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Seeing double corporate reporting through the materiality lenses of both investors and nature*

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ABSTRACT

Standards for financial accounting (set by the IASB) are complemented by those for sustainability-related financial disclosure (set by the ISSB). Both sets of standards contribute distinctive components to financial reporting, aiming to meet the information needs of investors. Yet the stakeholders in a corporation extend beyond investors, suggesting a demand for information broader than that provided by IFRS alone. This paper comprises a normative analysis of how that demand can be met, to which end we focus on the environmental impact of corporate activity. We argue that, in both the research literature and in market practice, the reporting of environmental externalities lacks the distinction between accounting and disclosure that characterises financial reporting. In particular, while disclosures of impacts are widespread, there is absence of an "externality accounting" that would parallel the income statement. We argue that the basis of such accounting should be the maintenance of natural capital, with measurement at replacement cost, and that (in this way) externalities can be made commensurate with financial profit to yield a "full-cost" income statement, yet this can be done while serving the ecological/societal demand for treating the conservation of natural resources as an end in itself. We argue that criticism in the research literature of investor-oriented sustainability reporting is misdirected. Instead of asking why investor-oriented reporting "fails" to meet the broader informational needs of all stakeholders, the more important question is why reporting for the benefit of those stakeholders remains under-developed, in theory and in practice.

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Financial accounting and sustainability reporting are both aspects of corporate reporting, yet they have remained largely distinct, both in corporate practice and in the research literature. At various stages in the long evolution of financial accounting (Basu & Waymire, 2006; Waymire, 2009), additional forms of corporate reporting have been proposed, most of which take financial accounting as a starting point, and

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seek to offer a complement (e.g. ASSC, 1975; Burchell et al., 1985; Lev, 2018). In contrast, a significant body of work in the sustainability reporting literature is concerned primarily with corporate social and environmental impact as an object of study in itself, rather than as a point of departure from, or extension of, investor-oriented financial accounting (e.g. Buhr et al., 2014; Gray, 1992; Gray, 2002; Guthrie & Parker, 1989; Mathews, 1997; Parker, 2005). Linking these perspectives is the concept of externality, which reflects the societal limitations of private economic calculation, thereby simultaneously drawing attention to economic effects that are internalised and those that are not (Unerman et al., 2018). By design, financial accounts are constructed through the lens of "financial materiality".[1] By definition, externalities are excluded from the determination of profit and so cannot be seen. In contrast, consideration of the environmental impact of corporate activity requires that externalities are brought into view (Larrinaga & Garcia-Torea, 2022). We refer to information on this external impact as environmentally material, in other words as relevant in evaluating the state of nature. The question we address in this paper is whether, and how, this separation between financial accounting and externality reporting can be bridged, in a coherent system of corporate reporting that allows for "double materiality" (EC, 2019), enabling users to view corporate performance through the lens of both financial and environmental materiality.

Reporting practice is characterised by Unerman et al. (2018) as largely "siloed", with the *economic* impacts of externalities excluded by definition from the financial accounts, but also absent from sustainability reporting. These authors observe that there is little research that "has focused on systematic recording or articulation of the financial impacts of externalities" and, further, that "the limited number of studies … have been sporadic and fragmented, with little connection in insights." We would add that, in a sustainability reporting literature dominated by positive studies of corporate reporting practice (Brander, 2022; O'Dwyer & Unerman, 2016; Parker, 2011; Quattrone, 2022), normative work is thinner still, and it comprises different (and inconsistent) theorisations of accounting for externalities, few of which are developed in much depth (Lamberton, 2005), in spite of the research potential they contain (Cuckston, 2013; Senn & Giordano-Spring, 2020). In this respect, Gray (2002) lamented "the relative paucity of kite-flying, of speculation, of imagination – or, if one prefers … the normative deductive." Yet Russell et al. (2017) offer him little progress, noting that while the early environmental accounting literature was "largely normative … this stream of thought … capturing 'externalities' and 'full cost accounting' has dwindled."[2] Moreover, normative contributions – even in the accounting literature – are typically not grounded in the logic of accounting but instead

[1]We use "financial materiality" as shorthand for information that is material to providers of finance (i.e. investors). More formally, and as defined in IFRS (2023a): "Information is material if omitting, misstating or obscuring it could reasonably be expected to influence decisions that the primary users of general-purpose financial reports make on the basis of those reports, which provide financial information about a specific reporting entity." In turn, "those primary users are existing and potential investors, lenders and other creditors – those users who cannot require entities to provide information directly to them and must rely on general purpose financial statements for much of the financial information they need."

[2]Gray (2002) and Russell et al. (2017) are here describing a secular trend in accounting research, which even earlier concerned Mattessich (1992), as follows: "After a decade of preoccupation with "positive accounting theory" – during which time the use of the notion of normative accounting has been slighted by the inner sanctum of leading accounting researchers – it may be time to break this circle and revive interest in the normative aspects of our discipline. But talking about normative accounting theory carries a risk, since the corresponding paradigm still seems to be branded as being unscientific."

in that of financial economics (Morgan, 1988), being guided by economic techniques for impact valuation, rather than by the accountant's focus on verifiable, historical measurement (e.g. Bebbington et al., 2007; Herbohn, 2005; Milne, 1991).

