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Time to move from accounting to decision support? Considerations for improved emission disclosure enhancing the green transition

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Abstract: To remain relevant in the green transition, companies are beginning to voluntarily account for the exchange of emissions in their supply chain transactions and using the resulting greenhouse gas inventories for climate resilient decision support. Market advantages of sustainability and transparency see a shift from internal decision support tools to external communication tools which potentially expose companies to the risk of uncovering greenwashing if claims are not supported by transparent data, sound modelling, and a climate just emissions inventory, which considers external impacts connected to the production system. The different methods and standards in place for such greenhouse gas inventories, despite all referring to the ISO life cycle analysis standards and guidelines, present mixed signals and leave room for different interpretations, that may ultimately lead to cascading greenwashing, misleading results, and false successes. The new GHG Protocol Land Sector and Removals Guidance draft addresses this in part. With the GHG Protocol moving into revision periods, we identify gaps that present barriers to companies, or allow for interpretations that goes against the intentions of reporting GHG emissions related to an activity or organisation. The literature agrees that not rectifying these subtleties present counterproductive decision support for the green transition's overall goal: to reduce global emissions.

Keywords - climate change mitigation and adaptation; economic structures; inequality; driving forces; transitional risks; consequential attributional

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Scope 3 emissions and inequalities

Companies are expected to play a pivotal role in reaching national emission targets by reducing their production related emissions, but such policies do not yet address embedded emissions in the value chain. Still, companies can voluntarily disclose their organisational or product footprints, and carbon management strategies e.g. via CDP (formerly the Carbon Disclosure Project) and Science Based Targets (SBTi) on a global level. In Europe, emission disclosure is expected to be part of the larger requirements for companies satisfying the Corporate Sustainability Reporting Directive (CSRD) (European Commission, 2022). The dominant language for how to estimate these emissions follow the Greenhouse Gas Protocol (GHGP), which define three scopes that emission sources are allocated to, and how to navigate varying qualities of data. For the majority of companies, the most significant portion of their emissions are in scope 3, the value-chain (Sanderson, 2021). Despite contributing so much, activities reported across the 15 categories of scope 3 (both up and down the value chain) are chosen by the company, and all 15 categories are considered optional by the GHGP. If we consider perceptions of justice and sustainability against the global emission distribution, we can say that including scope 3 emissions is a requirement for the climate just GHG inventory. Further, if the inventory is to provide adequate decision support, the methods used to estimate emissions need to represent the true impact, i.e. by including all relevant activities and considered from a systems perspective, for a just and sustainable global transition. The most significant

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scope 3 categories reported by companies today are currently voluntary, where incomplete, and incomparable data coupled with limited accountability will hinder the transition. As emission disclosure is becoming recognized as a must-have in seller/buyer transactions for companies who openly engage with and promote sustainability, disclosure acts to inform both parties of the invisible transaction costs. While the product and organisational footprint share many data sources, there remains the need for complete and transparent quantification, supported by sound data.

On a global scale, the disproportionate and inequal distribution of GHG emissions (and along with these, other production related hazardous emissions) between the North and South is the greatest. While industrialized countries have overall reduced their national emissions since 1990, outsourced production related emissions in China and India have increased dramatically (figure 1) in so called pollution havens (Taylor, 2004). One driver of this inequality is that companies of industrialized countries have increased their net-import of CO2 embedded in trade (figure 2) (Ritchie et al., 2020). In China, for example, intermediate products are identified as the main source of embodied emissions export (Fei et al., 2020) – in other words, the geographical distribution of companies from industrialized nations' scope 3 emissions highlight the inequality of global emission distributions. On an organisational level, who is responsible for these embedded emissions? Sanderson (2021) suggests a shared responsibility that reflect our perceptions of sustainability and justice, that lacks in many transactions of today, and which is also widely reflected in literature (Eder & Narodoslawsky, 1999; Kondo et al., 1998; Le Quéré et al., 2016; Munksgaard & Pedersen, 2001; Peters & Hertwich, 2008a, 2008b)

