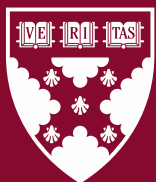


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Principles and Content for Downstream Emissions Disclosures

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Abstract

In a previous paper, we proposed the E-liability carbon accounting algorithm for companies to measure and subsequently reduce their own and their suppliers' emissions. Some investors and stakeholders, however, want companies to also be accountable for downstream emissions, those produced by their customers, their customers' customers, and so on down a value chain. In this paper, we describe the misconception of attempting to have all companies measure and be accountable for downstream emissions. But we also propose how to handle the important exception, when end-use consumers are the culpable party producing the downstream emissions.

The paper uses several consumer-product examples to develop three principles for corporate disclosure of downstream emissions. Principle 1: Only companies whose products are directly used by end-consumers (B2C companies) should be required to disclose downstream emissions. Principle 2: Only B2C companies with products that require energy for consumer use, and for which a reasonable causal link exists between the product's sourcing and design decisions and the emissions from consumer use, should be subject to downstream disclosure. Principle 3: Since companies have limited influence on consumers' quantity of use of their products, a B2C company's downstream disclosures should focus on emissions per unit of consumer use, not on total emissions. The paper concludes by explaining why reports of downstream emissions are "disclosures" not "accounting."

Principles and Content for Downstream Emissions Disclosures

Robert S. Kaplan and Karthik Ramanna

January 2024

Addressing climate change requires companies¹ to decrease their carbon footprints. In a previous paper, we introduced a robust carbon accounting algorithm, called E-liability, for companies to measure and subsequently reduce the emissions from their purchasing, product design, and operational decisions (Kaplan and Ramanna, 2021). A subsequent paper (Kaplan, Ramanna, and Roston, 2023) expanded the method to E-assets, accounting for companies' removal and storage of carbon previously emitted into the atmosphere. By applying these principles, companies can produce environmental (or E-) ledgers that are as accurate, timely, comparable, and auditable as financial statements.

E-ledgers, like financial-statement ledgers, account for delivered (past) performance. They are thus an important tool for companies, their investors, and other stakeholders, to track progress toward global emissions-reduction targets. Some investors and stakeholder in the climate change community, however, believe that measuring corporate emissions only from actions already completed does not capture full corporate accountability for greenhouse gas emissions. They want organizations to also be accountable for emissions prospectively generated by their customers, their customers' customers, and so on down a value chain. Such downstream emissions, of course, are often unknowable to a company at the beginning or even in the middle of an extensive and complex supply chain. Also, with one important exception, the E-liability algorithm already accurately measures downstream emissions when and where they occur, enabling accountability to be assigned to the actual emitting company, and subsequently to the customers purchasing its outputs. In this paper, we describe the fallacy of attempting to have all companies measure and be accountable for downstream emissions, and we propose how to handle the important exception: when end-use consumers are the culpable party producing downstream emissions.

Corporate Measurement and Accountability of Downstream Emissions

The Scope 3 standard of the Greenhouse Gas Protocol, currently the most widely used rulebook for emissions disclosures in corporate value chains, requires companies to report their full upstream and downstream emissions. We introduced the E-liability algorithm to implement, in a practical, accurate, and auditable way, the intent behind Scope 3 upstream reporting (together with Scope 1 and Scope 2 reporting). We consciously excluded, for several reasons, the

¹ For convenience, we use "companies" when referring to all entities measuring their carbon footprints. In practice, of course, non-profit entities, such as education and healthcare institutions, and government entities, such as departments of transportation, defense, health, and energy, should also be measuring and reducing their carbon footprints.

reporting of downstream emissions measurement from the E-liability accounting method. First, such reporting would require speculation about emissions yet to occur. Second, most companies have limited to no influence about future emissions by their customers and subsequently down a distribution chain. The E-liability method assigns accountability to a company for its upstream emissions since it has designed the products that use the purchased materials and services, and it has selected the suppliers for those materials and services. The company, however, has limited to no control on how their customers, customers' customers, and so on use their products. Indeed, in many instances, any attempt to exercise such control would be illegal.