In this paper we adopt a normative approach in exploring how users of corporate reporting can "see double", viewing financially material information through a shareholder lens, and also environmentally material information though a nature lens. While a norm stipulates that a certain behaviour "ought" to take place, a (positive) value judgment is that actual behaviour is in accordance with the norm (Kelsen & Knight, 1966). Our approach in this paper is to take as given the norms associated with conventional financial accounting practice and to focus on identifying norms for extending that practice to embrace double materiality. This should not be taken to imply that we reject constructivist challenges to financial accounting practice (e.g. Barker & Schulte, 2017; Hines, 1988; Miller & Power, 2013; Young, 2006), nor challenges to the underlying notion of shareholder primacy (Gaa, 1986; Mayer, 2013; Stout, 2012), nor criticism of financial accounting itself is so far as it relates to environmental matters (Cook, 2009; Giner, 2014; Schneider et al., 2017). Our paper is neutral on these issues, and by design we do not seek to challenge – in the tradition of Edwards and Bell (1961), Chambers (1965) and others – the norms of financial accounting. Instead, we take as given a financial accounting practice which, as evidenced by the centrality of equity and profit in the IASB's conceptual framework ("Framework", IFRS, 2023a), is embedded institutionally in directors' legal duties with respect to shareholders. We instead focus on a question that is under-explored in the literature, rather than seeking to add to a literature that is already extensive, and we therefore address how financial accounting practice "as is" can be extended, and not whether that practice "gets it right". The "norm" in our normative approach therefore concerns how corporate reporting "ought" to be conceptualised in this regard.

We focus on environmental aspects of sustainability, and we use the Integrated Reporting language of the "capitals", which allows consistent application of the accountant's logic of capital maintenance (Coulson et al., 2015; Humphrey et al., 2017; IIRC, 2013). We postulate that a "sustainable corporation" is one whose activities simultaneously maintain both financial capital and natural capital (Bebbington & Larrinaga, 2014; Gray, 2006, 2010; Milne & Gray, 2013; Tregidga et al., 2014), and this constitutes the normative premise in our deductive reasoning (Mattessich, 1992, 1995). Financial capital represents shareholders' beneficial ownership claim on resources, and the measurement of profit is premised on the maintenance of that capital (Whittington, 2017). In contrast, natural capital is a type of resource, with a broad range of stakeholders (Hicks, 1974; Nobes, 2015). We define natural capital as "the stock of natural ecosystems on Earth including air, land, soil, biodiversity and geological resources … (which) underpins our economy and society by producing value for people, both directly and indirectly" (NCC, 2016). While anthropocentric in its ultimate concern for human well-being, this perspective can also be understood as ecological (or "environmental") in so far as it concerns sustaining the physical properties of natural ecosystems, and in that sense – and by analogy with financial capital – it measures ecological gain or loss against the benchmark of maintaining (natural) capital (Helm, 2015; Neumayer, 2013).

We structure the paper as follows. In the next section, we examine financial accounting practice and we ask how effectively, in the context of natural capital, it serves its stated

function of providing material information to investors.[3] This approach enables us to draw foundations from financial accounting theory in a novel way, employing the literature to identify why financial accounting satisfies neither investors' needs for financially material, sustainability-related disclosures, nor an incremental "societal" need for information relating to externalities. The following section then expands this analysis, classifying components of financial reporting, and thereby setting out how financial reporting and reporting on externalities are complementary yet distinct. This lays the foundation for the subsequent section, in which we conceptualise externality accounting in a way that enables it to be an extension of financial accounting, while also responsive to the ecological imperative of the maintenance of natural capital. In the final section, we apply our analysis in a broad overview of the institutional landscape for frameworks and standards in corporate reporting, we explore our contribution to the literature, and we identify some of the limitations of our analysis and, thereby, avenues for further research.

1. Financial accounting

The objective of general-purpose IFRS financial statements is defined in terms of financial materiality, whereby the information needs of investors are deemed to subsume those of other stakeholders (IFRS, 2023a; Young, 2006).[4] For clarity of argument, we make the simplifying assumption that "economic rationality" defines those information needs, making investors' interest in the reporting entity purely financial (Sen, 1987). In turn, structure in IFRS is provided by a double-entry system of accounting, which yields financial capital (Macve, 2010).

As described above, we take extant IFRS as given, and our purpose is not to critique financial accounting but instead to explore how it can be extended within a broader system of corporate reporting. We start with a consideration of investors' information needs.

Within IFRS, the representation of economic transactions and events is the outcome of a two-stage filtration. The initial filter is that of recognition, whereby the balance sheet comprises the reporting entity's rights or obligations, arising at the reporting date as a result of past transactions and events (Chambers, 1965, 1998; Storey & Storey, 1998). The second filter is that of measurement attribute, typically either an exit price (fair value) or historical cost (Whittington, 2017). Measurement is sensitive to the reporting entity's incentives to mislead (Watts, 2003), against which prudence is a safeguard, supported by audit and mandatory application, which also promotes completeness, comparability and consistency (Bromwich, 1985; Christensen et al., 2019). Note that "accounting", as described here, is concerned with measurable past financial performance only, including rights and obligations at the current balance sheet date. Over and above such information, reporting entities also provide further disclosures to investors, such as forecasts of future earnings, or information relating to the entity's strategy or business model. The notion of reporting (on various aspects of prospective and historical

[3]The IASB"s stated objective in its Framework is to "provide useful financial information about the reporting entity that is useful to existing and potential investors, lenders and other creditors in making decisions about providing resources to the entity." (para. 1.2)

[4]While we focus on IFRS, our analysis applies equally to US GAAP, or similar financial accounting regimes.

performance) is therefore broader than the notion of accounting (on recognised historical performance only), an important distinction to which we return later.

