change in emissions caused by decisions or interventions. Examples include project-level accounting and consequential life cycle assessment [1]. This type of method is also sometimes called "intervention" accounting [6].

Figure 1 provides an overview of most GHG accounting methods and indicates whether they are attributional or consequential.

To give a real-world example for why the distinction matters: The Scottish whiskey industry has started using the grain residues from its distilling processes as a fuel because this substitutes for their use of fossil fuels [7]. With this change in fuels, the GHG emissions reported in their corporate GHG inventories decrease. However, livestock farmers who previously used the grain residues as animal feed now must buy more soy meal, which increases the cultivation of soy and contributes to deforestation in countries expanding their agricultural output. The decision to switch fuels might look good within an attributional inventory of a single company, but such an attributional accounting method will not inform you of any changes in emissions caused by the decision that occur outside the corporate inventory boundary.

Appropriate purposes of attributional and consequential methods

Attributional methods are appropriate for allocating "carbon budgets" to entities as, in theory, they can be "summed" to equal total global emissions (e.g. the sum of all national inventories should approximate to total global emissions and the sum of all sub-national scope 1 emissions should approximate total direct national emissions) without double counting or omissions [8]. Attributional methods generally provide clear rules for identifying a specific set of sources and sinks, and for allocating "ownership" or "responsibility" to different entities. For example, for national emission inventories, the boundary rule is all emissions/removals physically occurring within the country’s territorial borders. Such a rule can be applied with a high degree of certainty and is therefore appropriate for regulatory compliance or legally binding targets.
Consequential methods do not define a scope of responsibility concerning an entity in this way, as they are instead concerned with the impacts of specific decisions.

Problems arise, such as the example with the Scottish whiskey industry, when attributional methods are used to inform decisions aimed at reducing GHG emissions because attributional methods do not tell us about consequences that occur outside the entity’s defined inventory boundary [2]. As a result, decisions can be blind to indirect impacts and actors can be misled into implementing actions that lower their entity’s attributed emissions while inadvertently increasing global emissions.

Instead, consequential methods should be used for informing decisions aimed at reducing emissions, as they provide information on the system-wide or global change in emissions caused by the decision or intervention (e.g., they set the accounting boundary as large as it needs to be to capture all material direct and indirect impacts). Returning to the Scottish whiskey industry example, a proper application of consequential GHG accounting to estimate the impact of using grain residues for bioenergy would entail expanding the assessment boundary to include indirect effects, including those mediated through markets, and excluding from the assessment sources and sinks unaffected by the decision.

Table 1 provides a summary of the key features, limitations, and uses of each type of method.

**Common issues**

What is striking is that the attributional-consequential distinction is still not recognized widely enough by GHG management practitioners. Too often governments or companies implement climate change mitigation actions because doing so reduces emissions within an attributional boundary, without proper consideration of the system-wide consequences.

A further mistake that sometimes occurs is the mixing of attributional and consequential approaches within a single method or analysis, such as including values for avoided emissions within what should be an inventory of actual emissions and removals. For example, a mistake that was previously in the United Kingdom (UK) government guidance for corporate GHG accounting was the use of a negative emissions factor for recycled waste due to the avoidance of emissions from landfills. The results are problematic as they are inappropriate for managing carbon budgets as they do not sum to total emissions, and neither would the inventory results show the total system-wide change caused by specific decisions or interventions.

**Conclusion**

It is important that both attributional and consequential methods are used, with each used for their appropriate purposes. Attributional methods can be used for allocating responsibility, setting reduction targets, and tracking progress towards the achievement of those targets within specified boundaries. However, any actions aimed at reducing emissions should be checked with a consequential method to ensure they do not unintentionally increase emissions outside the inventory boundary. Further, you should be skeptical of any claims that actions taken led to “emission reductions” if the claim is based solely on attributional GHG inventory reporting. Such claims should be supported with impact estimations using an appropriately chosen consequential method.

[1] This paper focuses on GHG accounting, but the attributional-consequential distinction can be applied to all forms of social and environmental accounting.

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**Figure 1. Categorization of physical GHG accounting methods as “attributioanl” or “consequential”.**

![Diagram](image-url)
Table 1. Summary of key features and appropriate uses of attributional and consequential methods.

| Feature                        | Attributional methods                                                                 | Consequential methods                                                                 |
|--------------------------------|--------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------|
| Accounting purpose             | Allocating responsibility to entities for emissions/removals arising from specified sources/sinks; for establishing emissions quotas and/or tracking emissions over time. | Quantifying system-wide change in emissions/removals caused by a decision or intervention. |
| Boundary setting principles    | Boundary determined by a normative ruleset, typically based on physical connections between each entity and emissions source or removals sink. For example, for national inventories the rule is “all sources and sinks physically existing within the territorial jurisdiction of a country.” | Boundary determined by the intervention and output parameter (e.g. GHG emissions) that is studied, i.e. all (and only) sources and sinks that change as a result of the decision or intervention studied. |
| Type of “change” that can be accounted for | Change relative to a base year/period                                                  | Change relative to a counter-factual baseline (i.e. what would have happened in the absence of the decision or intervention studied). |
| Retrospective or prospective   | Generally, attributional methods are applied retrospectively (ex post), but this is not a necessary feature of attributional methods and they can be applied to future scenarios. | Generally, consequential methods are applied to inform future decisions (ex ante), but this is not a necessary feature of consequential methods and they can be applied to evaluate the impact of decisions/interventions in the past (ex post). |
| Output information             | Physically measurable quantity of GHGs released to and/or removed from the atmosphere. | Estimated change in GHG emissions to and/or removals from the atmosphere caused by a specified decision or intervention, relative to a counter-factual baseline (not physically measurable). |

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