A simple *reductio ad absurdum* argument illustrates why requiring all companies to disclose all their downstream emissions is both infeasible and meaningless. The argument starts with considering a set of companies at the beginning of many corporate supply chains, those extracting minerals from the earth and those growing agricultural products on plantations. These companies produce the raw materials that subsequently get transported and processed by numerous and diverse organizations into products and services purchased by end-use consumers. Expecting a cocoa grower, whether a smallholder farmer or an industrial plantation in West Africa, to calculate its share of the total emissions generated when an end-consumer in northern Europe purchases and enjoys a chocolate candy bar is both fanciful and useless. Likewise, having a company mining for nickel in Australia estimate its share of emissions generated when a consumer drives an electric car, uses a mobile phone, or flies on a jet plane (all of which contain embedded nickel) is similarly fanciful. Such disclosures don't serve any material purpose since the farmer or minerals extractor cannot possibly measure or influence the emissions generated by the complex value chain of companies that produce the candy bar, electric car, mobile phone, or jet plane.

The Exception

The persistence of demands, however, for a standard that requires all companies to measure their downstream emissions, suggests a belief that at least some companies can be reasonably expected to measure and be held accountable for the emissions from customers' use of their outputs. We agree with this belief, as we will describe in this paper. We develop below three principles for corporate accountability for downstream emissions.

The demand for downstream accountability cannot arise from a concern with the emissions by downstream *companies* since the measurement of those emissions, and accountability thereof, will be readily available in downstream companies' E-ledgers. The demand must arise from the emissions created when *consumers* (i.e., individuals, not companies) directly use a company's products or services and when they discard these products. Having consumers issue reports on their direct emissions, much less their complete cradle-to-grave emissions, is not, at present, a feasible or acceptable option. We therefore propose that the first principle for measurement and accountability for downstream emissions is that it should be restricted to companies that produce products and services that are purchased and used by end-consumers (also known as

B2C companies). This principle excludes cocoa producers and nickel miners from downstream reporting since these upstream companies produce *inputs* to the finished-goods products that consumers directly purchase and use. The logic embedded in this first principle of downstream accountability mirrors the logic in GDP accounting, where distributions to end-consumers constitute the “terminal” transactions in any period.

Our second principle for downstream accountability requires a clear causal link between a company’s product-design decisions and the emissions produced when consumers use and discard the product. We motivate this principle with several simple examples.

Consider a consumer-goods producer whose research lab has developed a process for pre-cooking a packaged rice product. The process reduces by more than 50% the consumers’ time and energy to heat and prepare the rice while still retaining its desired flavor, nutrients, and eating experience. The pre-cooking innovation substantially reduces the total energy and associated emissions produced by the manufacturer and its consumers.

Consider another consumer-goods producer, which has developed a laundry detergent that enables consumers to wash their clothes and achieve the same degree of cleanliness using cold rather than hot water. The innovation, as with the packaged rice producer, reduces consumers’ emissions when using the company’s product.

As a third example, an automobile manufacturer, through a myriad of design, engineering, and sourcing decisions, produces a vehicle with predictable consumption of energy (either gasoline or electricity) per kilometer driven by an end-use consumer. The decisions include the use of lightweight alloys, the car’s aerodynamic properties, its energy source, and the tires’ rolling friction. The energy consumption, and associated emissions, will, of course, be estimates based on averages of highway versus urban driving, high versus moderate speeds, rapid acceleration versus gradual from a stopped position, etc. But, holding driving conditions constant, vehicles can differ substantially in the emissions produced by consumers, and automobile OEMs have a strong influence on the emissions per km driven of their vehicles.

Finally, consider a high-tech producer of game-playing consoles. The company, through energy-saving designs, influences the per-hour usage of electricity required to play videogames. Also, the company, through its choices on the plastics and other materials used in the consoles’ circuit boards, can lower the post-use emissions when the circuit boards are incinerated to recycle copper and rare metal components.

These examples all illustrate how a company’s product designs can influence the emissions from consumer usage and disposal, causing some degree of emissions accountability for the company. Note that the accountable company is not necessarily the one making the end-sale to the consumer (e.g., the retailer). The accountable company would typically be the one whose brand name appears on the product that the consumer buys, even when distribution and retail intermediaries operate between that company and its end-use consumer.