What information does financial accounting provide with respect to the maintenance of natural capital? A first observation is that, while natural capital is not a defined term in IFRS, natural resources are reflected in the financial statements in so far as they are implicated in (recognised) economic transactions and events (Anderson, 2019), such as: buying and selling natural resources (land, IAS 16; minerals, IFRS 6; agricultural produce, IAS 41); providing for environmental clean-up costs or litigation (IAS 37); impairment of assets resulting from environmentally-related transactions or events (IAS 36); and carbon trading (Cook, 2009; Giner, 2014). In practice, however, this recognition is likely to fall short of meeting investors' needs for (financially) material information on how environmental issues affect the reporting entity. Consider the case of accounting for provisions. Guidance in IAS 37 turns on the distinction between a legal obligation resulting from a past event, and a legal obligation that falls due at a future date, and there is no liability for future expenses that must be incurred for the business to continue to operate, such as those related to a transition to net zero carbon emissions – no matter how much the business is committed to the outflow (IAS 37, Example 6). Similarly, assets which could not (for example) operate in a future net zero setting are not necessarily impaired currently; they might be due for replacement before (say) any carbon emission commitment affects their economic viability, giving no reason for impairment under IAS 36, or else there is maybe a shortening of expected useful life under IAS 16, which raises future annual depreciation expense but maintains current carrying amount. In addition, and with the notable exception of agricultural produce measured at fair value (IAS 41), natural resources are anyway likely to be carried at historical cost, and in substance therefore not fully recognised.[5] The accounts are therefore unlikely to provide much information concerning what can be understood as a "predictable discontinuity" associated with any *future* transition from current, unsustainable business practice. In general, even if there is general confidence and expectation that we are heading towards a future of net zero carbon emissions, or more generally net zero impact on natural capital, we find little, if any, indication of this in the financial accounts.

With some exceptions (e.g. Cook, 2009; Bebbington et al., 2020b), these informational limitations are generally not failures of financial accounting *per se* but instead reasons why the financial statements do not, *in principle*, provide all of the financially material information that is relevant to the determination of enterprise value.[6] Instead, the information provided is limited to a subset that is relatively "reliable" and that relates only to the entity's historical economic performance and current economic position. This relative reliability is a defining characteristic of useful accounting information, a strength not a weakness (Barker & Penman, 2020; Basu & Waymire, 2006).

That financial accounting is a subset of financially material information is not specific to environmental issues, and it applies as much (for example) to intellectual capital and

[5]A special case is mineral reserves, which are "gifts of nature" that predate human institutions, such that there is no operational economic "past event" that gives rise to recognition under IFRS 6. They also have uncertain yields, creating a challenge for "reliable" measurement.

[6]Note that information that is material to investors is broader than that which is concerned directly with the determination of enterprise value; see footnote 2.

human capital as it does to natural capital (Barker et al., 2021; IIRC, 2013; Lev, 2018). It does, however, point to an information shortfall from an investors' perspective. This concerns not least natural capital information that is relevant in determining enterprise value, yet that is not reflected in the subset of that value that is captured on the balance sheet. Such information relates to expected cash flows where rights and obligations have not yet been established, or where measurement is currently uncertain (Barker, 2015; Storey & Storey, 1998). Examples include the disclosures on climate-related risks and opportunities called for by the Taskforce on Climate-related Financial Disclosure (Gibassier & Schaltegger, 2017; O'Dwyer & Unerman, 2020), and similarly in IFRS S2 (*Climate-related Disclosures*; IFRS, 2023b). These include disclosures on climate-related governance, strategy, risk management, and metrics and targets, including such things as transition plan, scenario analysis and financial effects. Such information can be termed "sustainability-related financial disclosure". It is a complement to financial accounting information in reporting to investors.

The implications of this gap, between the set of information relevant to the determination of enterprise value and the subset that is captured in the carrying amount of financial capital, are best understood in terms of the information content of the income statement, rather than the balance sheet (Edwards & Bell, 1961; Ohlson, 1995; Penman, 2009). The income statement provides the foundation for forecasts of future value creation, making of central concern the predictive value of past financial performance, sometimes referred to as earnings quality or persistence (Black, 1980; Hicks, 1946; Kormendi & Lipe, 1987). In a sustainability context, where business model transition is forthcoming, the entity will find different ways to generate profit in the future than it achieved in the past, and earnings quality is therefore low.[7] And while this problem of the past not guiding the future is inherent in financial accounting, there are several reasons why it has a particular resonance for sustainability-related financial disclosure (Bebbington & Unerman, 2018).

First, while there is genuine uncertainty about future outcomes relating (for example) to the creation of value through intangible assets, there is an element of inherent predictability in science-based environmental targets, grounded as they are in observable breaches of planetary boundaries (Rockström et al., 2009; Steffen et al., 2015; Whiteman et al., 2013).[8] Currently-available data on corporate environmental impact thereby have predictive value, in the specific sense that they alert investors to future business model changes. To illustrate, the economic implications of a corporate commitment to net zero carbon emissions will vary by business, according to the extent to which the current business model imposes emissions-related externalities. In this regard, while historical financial profit by definition excludes externalities, an entity's current external impacts may influence its future capacity to generate profit, not least by affecting its "license to operate" (Dowling and Pfeffer, 1975; Bebbington et al., 2020a). In this way, information on current externalities, such as those relating to carbon emissions, water consumption or deforestation, can be financially material. The inclusion of this

[7]A similar claim can be made for social sustainability issues. A commitment to gender equality, for example, is a commitment to a "knowable" future outcome.

[8]The predictability of the related financial implications is of course much less certain.

information in sustainability-related financial disclosure can help compensate for the limited predictive value of current earnings.