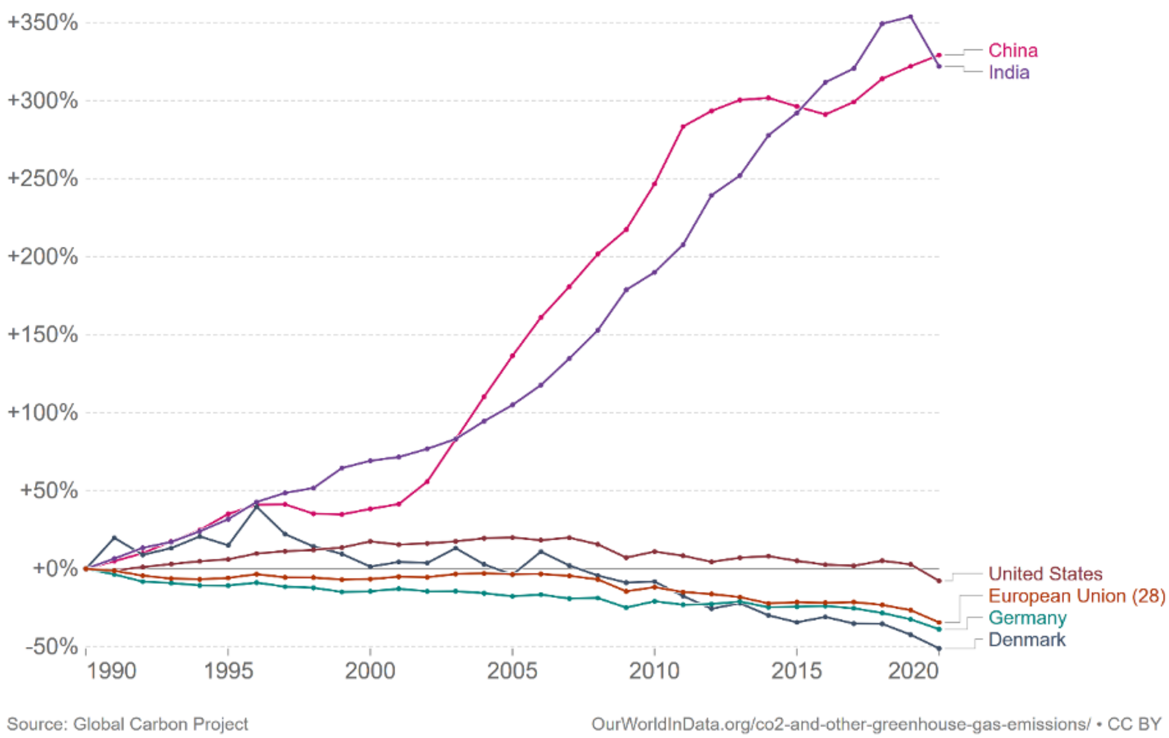

Figure 1. 1990 to 2020 change in annual CO2e emissions from fossil fuels and industry. It should be noted that the increase in India and China reflects production to both foreign and domestic consumption. Land use change is not included (Ritchie et al., 2020).

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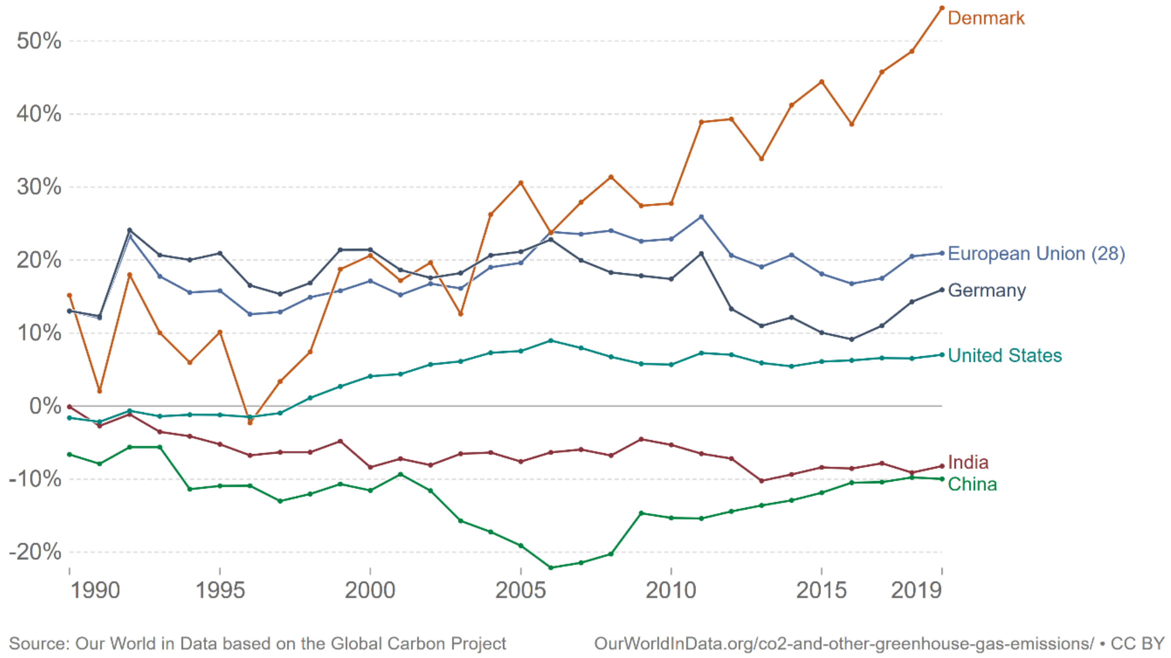