In summary, the second principle establishes downstream accountability for end-consumers' use and disposal emissions to (a) the company furthest downstream whose output product or service is distinguishable in use by the consumer and (b) when no company further downstream has added substantial value to that output. Applying this principle, the accountability for reduced cooking time for the pre-cooked package of rice lies not with the rice farmer, the fertilizer company supplying the rice farmer, or the company transporting the rice from field to manufacturer. Rather, accountability resides with the consumer-goods company that designs and produces the energy-saving rice product. A retail intermediary, such as a grocery store or car dealership, will already, when using the E-liability method, have accountability for its cradle-to-gate emissions. But it should not be accountable for the downstream emissions from products it sells to consumers if the causal link to those emissions is more appropriately attributed to one of its suppliers, such as the consumer-packaged goods company or the car's OEM.

Turning now to a third principle: Not all companies selling to consumers have downstream emissions accountability. When consumers use a company's product without consuming energy, such as to eat a candy bar, wear an article of clothing, or read a physical book, no emissions are generated. Consequently, the company that produced the candy bar, clothing item, or book has no downstream emissions accountability for consumer usage. This principle applies even when the consumer travels in a commercial taxi, bus, plane, or train that produces emissions, and, even, and somewhat ironically, when consumers purchase electricity to light, heat, and cool their homes. The emissions from these activities are already measured, using E-liability accounting, by the commercial company supplying transportation or electricity.

Companies are accountable for downstream emissions only when their consumers need energy to use the company's product, such as to cook a package of rice, wash their clothes, drive their car, or play a video game. These downstream-accountable companies, however, cannot be held responsible for the total emissions produced when consumers use their products, since the companies do not control consumers' actual cooking times, number of washing machine cycles per month, kilometers driven, or hours of playing time. But the companies can have accountability for the emissions produced per unit of use of their outputs. Our reasoning follows, by analogy, the fundamental cost equation:

$$\text{Cost} = \text{Price per unit} \times \text{Quantity (in units)}.$$

The cost of steel used in a car, for example, equals the quantity (in kg) of steel in the car multiplied by the price/kg of the steel in the car.

A similar equation can be used for consumer-generated emissions:

$$\text{Consumers' total CO}_2 \text{ emissions} = \text{CO}_2 \text{ per unit of use} \times \text{Units used},$$

where units would be measured by minutes of cooking time, number of washing machine cycles, kilometers driven, or hours of game-console playing. The company producing a

consumer end-product can be held accountable for the first term in the right-hand side of the equation, CO₂ per unit of use, but not the second, the quantity of units the consumer actually used. The accountability disclosure of the company's downstream emissions should, therefore, focus only on the rate of emissions per unit of use. The principle is to hold companies accountable for what they can control, the emissions per unit of use, but not for what they cannot control, the consumers' quantity of usage. The process of estimating this disclosure will, of course, be distinct for each product or service, for each company.

Note that different companies can, based on their products and services, sometimes arrive at reasonable estimates for the quantity of usage. Obtaining data from consumers on their actual cooking times is likely infeasible. But the auto OEM and the OEM of consumer washing machines could embed electronics in their products that measured kilometers driven and number of washing cycles, and have that data communicated back to them. Such monitoring of consumer behavior, however, would likely be considered intrusive even if not illegal. For the game-console maker, tracking hours of playing time is likely already happening for online games, but doing so for offline games is less palatable for consumer-privacy reasons. But, even in these cases, we argue that companies should not be held accountable for the quantity of consumer usage, which is beyond the companies' control.

Consumers also generate emissions when they scrap products after use. We propose that the relevant producing company (as identified by our first-two principles described above) estimate and disclose the emissions expected when their consumer product is discarded. Following this principle, the candy-bar company would disclose estimated emissions from disposal of its candy-bar wrapper; the packaged foods company discloses the estimated emissions from disposal of the pre-cooked rice packaging; the game-console producing company discloses estimated emissions from disposal of that unit; and the auto OEM discloses estimated emissions from scrapping the car. Some consumer products can be recycled, such as the steel in an automobile and the copper in a phone or game-playing console. In these cases, the company that originally produced the consumer product would also disclose estimated emissions from such recycling operations.

All such disposal emissions can be, of course, only a rough estimate since disposal practices and technologies will be highly variable and subject to change. But the relevant companies should be encouraged to disclose a prudent (or conservative) estimate of emissions incurred at disposal using current practices, especially as any responsible audit of such an estimate would likely err on the side of avoiding aggressive underreporting.

To summarize, our three principles for accountability for downstream emissions are:

1. An company's downstream accountability is limited to cases where its outputs are directly used by end-consumers; that is business-to-consumer (B2C) companies, but not business-to-business (B2B) companies.