Second, in the case of natural capital, there is potential misinformation in the accountant's traditional matching process, whereby amounts given up in exchange are linked with associated revenue in measuring periodic financial performance (Barker & Penman, 2020; Penman, 2009). Matching works well, as a guide to prospective decision-making only if the past serves as a guide to the future, yet this can break down if there is depletion in the natural capital on which an entity depends. This applies whenever renewable natural capital is depleted beyond a critical threshold, not least when a 'tragedy of the commons' arises from the over-consumption of common pool resources (Hardin, 1968). It applies also whenever renewing is not an economically viable option (i.e. where replacement cost exceeds recoverable amount), or else in cases of finite, non-renewable natural resources. In each of these cases, and especially when the natural capital itself is not owned by the reporting entity (and so there is no signal from an impairment charge), achieved financial performance is a poor guide to achievable future performance, because the resources consumed to generate profit in the current-period cannot be assumed to be continually available in future periods.

Third, reporting entities are increasingly exposed to risks and opportunities resulting from the expected effects of climate change, regardless of the scale of carbon emissions resulting from that entity's own activities (TFCD, 2017), and they are likewise exposed to broader ecosystem degradation, regardless of whether the entity's own activities are responsible (Helm & Hepburn, 2012). Earnings quality is again low, because financial profit is measured against the maintenance of the entity's own financial capital, and not against the maintenance of natural resources beyond its direct control. Sustainability-related financial disclosure therefore need not relate directly to the activities of the entity itself, but instead includes information about the natural capital on which the entity depends. This requires a different reporting mindset from that of the financial accountant (Spence & Rinaldi, 2014). It is reporting to investors, yet not as viewed through the lens of control over net assets. It is a perspective that is unexplored in the IFRS Framework (Barker and Teixeira, 2018), in spite of being concerned with financially material information.

Each of these three considerations speaks to inherent limitations in the capacity of financial accounting to provide investors with value-relevant disclosure. Earnings have reduced predictive value if: first, there are current externalities that are value-relevant for future earnings; second, the entity's current capacity to generate earnings depends upon the availability of natural resources, yet the sustainability of those resources is under threat; and third, the entity has limited direct control over its own performance, which depends increasingly upon external factors, such as extreme weather events or supply chain disruptions. Yet, in each of these cases there is currently-available information than can supplement financial accounting, thereby enabling investors to factor sustainability considerations into projections of future earnings, capital requirements and risk exposures, and in turn thereby informing the current determination of enterprise value. This set of information is sustainability-related financial disclosures, being information relating to natural capital (sustainability-related) that is explicitly oriented towards meeting an investor demand (financially material).

2. Corporate reporting

The discussion above has identified that financial accounting and sustainability-related financial disclosure are two distinct, complementary categories of information, both of which are financially material.

While these two categories are concerned with the information needs of investors, an additional consideration is that the interests of investors in corporate activities are a subset of the broader interests of society as a whole (Bebbington & Larrinaga, 2014; Gray, 2010). This implies a second, environmental materiality lens on corporate reporting. These distinctions are summarised in Figure 1.

We take the adjective "financial" to mean material to providers of finance; if information is decision-relevant to investors, then by definition it is financially material. Accounting is therefore constructed as "financial accounting" if, as in IFRS, its purpose is defined by financial materiality.[9] In practice, the terms "financial accounting" and "financial reporting" are commonly conflated. In contrast, the discussion in the previous section of this paper locates financial accounting as a subset of financial reporting, since the latter comprises not only historical financial performance and current financial position, but also information relating to environmental sustainability. In other words, an investor seeking to understand how an entity's enterprise value can hold up to climate change, and to other environmental exposures, requires both financial accounting and sustainability-related financial disclosure. It is for this reason that the IFRS Foundation, in seeking to provide investors with financially material information, has supplemented the International *Accounting* Standards Board with the International *Sustainability* Standards Board.

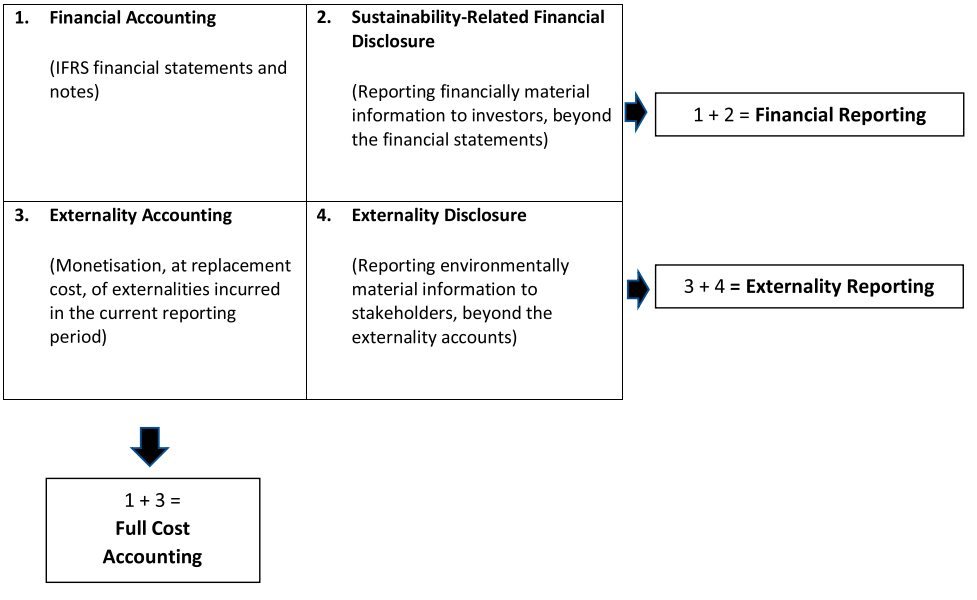


Figure 1. Components of corporate reporting.

[9]Investors can be understood here as either shareholders or a broader group; the difference is not critical to the argument.