Figure 2. 1990 to 2019 change of CO2e emissions embedded in trade measured as emissions exported or imported as the percentage of domestic production emissions (Ritchie et al., 2020).

Not reacting to these inequalities will perpetuate the pollution havens of the world continuing to bear the unfair emissions burden of global transactions. However, when considering this, it is important to note how one determines who is responsible for what. The notion of shared responsibility is linked to the value chain, but as we will return to, there are compelling arguments for linking the responsibility to changes of flows in response to decisions, which may be both in and outside the value or supply chain (Weidema et al., 2018). This opens for important discussions of what determines the changes in CO2e emissions as depicted in figure 1 and 2, and what actions are needed to control these.

Decision Support

The emissions inventories that result from the GHGP framework start as an internal decision support tool and develop to an external tool. Like economic accounting, there can be two inventories, internal and external, each serving a different purpose by answering different questions e.g. inventories that disclose proprietary information are naturally suited for internal use and can point to emission reduction interventions. In emission inventories, conflating internal and external inventories hem the usefulness of the exercise, unless the investigator can identify what is a relevant and useful assessment.

Organisations and frameworks such as CDP, SBTi, and the CSRD require and assess disclosure of climate impacts and climate plans, which for the unwitting company, points the internal tool outwards, aimed at among others, investors. Climate responsible investors are expected to represent a substantial portion of the €1 trillion that EU Green Deal plans to mobilize over the next decade (European Commission, 2020). Investor's actions will be based on assessments and reports underpinned by company disclosures from organisations and frameworks such as CDP, SBTi and the CSRD. For reporting companies, determining what a relevant and useful assessment is, present uncertainties that embody the transitional climate risks presented by the Task Force for Climate Related Non-Financial Disclosure (TCFD, 2020). Therefore, if a company is supported with climate related information, they can make climate resilient decisions, which, in turn reduces their climate related transitional risks (and present opportunities). Central to managing transitional risks are sound, robust, and quantitative assessment of risks, which is supported through accurate and transparent climate related information (Sanderson & Stridsland, 2022).

But where is the emissions data coming from and what kind of data quality is sufficient? Traditional transactions focus on the material bought, and the money received, but CO2 is also embedded and often hidden in the transaction (Sanderson, 2021). As the majority of a company's emissions are in scope 3, they are by definition and in part, another company's direct scope 1 and 2 emissions. This is all good and well, as these emissions are some of the more direct and easier emissions to manage, which may provide advantageous reductions in a producer's carbon intensities and opens up for buyer/seller dialogue on how to find mutual environmental benefits in their partnership. For example, a clothing company may suggest low carbon intensive energy solutions to the textile supplier which will "contribute" less emissions to the final delivered product, reducing the product intensity and lowering the operation emissions. Customers can also request the emission intensity of the products they purchase, which can be satisfied by conducting a life cycle assessment (LCA).

As transactions work to normalize the CO_2 emissions exchange, it brings to question how accurate and relevant the disclosed emissions are, and what purpose they serve? Greenwashing is a pervasive risk in this process, with some countries introducing policies to combat it. For example, the European Green Deal describes that greenwashing is reduced when reliable, comparable, and verifiable information is presented to buyers, and that "companies making 'green claims' should substantiate these against a standard methodology to assess their impact on the environment" (EU, 2020). The emission disclosure of products and transactions are done so with the risk of greenwashing, if the emissions are not relevant, accurately determined, and disclosed, or do not follow accepted standards, which even may be based on contradictory methodological basis.

