The differences between allocational and consequential greenhouse gas accounting —Summarized

Michael Gillenwater

Photo: Vlad Chețan/licensed under https://creativecommons.org/licenses/by-sa/2.0/

January 2025

ghg management institute

Author

Michael Gillenwater co-founded the Greenhouse Gas Management Institute and serves as its Dean and Executive Director.

Dr. Gillenwater is a leading expert on climate change and renewable energy, with a specific focus on greenhouse gas (GHG) measurement, reporting, and verification (MRV) issues. He has dedicated his career to the development of the policies and infrastructure needed to produce highly credible environmental information that can serve as the basis of voluntary, regulatory, market, and other compliance mechanisms, especially monitoring and verification policies and management and reporting systems for GHGs and ecosystem services.

Acknowledgments

We are grateful for the insightful comments from and discussions with Derik Broekhoff (SEI), Matthew Brander (University of Edinburgh), and Tani Colbert-Sangree (GHGMI).

Recommended Citation

Gillenwater, M., (2025). The differences between allocational and consequential greenhouse gas accounting—Summarized. Greenhouse Gas Management Institute, January 2025. https://ghginstitute.org/2025/01/13/the-differences-between-allocational-and-consequential-greenhouse-gas-accounting-summarized

Introduction

For the last few years, through our writing and teaching, the Greenhouse Gas Management Institute has been spreading and elevating technical knowledge on greenhouse gas (GHG) accounting theory and methods (see here for the full series of installments). From the beginning, we started with the fundamental distinction between types of methods.[1] With this blog, I am providing a compact explanation and summary, in different formats, of these two fundamental types of GHG accounting, with a focus on their differences. Hopefully these summaries will serve as a useful reference for your work.

The one-sentence summary—an allocational method quantitatively assigns responsibility for emissions and removals to an accounting subject, while a consequential method quantitatively attributes avoided emission and enhanced removal impacts to an intervention. This table provides a richer summary in a tabular format (Table 1) from which distinctions can be derived, followed by a summary in a narrative format.

Summary Table

Table 1: Summarized qualities of allocational and consequential GHG accounting

Quality	**Allocational GHG Accounting**	**Consequential GHG Accounting**
Subject of accounting	An entity, such as a facility, organization, company, country, or other geopolitical jurisdiction (e.g., EU).	A specific action or decision (i.e., an intervention) such as subsidizing the construction of a solar energy installation project.
Purpose	To assign responsibility for emissions and removals to entities (e.g., countries, companies, or facilities) so that emissions from these assigned sources can be totaled and tracked over time and reduction targets established (e.g., a 50% reduction in total corporate emissions from 2010 to 2030).	To quantify the global change in GHGs in the atmosphere (i.e., avoided/induced emissions and enhanced/inhibited GHG removals) caused by an action (i.e., intervention) to inform decision making regarding the choice of actions to take as well as evaluate the impact of past actions.
Accounting boundaries	GHG accounting boundaries include only those emission sources and removal sinks that the subject of the	GHG accounting boundaries extend to whatever GHG emitting or removing processes are altered

[1] As discussed in Installment N.1 "Furnishing Definitions", allocational and consequential methods are two subtypes of physical GHG accounting. The three overarching types of GHG accounting are physical, performance, and economic.

	GHG accounting is deemed to embody and/or allocated responsibility for. For example, for national GHG accounting under the IPCC and UNFCCC guidelines, the GHG accounting boundary is the sources and sinks existing within the geographical border of the country (including territories).	(including additions and/or subtractions) by the intervention, while processes that remain unchanged by the intervention (i.e., are the same in the intervention and without-intervention scenarios) are excluded. For example, an intervention in the form of replacing an oil-fired boiler before the end of its life with a heat pump would exclude the employee commuting emissions of the building superintendent from the consequential method's boundaries.
Temporal reference	Quantifying time series trends in emissions and removals within a defined accounting boundary relative to emissions and removals occurring within that same boundary that occur *during another*, typically earlier, time period (e.g., a base year).	Quantifying avoided emissions and enhanced removals relative to what would have happened in *the same* time period (e.g., within the same year) in an alternative scenario (i.e., the scenario without the intervention).
Comparability	Comparability exists between accounting subjects as determined by their accounting boundaries, temporal resolution (e.g., annually), and category resolution (i.e., disaggregation of GHG sources and sinks). If these elements are uniform between accounting subjects, then their inventories are comparable.	Comparability exists between scenarios as determined by the scale of the interventions being compared; that the two scenarios provide the same level of products, function, or services; and the holding of other unaffected factors constant (i.e., assuming the same independent variables or input conditions for all scenarios).
Appropriate type of activity pool (e.g., electrical grid) emission factors[2]	Average emission factors that allocate emissions from all producers (e.g., energy generators supplying an electrical transmission and distribution grid) within a defined area as all consumers draw on an untraceable pooled supply of output (i.e., electricity) across all producers (i.e., grid-connected generators).	Marginal emission factors that represent production changes by producers (e.g., power plants) operating "at the margin" that will change output levels (short-term) as well as broader production capacity changes (long-term) because of the intervention.

[2] See here for an explanation of the "activity pool" concept: https://ghginstitute.org/2024/01/31/what-is-ghg-accounting-market-based-mistake/

Technical Definition	Regularly quantifying (i.e., estimating and/or measuring) physical quantities (mass) of GHG emissions and removals allocated to subjects (e.g., facilities, organizations, jurisdictions, countries) over time with comparability between subjects' estimates, time series consistency, completeness, and additivity to system-wide total emissions from the defined population of subjects. Allocation (i.e., assignment of responsibility) of emissions and removals should entail a physical (i.e., matter or energy) connection to the accounting subject. The general purpose of the GHG accounting of emissions and removals is to quantify changes over time and the result for each unit in the time series is a GHG inventory.[3]	Estimating the differences in physical quantities (mass) of atmospheric GHG emissions and removals between a baseline (i.e., non-intervention) scenario relative to an intervention scenario, with comparability between scenarios over time for the purpose of quantifying avoided/induced emissions and enhanced/inhibited GHG removals caused by an intervention. Also referred to as "intervention" accounting, as the subject of the accounting is an intervention.