The scope of financial reporting does not, however, include all economic effects of corporate activity on all stakeholders of the corporation. It would do so only in the hypothetical case in which there were no externalities, such that all economic effects in the reporting period would in principle be included in the measurement of financial profit, while sustainability-related financial disclosures would (as described above) supplement the predictive value of earnings by providing information about the entity's dependence upon natural resources, especially those over which it has limited direct control. There would be no demand for the corporate reporting of economic effects other than that which is already satisfied by financial reporting, because the absence of externalities implies that such effects are already fully captured.[10]

In the realistic case in which externalities are present, however, there is an *incremental* demand for information, for the benefit of stakeholders other than investors. This is not to say that financial reporting is irrelevant to non-investors but instead that it is insufficient. Continuing the distinction made above between accounting and reporting, the informational shortfall relates not just to externalities that are realised, and for which an account can therefore be given ("externality accounting") but also to the prospective effects of externalities in future periods ("externality disclosure").

3. Externality accounting

Externalities have long been understood to be a consequence of economic activity (Pigou, 1920). Yet only relatively recently have they become understood as an existential threat, capable of derailing economic wellbeing as a result of breaching planetary boundaries (IPCC, 2022; Rockström et al., 2009). From a societal perspective, externalities can no longer be understood simply as an unwelcome by-product of otherwise inexorable economic growth.

At heart, the existential importance of natural capital is an issue of substitutability. Nature has no substitute as the source of essential energy, water, air, genetic materials and minerals, and as the sink that absorbs and recycles waste (Fitter, 2013); without it there can be no economic activity (Arrow et al., 1995; Helm, 2015). Continued growth in financial capital cannot be traded off against continued depletion in natural capital; instead, the maintenance of natural capital is better understood as a precondition for economic growth, while an externality associated with a depletion of natural capital is different from that associated with, say, the loss of a community facility.

This difference is not captured in financial accounting. Consider natural capital that is owned by a reporting entity and take a simple example in which a privately owned area of ancient-growth tropical forest is felled, so that the valuable hardwood can be sold, but

[10]In the absence of externalities, which concern effects on parties external to transactions, corporate activity affects only its own shareholders and those with whom the company has entered contractual relationships. By design, financial reporting meets the information needs of shareholders and other investors. An implicit, simplifying assumption made above, in the claim that there would be "no demand for the corporate reporting of economic effects other than that which is already satisfied by financial reporting," is that – for those in non-investor contractual relationships with the company (notably customers, employees and suppliers) – economic effects are fully and fairly captured in the terms and enforcement of the contract. This is a common, though not unproblematic, assumption in corporate governance theory (Mayer, 2013).

with the effect that the ecosystem cannot be restored.[11] If the revenue from this activity exceeds recognised expenses, then although natural capital has been consumed, financial capital has increased. There is, in effect, an implicit assumption that natural capital is not unique but is instead substitutable, such that financial profit can be measured as the aggregate change in net assets, independently of the composition of that change. This is problematic because it overlooks that we are ultimately entirely dependent on nature. The financial accountant's implicit assumption is one of weak sustainability, instead of something closer to strong sustainability (Laine, 2005; Neumayer, 2013; Norton, 1995).[12] By measuring transactions and events in this example by reference to the market, financial accounting precludes consideration of any attribute that is not priced, thereby understating social cost and "overstating" profit. Nature is particularly vulnerable to over-consumption in this way if, as is typical for natural resources such as the atmosphere, oceans and forests, there is an absence (or lack of enforcement) of property rights or regulation (Coase, 1960; Heal, 2016), an under-pricing problem which becomes especially acute when viewed through the lens of future generations, for whom the market has little regard (Arrow & Debreu, 1954).[13]

These problems of imperfect substitutability cannot, by design, be seen through the lens of conventional financial accounting practice. They can, however, be addressed directly by adopting a second, environmental lens on corporate reporting, which views the maintenance of natural capital as an end in itself. There is an analogy here with financial accounting. Just as a "legal person" is an anthropomorphic fiction, which allows the construction of financial capital, so too the concept of anthropomorphising nature gives it a legal and economic standing that helps to construct externality accounting (New Zealand Government, 2014; Stone & Hardin, 1974). Accordingly, we use the term "environmental materiality" as analogous to financial materiality: information is environmentally material if its omission would affect users' understanding of the impact of a corporation's activities on natural capital.

Nature is of course not a "user" of corporate reporting in any conventional sense; it cannot think or speak for itself. Yet, by arguing that natural capital should be maintained, we are in substance taking a neutral stance on environmentally material information. The implied voice that we are giving to our anthropomorphic fiction of Nature is one that says "do no harm." While this does not address what Nature would ideally "demand" as a result of corporate activity (presumably an enhancement of natural capital), our definition of environmental materiality is consistent with an accountability that would make this particular user indifferent to the corporation: if there is no depletion of natural capital as a consequence of corporate activity, then there is respect for Nature's negative right not to be harmed.

A benefit of this approach is in recognising that natural capital is subject to anthropogenic influence, yet (unlike other capitals) not entirely subject to anthropogenic control, as the example of climate change illustrates (IPCC, 2022). And as neither the extent of influence nor the limits of control are fully understood, there is merit in a precautionary

[11]The point being made here applies more generally in practice to natural capital that is not owned by the reporting entity. Either way, the increase in financial capital is "overstated", as a result of the externality arising from consumption of the unpriced attributes of natural capital.

[12]Strong sustainability is a form of physical capital maintenance that implies that no substitutability is possible for natural capital, while an extreme weak sustainability implies the opposite.