The disclosed emissions embedded in transactions must answer the right question, and is often related to why one conducts an emissions inventory. The environmentally conscious company will likely point to global emission reductions, but as we have discussed above, pollution havens suggest that blame and guilt contribute as well. Regardless, the outcome is presented and interpreted, as decision support material. Responsible decision support must refer to a system perspective that reflects the consequences of decisions if the intention is to reduce global emissions (Weidema et al., 2018). The current GHGP framework does not explicitly facilitate this on the level where buyers and sellers disclose emissions, however, the World Resource Institute suggest using consequential modelling when providing decision support, or determining product emissions against a counterfactual baseline scenario (Russell, 2019). Weidema shows how three different perspectives are used to describe the impacts and responsibilities related to an activity, i.e. a product or a service: value chain responsibility, supply chain responsibility and consequential responsibility, where they argue only the consequential is indispensable in terms of linking actions to changes in the state of the earth (Weidema et al., 2018). The GHGP Policy and Action Standard (Source) and recently in its Land Sector and Removals Guideline draft (currently in its pilot testing phase) address the consequential perspective. They conclude that intervention based accounting (consequential perspective) should be used to determine the impacts of corporate actions, but should be reported outside of a GHG inventory (GHGP, 2022).

Assessing emissions related to activity

There are many standards that describe the methods for determining and disclosing the environmental impact of products, such as the PAS 2050, the GHG Protocol, and the European PEF Guide, all referring to the canonical ISO 14040 series. The ISO 14040 series defines the most appropriate way to navigate the many decisions that go into conducting a LCA – constituting how to build the emissions inventory that relates activities to emissions both in the foreground system, mostly representing activities with scope 1 and 2 emissions, and the background system, mostly representing activities with scope 3 emissions. An essential support for the practitioner is the availability of databases supplying background data. There are various paid and free databases connecting activities to

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emission intensities[1] (EI) and they are widely accessible, although some, especially the free databases lack the variety that companies with diverse value-chains need for a climate just emissions inventory. A significant difference between available databases is the openness in terms of possibility to track combined productions, i.e. the availability of connected unit processes or conflated system processes. Furthermore, the majority of databases are 'calculated' according to often diverging modelling principles, using system expansion or various allocation procedures i.e. mass allocation, value allocation, or exergy allocation.

The GHGP has a set of recommendations that suggests how to navigate the variability between supplier specific and average data EIs (see table 1), starting with the most desirable – supplier specific. Here suppliers can present a detailed account of the emission intensities underlying the product transaction, however while the green transition is still evolving, this is not yet commonplace. Least desirable in the GHGP is the spend based method, which uses e.g. Environmentally Extended Input/Output (EEIO) models, that produce results based on spend using sector average data. The GHGP suggests that mixing these methods is acceptable, where for example, purchased goods may be calculated using an EEIO, and downstream emissions using a process-based, or supplier specific approach (WRI and WBCSD, 2004).

Table 1. Greenhouse Gas Protocol Data Hierarchy taken from the GHGP (WRI and WBCSD, 2004).

Calculation Method	Upstream Production Emissions	Supplier's Scope 1 and 2 Emissions
Supplier Specific	Supplier Specific Data	Supplier Specific Data
Hybrid Method	Supplier Specific Data or average data, or a combination of both	Supplier Specific Data
Average Data Method	Average Data	Average Data
Spend Based Method	Average Data	Average Data

Consequential and Attributional LCA

An important distinction to make when it comes to LCA's, and the subsequent EIs used in GHG inventories, is that there are two main trains of thought that are defined by asking different questions of the same data: Consequential LCA (cLCA) and Attributional LCA (aLCA).

As the names suggest, aLCA considers the product-specific attributes that define the impacts from producing, consumption, and disposal of a product, asking the question "what was the impact of this product?". The method applies normative attributional allocation of coproduction or partitioning of unit processes, in the attempt to model the supply chain or the value chain, by using partitioning according to mass or value.