2. An B2C company’s downstream accountability is limited to cases where a reasonable causal link exists between downstream emissions incurred by consumers when using the company’s outputs and the company’s product-design decisions. In practice, this requires that the company’s product remains distinguishable when the consumer purchases and uses the product, and no further-downstream company adds substantial value (other than transportation and distribution) to the product.
3. Downstream accountability disclosure of consumer-use emissions should focus on emissions per unit usage not on total emissions. In practice, this applies only to products that involve energy use. Downstream accountability disclosure of product-disposal emissions should provide a prudent estimate of emissions to be incurred per unit of product disposal given current practice.

As a final hybrid example, illustrating when a company should or should not disclose downstream emissions, consider a manufacturer of passenger and truck tires. The company applies design and technology innovations that lower the tire’s rolling friction and, therefore, the emissions produced when driving a vehicle using those tires. When the company sells tires to automotive OEMs, or to commercial operators of car and truck fleets, it does not trigger downstream accountability. But if the tire company also has a B2C line of business, selling replacement tires to end-consumers (via distributors and retailers), it should disclose an audited estimate of the quantity of emissions per km driven, but not the total emissions when consumers drive their vehicles with the company’s replacement tires.

In practice, such downstream disclosure should be combined with disclosure on the incurred cradle-to-gate (or E-liability) emissions of the tire. For instance, the disclosure of the tire company, say “Acme Tires,” for sales to end-consumers (via retail intermediaries) could look as follows:

	Acme Tires	Industry Average
Total incurred cradle-to-gate emissions: ¹	25 kgCO ₂ e/tire	34 kgCO ₂ e/tire
Expected consumer-use emissions per km: ²	10 gCO ₂ e	15 gCO ₂ e
Expected lifetime of the tire: ³	60,000 km	50,000 km
Expected emissions from disposal of the tire: ²	3 kgCO ₂ e/tire	4 kgCO ₂ e/tire

1: Full-scope audited to a “true and fair” standard; 2: Limited-scope audited; 3: Unaudited.

Note: Numbers are conjectural, not reflective of actuals.

The incurred cradle-to-gate emissions in the first row are generated from a comprehensive accounting system (the E-liability approach) to measure the actual emissions produced from original extraction and transportation of all raw materials through to the delivery of Acme’s tires to the consumer’s retail outlet. The cradle-to-gate emissions can be audited to a full-scope

(“true-and-fair” or “reasonableness”) standard, akin to the numbers reported in audited financial statements.

The numbers in the second and fourth rows are expected emissions, yet to occur, from consumers’ driving activities downstream from the tire company. As shown, Acme Tires’ product-design decisions are expected to yield lower in-use emissions per km driven and lower disposal emissions per tire. Providing such information generates accountability for Acme and its competitors to innovate to reduce the emissions when consumers use their products, and a new potential source for competitive differentiation. But the information disclosed in the second and fourth rows is neither mutually exclusive to emissions reported elsewhere (such as by the tire-disposal company) nor comprehensive (since it likely omits the full emissions attributable to the consumer’s actual driving behavior). Because the emissions data in rows two and four have yet to occur, and, also, are not completely determined or controlled by Acme Tires, they can be audited only to a “limited scope,” as noted below the table.

Finally, the expected life of an Acme tire, the table’s third row, is even more speculative, reflecting a highly generalized average of consumer driving experiences. Such disclosure is more like a manufacturer’s marketing materials and is likely to be unaudited.

Implications for Fossil-Fuel Companies

Companies sourcing fossil fuels as an energy source – coal, petroleum, and natural gas – have been in the crosshairs for downstream emissions disclosure for several decades. Indeed, the focus on consumers’ emissions when using these companies’ products is likely why downstream emissions were even originally included and still remain in the Greenhouse Gas Protocol’s Scope 3 standard. How do our proposed principles apply to fossil-fuel companies?

When hydrocarbon energy sources are consumed by corporations, such as electric utilities, those providing HVAC services, and those providing commercial transportation services, such as railroads, airlines, trucking companies, and ocean transport, the total emissions will be accurately and fully measured in the E-liability accounts of those corporations. As the downstream energy and transport companies sell, in turn, to consumers, they will be accountable for the CO₂ emissions as described above. Similarly, when the corporate customers of the energy and transportation companies produce their own outputs (such as packaged rice, automobiles, and game-playing consoles), then the fossil-fuel companies’ products are no longer distinguishable in use, and they should not consider those outputs as part of their downstream accountability.