[13]If historical cost is used, then some form of a "correction" to financial profit is called for, as an adjustment for changes in the value of natural capital that would otherwise remain unrecorded.

approach in the maintenance of natural capital as an end in itself (Wilson, 2016). [14] This is better achieved by adopting a capital maintenance concept grounded in the physical properties of natural systems, rather than in the economic value of those systems to different stakeholder groups within society.[15] It also makes irrelevant the (highly subjective) determination of best economic use (Hayek, 1935; Hicks, 1974). Moreover, by placing nature outside the realm of the economic (Satz, 2010), and so distancing natural capital conservation from questions at the interface of economic valuation and social justice, this approach helps to avoid "critical concerns … (relating to) the distributional, anti-democratic, moral and relational effects (of natural capital valuation)" (Russell et al., 2017).

To be operational, such an approach would require addressing what "counts" as natural capital, and which attributes of that natural capital are to be measured. Here we adopt the notion of "critical natural capital" from the environmental economics literature, which Ekins et al. (2003) define to be "natural capital which is responsible for important environmental functions and which cannot be substituted in the provision of these functions by manufactured capital." This overlaps with the concept of planetary boundaries (Rockström et al., 2009; Steffen et al., 2015; Whiteman et al., 2013), though takes a more anthropocentric perspective. In this regard, Helm (2015) advises that special consideration should be given to renewable natural capital, in part because the natural property of renewing provides a perpetuity "free lunch" and so is especially valuable, and also because of the greater risk of reaching a critical, irreversible threshold. What makes a particular category of natural capital critical is that it has no substitute, its loss would be irreversible, and the consequence of its loss would be significant to human wellbeing (Ekins et al., 2003; Marshall & Toffel, 2005).[16]

But how can the maintenance of (critical) natural capital, as an end in itself, form part of the same corporate reporting system that also measures (financial) performance by reference to the maintenance of financial capital? Is it plausible that a single reporting system can, in this way, combine seemingly orthogonal financial and environmental objectives?

Recall that our starting point is to take financial accounting practice as given, and to ask the normative question of whether and how this practice can be extended to embrace double materiality. And recall also that we are seeking a reporting system for the activity of the corporation. In this context, there is a critical difference between the legal person of the corporation and its natural world equivalent, which is that financial accounting is designed for the former, and not the latter.

Our aim here is not to produce a balance sheet for nature, in which a debit in recognition of enhanced natural resource is matched by a credit to natural capital, but instead to somehow extend corporate accounting to incorporate an accounting for natural capital maintenance.[17] While a (financial) balance sheet includes net assets with

[14]There is also an option value to natural capital that is difficult to price accurately, and so a prudential approach to natural capital conservation is additionally justified by a failure to account fully for the benefit that future generations might derive from it (Mayer, 2013).

[15]Consistent with the language and logic of natural capital, these physical properties can be conceptualised as ecosystem services, being the flow of benefits that underpins the concept of capital (Helm, 2015).

[16]These can be understood as the conditions for applying the concept of strong sustainability as opposed to weak sustainability. The extent of reporting is determined by the acceptable level of substitution.

[17]In any event, the corporate structure of rights and obligations is a social construction, which has no parallel in nature (Searle, 2010). The concept of a liability has no parallel in the natural world, with the implication that assets must always be equal to capital, making the concept of double entry redundant.

respect to which financial capital represents an exclusive ownership claim, in contrast the corporation has no exclusive ownership claim to shared resources such as oceans, ecosystems and the atmosphere, nor to natural resources that it relies upon in its supply chain (or that it otherwise impacts) but that it does not own, such as land, water or mineral resources. In short, if the motivation for externality accounting applies to external impacts on natural resources outside of the reporting entity's economic control and obligation, or to the inadequate costing of resources consumed through market transactions, then a balance sheet designed to report financial capital is an inherently unhelpful construction.

Somewhat paradoxically, however, given that it represents a change between two balance sheets, the concept of an income statement *can* be employed to connect financial accounting with externality accounting. The concept is that of an accrual-based, historical representation of performance during a reporting period. If performance is measured as an increment in financial capital, then the bottom line is financial profit. If, in addition, external costs are measured as changes in natural capital, then the fully-costed bottom line comprises financial profit plus externality cost. It is incidental for the purpose of this calculation whether or not corporate activity affects net assets owned by the corporation. Either way, and notwithstanding that the externality costs are (by definition) not actually incurred by the entity and in that sense hypothetical, the fully-costed income statement measures fully-costed performance within the period.[18]

Practically, the financial accounting concept of consolidation is readily applicable here. In the case of economic transactions and events, the original incidence of expenses reported in the income statement could, in principle, have been anywhere in the entity's supply chain. While the balance sheet is constrained to report assets and liabilities controlled by the entity, which requires consolidation of group companies, expenses are "passed on" by means of transactions through the supply chain. Yet this passing on does not take place for externalities, which are therefore of two distinct types: the entity generates externalities from its own operations (for example Scope 1 Greenhouse gas emissions; WBCSD and WRI, 2004), while it can also be understood to be "responsible" for externalities in its supply chain (Scopes 2 and 3) which, if internalised as costs to suppliers, would ultimately be reported in the entity's income statement.[19]

In short, it is possible to maintain the existing system of financial accounting, as a record of "realised" business transactions and events (which yields financial profit), but then to extend profit measurement by including some form of externality accounting; this provides a "full cost accounting", as illustrated in Figure 1.

The possibility of a full-cost approach based on the maintenance of natural capital is acknowledged in Gray (1992, 1994), yet it remains undeveloped and has instead been "crowded out" by other systems of accounting and reporting, both in the literature and also in corporate practice (Deegan, 2017). This oversight in corporate practice might be explained by corporate economic self-interest. Gray (2010) speculates that

[18]This approach is consistent with the IFRS conceptual framework, in which the balance sheet is not designed to capture the economic value of the reporting entity (Penman, 2009; Barker & Penman, 2020).