Consequential LCA provides information on the consequences or relative change of impact at system level as a result of the production, consumption, and disposal of a product, both in and outside of the product lifecycle. cLCA avoids allocation by using substitution, or systems expansion as it is called in the ISO 14040 series, where it also is stated that "Wherever possible, allocation should be avoided" (ISO, 2006). Therefore, cLCA asks "what will the impact be of purchasing (consuming and disposing of) this product?".

Under both approaches, the impact can be determined per unit of specific product, such as a L of milk, or a kWh of electricity. However, since cLCA methodology includes effects beyond the boundaries set in the supply or the value chain, it relies on modelling which productions respond to the increased demand, and delineates the effect of these changes by considering market effects and marginal suppliers, including considerations

[1]Emission intensity (EI) is often mixed up with Emission Factor (EF), which by the IPPC is reserved to describe the amount of GHG's i.e. emitted when combusting a fossil fuel. EFs are used as a component when determining EIs describing emission intensities of products or activities

of public regulations and other market external constraints (Brander et al., 2008; Weidema et al., 1999; Weidema, 2001; Weidema et al., 2018).

The marketability of product emission disclosure is not lost on many producers, as it presents a competitive metric their products can be evaluated on. In 2020, an 866-product carbon footprint database was published using CDP data, of which all follow aLCA methodology (Meinrenken et al., 2020). This may be due to a range of influences, such as the institutional inertia supporting aLCA methods (the GHGP suggests using aLCA for organisational inventories), or the market advantage of communicating on specific products, which may be perceived by the customer as more precise as it reflects precise supply chain data and proprietary information. Precise supply chain data, and thereby precise emission estimates within the supply chain is not in contradiction to cLCA methodology – the difference lies in the interpretation of the data (Løkke and Madsen, 2022). As such, those assessing and disclosing the impact must be clear on if their interests are within the impact of the product or impact of the supply chain, as supply chain management tactics may be a better solution for the latter.

Practitioners and suppliers following aLCA methodology must also agree on the allocation method in aLCAs, where allocation is mostly determined by the value- or supply-chain. This is described by ISO as the partitioning of in/output flows of a process and can be done via economic allocation or mass allocation. However, in aLCA using partial substitution is also seen especially in the modelling of end-of-life, i.e. in the PAS2050 standard. The decision of which allocation method to use parallels the complexity of the aLCA vs cLCA decision, and the subsequent effects (intentional or unintentional greenwashing, or misguiding results). In short, aLCA does not aim to quantify the total change caused by the decision in question, which Plevin and Wenzel argue is information essential for overall emission reductions (Plevin et al., 2014; Wenzel, 1998).

The LCA literature agrees that uncritically mixing the two methods in a single analysis opens for misleading interpretations (Sandén & Karlström, 2007) as they ask different questions and should therefore be avoided. Using data from both methods in the same assessment is possible, however the problems arise when different data sources (implying different data collection principles) are vertically integrated, i.e. using a tiered approach or partial disaggregation. Brander suggests an application for both, where aLCA is be used for allocating responsibility, setting targets and tracking progress, however actions intended to reduce emissions are checked with a cLCA method to prevent undesirable effects outside of the inventory boundary (Brander, 2022a). The central discussion here is whether the transaction needs both methods. This has been discussed between Weidema et al. and Brander et al. (Brander et al., 2019; Weidema et al., 2018, 2019), who agree regarding the importance of applying consequential LCA to avoid suboptimized decisions but disagree regarding the need of applying both methods. Our take-away is that in principle, consequential modelling provides the essential answers for guiding decisions, and that the attributional modelling is best substituted with traceable supply chain management, that partly enables accounting, and partly enables relevant modelling of the consequences of the system (Løkke & Madsen 2022). However, the aLCA approach is seen in so many company level efforts on presenting sustainability, through baseline emission inventories and net zero pledges, that it is unthinkable to abruptly change the systems. Furthermore, the transition will in reality require a massive learning process in terms of deeper understanding of what questions the two modelling approaches answer, and for that reason a parallel combination of aLCA and cLCA may be needed.