Our principles, however, do imply that fossil-fuel companies remain partly accountable for the emissions produced when consumers combust the companies’ fuels to drive their vehicles or heat and cool their homes for personal use. In these situations, the gasoline, natural gas, and heating oil used by consumers are distinguishable and attributable to the fossil-fuel company. And no company further downstream, such as gas stations, has substantially added value to the fossil fuels. But the accountability for fossil-fuel companies, as with all other companies selling

products to consumers, is for emissions per unit of use and not for the consumers' quantity of use.

Critics of fossil-fuel companies may observe that these companies often incentivize greater use of their products by consumers, and their associated emissions, by efficiently finding, extracting, processing, and transporting their products, and passing some of the gains to consumers through lower prices. But decisions on purchasing the energy products and the quantity of use are, ultimately, made by consumers. Citizens that want smaller volumes of fossil fuels consumed can voluntarily lower their consumption, or – preferring collective rather than individual action – work through their governments to restrict supply or raise taxes. No private company, including a fossil-fuel company, will voluntarily reduce its own volumes below profit-maximizing levels. Advocating for a downstream accountability system that assumes otherwise is unlikely to generate sensible information or motivate the needed climate-friendly outcomes.

Disclosure, not Accounting, for Downstream Emissions

We have argued that companies should disclose but not *account* for downstream emissions. The distinction is not minor or based on a narrow discipline-based (accounting) perspective. What happens downstream from any company is, by definition, a future event from that company's perspective, and, therefore, outside the scope of accounting and full scope audits. We have argued, however, that companies can, in certain circumstances, influence consumers' downstream emissions, and, therefore, have limited accountability for such emissions. This accountability is best accomplished through non-accounting-based disclosures, which can be subject to limited-scope audits.

Accounting is a distinctive discipline, with an established set of practices for performance measurement. Accounting data should be (i) comparable across entities and over time, (ii) verifiable as being objectively determined as true or false within a materiality threshold, and (iii) representationally faithful as a reliable report of the underlying phenomenon. When universally applied across an entire system of entities, accounting information is collectively exhaustive across arm's-length entities, and, in aggregate, representative of the reported economic performance of all entities within the system, and for the system as a whole. Non-accounting-based disclosures on performance, by contrast, are prepared under lower standards for comparability, verifiability, and representational faithfulness. Such disclosures are, also, done selectively and idiosyncratically so that the disclosed information is neither mutually exclusive across entities nor collectively exhaustive.

Specifically, some of the disclosed downstream emissions in our proposal counts the same emissions multiple times, such as when consumers drive cars produced by the OEM company, equipped with tires directly purchased from the tire company, and fueled by gasoline produced by the fossil-fuel company. Consumer emissions would also be counted by both the manufacturer of washing machines and detergents, and by the game-console producer and the electric utility. Similarly, emissions from anticipated disposal of a consumer products will be

recognized by both the producer of the product and (subsequently in its E-ledger) the waste-management company that disposed the product.

Information in downstream disclosures cannot be audited to the same standard as cradle-to-gate emissions in E-liability accounts. In contrast to downstream disclosures, the universal application of E-liability carbon accounting counts all companies' direct (i.e., Scope 1) emissions once, and only once, while still providing transparent accountability for the emissions produced in their global supply and delivery chains. of all the world's products and services. Further, a global measure of CO₂ emissions, along with E-asset accounting for actual CO₂ removals, can be readily calculated by adding the annual change in emissions balances across arm's-length entities. Such a measure will track the world's collective progress toward geological net zero, the only net-zero goal to stabilize, and hopefully reduce, the quantity of CO₂ in the atmosphere.

Under such a global E-ledger carbon accounting system, the only uncounted major source of planetary emissions will be those produced when consumers burn fossil fuels for personal use, such as to drive their vehicles or heat their homes. Such emissions can be imputed from the volume of fossil-fuel sales to consumers, which should become a required disclosure in the management disclosure and analysis (MDA) section of those companies' financial statements.

Disclosure of downstream emissions, under the principles introduced in this paper, will help to drive accountability for relevant companies' emissions-reduction technologies. Our proposed principles should enable downstream emissions disclosures to become valuable supplements to global adoption of E-ledger carbon accounting for actual and removed corporate emissions.

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