Narrative Explanation

There are two major types of physical GHG accounting methods—allocational and consequential. (If you thought the term was "attributional" instead of "allocational", then read this rationale for the shift in thinking and language.) Allocational methods are GHG inventories of emissions from sources, and removals from sinks, which are conducted repeatedly to produce a time series. Consequential methods quantify the impact (i.e., avoided emissions or enhanced removals) of specific actions or decisions.

The subject of GHG accounting using an allocational method is some form of entity, such as a country, company, facility, or product. The subject of GHG accounting using a consequential method is an intervention (i.e., action). Fundamentally, every decision to act can be viewed as an intervention, and a decision not to act is then viewed as the absence of that intervention.[4]

Allocational methods quantify emission reductions relative to emissions occurring within a defined boundary in the previous time period (e.g., year), and importantly they do not account for any emissions or removals occurring outside of that accounting boundary. While consequential methods quantify avoided emissions relative to what would have happened *in the same time period* (e.g., year) in an alternative scenario (i.e., "baseline scenario" without the intervention).

[3] Although, colloquially, the entire time series is often referred to as a "GHG inventory."
[4] An intervention could also be deciding to not act, when otherwise one would have acted. Generically, an intervention means deviating from a baseline course of action.

The purpose of allocational (i.e., inventory) GHG accounting methods is *to assign responsibility* for emissions and removals to entities, such as companies. Ideally these inventoried quantities can be summed to produce a total for all entities in a population applying the same method (i.e., additivity). For example, the sum of all national GHG emission inventories produces a total for global anthropogenic emissions without double counting or omissions.[5] By assigning responsibility to a company for emissions from specific sources (ideally exclusively[6]), emissions from these assigned sources (and removals from assigned sinks) can be totaled and tracked over time, thereby allowing reduction targets to be established (e.g., a 50% reduction in total corporate emissions from 2010 to 2030).

In contrast, the purpose of consequential methods is to inform decision-making regarding the choice of actions to take (*ex-ante*) as well as evaluate the impact of past actions (*ex-post*) by quantifying all of the changes in emissions *caused* by an isolated action (i.e., an intervention) regardless of where the impact occurs. In other words, the GHG accounting boundaries of a consequential method extend to include whatever GHG emitting or removing processes are altered by the intervention (i.e., any sources that are different in the intervention scenario relative to the no intervention scenario are included in the boundary), while processes that remain unaltered, directly or indirectly, by the intervention (i.e., are the same in the intervention and no-intervention scenarios) are excluded from the accounting.

An allocational method can be used to quantify changes in emissions and removals relative to emissions and removals occurring in another, typically earlier, time period. While a consequential method quantifies changes in emissions and removals relative to emissions and removals occurring in the same time period but in an alternative scenario (e.g., absent the intervention). Both types of methods, though, produce a time series of estimates, but their respective time series represent two different types of physical quantities.

Problems arise when allocational (inventory) GHG accounting methods are used as the basis for choosing which action will result in lower emissions to the atmosphere. Allocational methods will not account for changes in emissions over time that occur outside a subject's defined inventory accounting boundary. Any impact outside of that boundary caused by the actions under consideration will be overlooked.[7] For example, companies can be misled into implementing actions that lower their emissions inventory while inadvertently increasing global emissions relative to the alternative of not taking that action. Allocational methods are also generally unable to evaluate the impact of actions because even the changes in emissions from sources that are within the inventory accounting boundary of an entity will typically be affected by many factors (e.g., weather, process changes, production changes). A trend in inventoried

[5] International aviation and marine bunkers are treated as "entities", akin to countries, for the purpose of identifying total global anthropogenic emissions.

[6] Exclusive allocation (i.e., assignment of responsibility) enables additivity across accounting subjects (i.e., sum of the parts equal the whole). Further, the less exclusively that emissions are allocated the more that responsibility is effectively assigned collectively, resulting in a dilution of accountability.

[7] One approach that attempts to address this limitation in allocational methods is to expand GHG inventory boundaries to extreme limits (e.g., corporate life cycle inventories also referred to as Scope 3) hoping that all possible effects of a decision will occur within the inventory accounting boundaries. An obvious problem with such an approach is that the emissions data and calculations for sources and sinks unaffected by the decision are unnecessary (i.e., wasted effort) for the evaluation of impact.

emissions over time does not isolate the impact of individual actions but instead reflects the combined effect of all factors (i.e., there exists a signal-to-noise problem if trying to claim that specific action(s) cause the trend).

Both allocational and consequential methods entail predictions when applied *ex-ante*. However, consequential methods involve the added challenge of predicting results under two scenarios. And when applied *ex-post*, a consequential method will still require a prediction of the scenario that is not observed (i.e., the counterfactual baseline).

Lastly, to produce meaningful physical GHG accounting results (i.e., true changes in GHGs entering and leaving the atmosphere), allocational and consequential methods should not be mixed in a single metric because they quantify changes relative to two entirely different references (e.g., previous year and alternative scenario in the same year, respectively). Combining allocational and consequential methodological elements into one time series leads to incoherent results that are a mishmash of physically occurring emissions and avoided emissions.