Certainly, the debates in this space will have an impact on the future of GHG accounting, but this still leaves companies with a current dilemma of how to navigate economic and environmental transactions. Even with the standards in place to avoid misdirection (greenwashing), there has been criticism that there is room for different interpretations, such as the ISO 14044, which has been interpreted for both cLCA and aLCA methods (Weidema, 2014). The same is seen in the GHGP, as the standard, specifically relating to purchased goods and services (Scope 3.1), leaves room for both cLCA and aLCA interpretation. Those communicating results are faced with choices that don't have very many repercussions, yet. A more comprehensive assessment yields higher emission intensities, which despite providing more decision support, risk climate-shaming the reporter in the short term. On the contrary is an immediately marketable product boasting low emissions lacks accountability and restricts the potential for meaningful betterments and emission reductions.

Completeness or precision?

To remain relevant through a green transition and minimize their transitional risks, companies must reduce their emissions and disclose their plans through frameworks such as CDP, SBTi, and the coming CSRD. To be compliant to these frameworks, a climate just organisational emission inventory should take a consumption-based approach by including scope 3 emissions. This is mindset is seen on a national level as well. Sweden is the only country currently considering a consumption-based target, and as discussed above, face the same challenges in how to navigate just emission disclosure and decision making.

The GHGP's data hierarchy prioritises supplier specific data, but companies (especially ones with complex supply chains) lean towards spend based analyses of their transactions due to their size, and limitations in supplier specific data. If some suppliers are able to supply aLCA product information, the reporting company is now be tasked with identifying and keeping similar allocation methods to allow for a meaningful decision support while risking misleading results, or choosing between precision or completeness, and potentially disregarding supplier specific data. The supplier must also balance how to supply data that maintains transparency and relevance, while protecting trade secrets. There is a need for a data ontology that preserves both aspects.

Many are unknowingly hybridizing allocation methods, and a/cLCA inventories, either through the assessments of their transactions, their suppliers' decisions supporting product specific emissions, or through other GHGP scopes – many of the national energy related EIs for scope 2 are reported using aLCA methods. Despite this, there is no reason that supplier specific data cannot be used for a cLCA estimation, e.g., using life cycle inventory data. There are many aLCA, and increasingly cLCA, unit-based databases available to the public, but there is still need for a greater data foundation for cLCA. An example of a public cLCA database is The Great Climate Database focussing on food products, which draws on Exiobase 3, an EEIO database (CONCITO, 2021). The major EEIO database Exiobase 3 is freely available for download (Stadler et al., 2018), and is being used to develop a disaggregated open access database covering all global regions (AAU, 2021). Easier access to both methods increase the risk for inadvertent hybridization and underpins the necessity for systematic clarity.

Regardless, it brings to question, who is responsible for the type and quality of data? Industrial countries cannot continue to outsource emissions and preach water while drinking wine; inaction on this matter will continue to present problems in the future. Is it the responsibility of the buyer? The buyer must now purchase the product, emissions, and decisions behind the emissions in one transaction, potentially compounding the variability, uncertainty, and usefulness of the results. aLCA produces relatively intuitive results focusing on the supply chain, which is why the majority of carbon footprinting has followed the aLCA methods. However, based on the research in this space, companies using the GHGP as guidance for conducting GHG inventories risk not seeing important aspects of the production system and therefore risk making suboptimal decisions. Companies should therefore possess the background knowledge to flip the hierarchy and make critical counterintuitive decisions, and as a part of the process gain sufficient system understanding to make the counterintuitive become intuitive.

The first GHGP was published in 2001 and is now entering a revision period, and its new Land Sector and Removals Guidance is entering its pilot phase. We see this as a step towards making system thinking more commonplace in the emission inventory, leading to truer decision support, but also recognize the need for correct and transparent data. Flow data, just as much as product carbon intensities, of the transaction should be disclosed in such a way that balances proprietary information and transparency. We suggest

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that future guidance emphasizes decision support with systems thinking and for it to become a cornerstone for users of the GHGP to facilitate an understanding of both their own system and the related global impacts. There is potential for misleading results when overlaying the a/cLCA methodologies with the GHGP data hierarchy. We suggest introducing systematic clarity to what the GHG inventory can and cannot be used for, what characteristics such accounting methods would need to have, and by extension, increasing industrial ecology literacy through clearer understanding of how organisation supply chains interact with surrounding systems using consequential modelling principles. Fast-tracking such academic debates to limit interpretations could reduce the risks of greenwashing and add to a swifter and more just green transition.

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