[19]The presence of supply chain externalities means that, while the conventional scope remains unchallenged, there arises a need to gather information from the supply chain, which does not arise in the case of financial reporting. This does not imply double counting. By analogy with expenses, labour costs incurred by a supplier (Scope 3) differ with respect to control from those incurred by a reporting entity (Scope 1), and the supplier's costs are correctly in the determination of profit for both the supplier and the reporting entity.

because "the calculation would wipe out almost any company's profit," it would be understood to give the "wrong answer", suggesting a corporate preference instead for an opportunistic appropriation of the concept of sustainability, interpreting it to mean the sustainability of profit rather than profit earned in an (environmentally) sustainable way (e.g. Milne et al., 2009; Milne & Gray, 2013; Van Bommel, 2014).

Full-cost accounting requires, of course, that externalities are monetised. In this regard, our analysis above leads us to reject two alternative approaches that have been proposed in the literature. The first of these avoids entirely the use of money as a common metric, representing financial accounting and impacts on the natural world as in principle incommensurable (Espeland & Stevens, 1998). Reporting on each domain is kept separate, and the monetisation of externalities is avoided altogether (Bebbington & Gray, 2001; Davies & Dunk, 2015; Gray, 1992, 1994; Milne & Gray, 2013). There is neither commensurability with the financial statements, nor even among different metrics within an environmental report (Norman & MacDonald, 2004; and see Russell et al., 2017). Sometimes termed an "inventory approach" (Gray, 1994; Lamberton, 2005), this method is most closely associated in practice with the widely-adopted standards of the Global Reporting Initiative (GRI, 2015). While we see merit in this approach, it has several limitations. From an investor perspective, it does not apply financial materiality as a distinct lens, and so does not provide investors with sustainability-related financial disclosure, as a defined subset of corporate reporting and a complement to financial accounting. From a nature perspective, it does not provide a bottom line, a comprehensive accounting for corporate performance that would satisfy both financial and environmental materiality, thereby supporting an overall accountability for corporate impact (Roberts, 2009). In these respects, it reinforces rather than resolves the issue of siloed reporting.

The second alternative in the literature differs from our approach by not taking existing financial accounting as its starting point. This approach seeks to maintain a single bottom line, by means of revising the financial accounts in order to accommodate considerations of sustainability (e.g. Rubenstein, 1992). So, for example, a liability would be recognised for environmental impact, even though no such liability would be required in conventional financial accounting (Chabrak, 2018; Lev, 2018; Mayer, 2016; NCC, 2015; Rambaud & Richard, 2015; Serafeim et al., 2019). Our analysis does not support such an approach because it conflates "actual" legal and constructive rights and obligations of the entity with those that are hypothetical and discretionary (in the case of liabilities) and wished-for but not controlled (in the case of assets). This corrupts IFRS, rather than extending and complementing it.

Our approach instead calls for a comprehensive income statement, in which we neither presume IFRS to have "got it wrong", nor to remain siloed from reporting on externalities, but where impacts on both financial capital and natural capital are instead made commensurable, and in a way that protects the integrity of the joint objectives of maintaining both financial capital and natural capital. Instead of reporting a single bottom line, we call for financial profit and externality cost to be reported as distinct subtotals within an overall full-cost accounting. In this regard, there are parallels with the adapted value-added statement proposed by Quattrone (2022), in which a deduction for Nature plays the role of alerting actors to institutional arrangements that would otherwise render natural resource externalities invisible.

In practice, our approach requires taking two steps, the first being physical measurement of the natural resource itself, and the second being monetisation (Antheaume, 2004; Bebbington et al., 2001; Gibassier & Schaltegger, 2015; Lamberton, 2005; MacKenzie, 2009; Milne, 1991). The first of these steps can be unambiguously aligned with the maintenance of natural capital. The second is more contested (Cuckston, 2013), yet arguably it enables accounting to give "visibility" to natural capital (Jones, 2010), providing "a means to fight on the terrain of 'hard' financial calculation" (Bebbington et al., 2007; see also Chabrak, 2018).

Consider the practice of financial accounting, in which diverse physical activities, ranging from idea generation to manufacturing and distribution, are made commensurable by means of standardised, transaction-based monetisation. In the case of externality accounting, however, the absence of market transactions invites plurality, with Unerman et al. (2018) noting "many acceptable and defendable methodologies for quantifying and financially internalising externalities." A common approach to monetisation is to borrow from the logic of financial economics (Barker & Schulte, 2017; Morgan, 1988; Power, 2010), conceptualising externalities as economic impacts, measured as the output of valuation models that employ methods such as hedonistic pricing or survey-based measures of willingness to pay (Antheaume, 2004; Bebbington et al., 2007; Bebbington & Larrinaga, 2014). This valuation approach is commonly advocated in the literature, and it can be relevant in managerial decision-making contexts (Milne, 1991).

There are several reasons, however, to regard a valuation approach as conceptually inconsistent with financial accounting in a full-cost income statement, making use of the term "accounting" inappropriate to describe such an approach. As discussed above, an important feature of accounting representation is its historical nature, being concerned with past transactions and events only (Milne, 1991; Morgan, 1988). A recording of the past is concerned with observable activities, making it in principle accessible to measurement, and so to verifiability, and to giving a reliable *account* (Barker and McGeachin, 2013; Chambers, 1998; Storey & Storey, 1998; Basu & Waymire, 2006, 2010). Such properties also help to counter managerial agency in the context of accountability (Watts, 2003; Roberts, 2009). These defining features are lost when the monetisation of externalities is drawn directly from the environmental economics literature. This is because valuations are subjective estimations of future outcomes that cannot have the verifiability of the measurement of past performance. They therefore invite managerial discretion in reporting. In short, valuation is not accounting. Indeed, the sustainability reporting literature is itself rich with evidence of why that is so. There is opportunistic agency when companies control their own reporting (Boiral, 2013), and an economic self-interest in exploiting that reporting as a vehicle for socially accepted legitimacy (Dowling and Pfeffer, 1975; Deegan, 2014; Cho et al., 2015b; Suchman, 1995) and for shaping a perception of responsiveness to stakeholders (Deegan and Blomquist, 2006). Consistent with this, discretionary reporting practice varies over time, as any given corporate activity is perceived to become more or less legitimate (Brown and Deegan, 1998; Islam and Deegan, 2010), and also across different industries, as legitimacy is sustained or threatened in context-specific ways (Patten, 1992). Discretionary sustainability reporting can be understood as grounded in social salience, rather than in scientific "reality", for which the development of institutional pressures carry a formative power (Bebbington et al., 2008; Di Maggio and Powell, 1983; Hoffman, 1999; Higgins & Larrinaga, 2014;

Rankin et al., 2011). Such pressures lead to variation across different cultural settings, and not just across industries. Discretionary sustainability reporting can therefore be understood as the outcome of a (private) cost–benefit analysis, whereby the corporation can be understood as "weighing up" the (financial impact) to itself of its own reporting. As such, it is no more consistent with a genuine commitment to sustainable business practice than to a disingenuous signal of such a commitment (Deegan et al., 2002). For these reasons, the relatively rigorous foundations of (historical, verifiable) financial accounting are especially pertinent.

A further inconsistency is that environmental impact valuation does not correspond directly to the economic decisions faced by the corporation. It does not, therefore, provide users with information on what the financial consequences would be for the entity in acting to eliminate externalities.[20] In the logic of deprival value, an economic valuation is the appropriate measurement attribute for an asset only in the limited case when replacement is not viable and where, in addition, value in use exceeds that from disposal (Edwards et al., 1987). Similarly, for a liability, valuation of the impact on stakeholders is the appropriate measurement attribute only if this amount is lower than both direct costs in settling the liability and costs of outsourcing settlement to a third party. Financial accounting measures (for example) revenue for the entity, it does not seek to measure consumer surplus for the customer. If financial accounting reports on the economics *of* the corporation, while impact valuation reports on how stakeholders are affected *by* the corporation, then bolting together data with these different attributes does not produce a conceptually coherent full-cost income statement.

Finally, and perhaps most serious, the use of valuations falls into the pernicious trap of economic logic, described above, whereby all forms of capital are presumed to be inherently substitutable, when they are actually not so, given the uniquely valuable nature of ecosystem services. The compensation of a (human) third party is not a restoration of nature and the environmental criterion of natural capital maintenance is thereby not met.

In the light of these difficulties, and consistent with one of the options indicated in Gray (1992, 1994), we propose that replacement cost is employed as a measurement attribute, in place of impact valuation (Edwards & Bell, 1961; Whittington, 2017). A replacement cost approach asks the following question: what cost would the reporting entity incur to make good any depletion of natural capital? This question is of course hypothetical, because if costs were actually incurred, they would form part of the measurement of financial profit, and – whatever level of financial profit was achieved – natural capital would have been maintained. If financial profit differs from full-cost profit, it is because the former has been achieved at the expense of natural capital; costs have been imposed externally, and not incurred internally.

The use of replacement cost grounds externality accounting in the physical measurement of the natural resources themselves. The question is not what economic value has been lost by the depletion of natural capital, but instead what ecological loss has taken place. Accordingly, monetisation asks what financial resources must be consumed to replenish natural capital, and not what depletion of financial value has resulted from the depletion of natural resources.

[20]In addition, users do not need the entity to estimate the impact on them; this they can do better for themselves.

Yet, in spite of being grounded in this way in the physical properties of natural resources, a critical benefit of a replacement cost approach is conceptual alignment with financial profit. This follows fronm the discussion above, in two ways. First, replacement cost represents the economic decision facing the reporting entity, namely the cost required to operate. This stands in contrast with a valuation approach, which concerns impacts on others, rather than on the entity itself (Edwards et al., 1987). In other words, a replacement cost approach is consistent with financial accounting in being an accounting for the entity, rather than an incoherent hybrid in which financial profit is measured from a shareholders' perspective while externalities are an amalgam of perspectives of different stakeholders. Second, and by applying the common metric of money, financial performance and impact on natural capital are made commensurable, notwithstanding that the maintenance of natural capital is understood here as a non-monetary concept. There is no direct comparison of, for example, carbon emissions, water contamination or deforestation, but instead measurement of the (commensurable) costs of remediation in those (otherwise incommensurable) different settings (Bebbington et al., 2007; Russell & Lewis, 2014). There is monetisation, yet because the focus is the cost of conservation, and not the economic value thereby created, the monetisation process does not take the contentious step of placing an economic value on nature (Piccolo, 2017).[21] Note here the particular sense in which commensuration is a process that "creates relations among things that seem fundamentally different" (Espeland & Stevens, 1998). While there is usage of a common metric, which enables a single bottom line, there is not a comparison created between financial capital and natural capital, in which both are understood as alternative expressions of economic value, and where the non-economic value of nature is thereby rendered invisible. Commensuration is achieved by measuring the (hypothetical) effect on financial capital of the resource consumption that would be required to maintain natural capital. The common metric of money enables financial performance to be measured subject to the constraint of natural capital maintenance, in effect (and echoing Miller & O'Leary, 1987) employing accounting as a device to reconstruct the governable entity. What it does not entertain is a valuation-based trade-off between economy and nature, and in that critical sense these two domains remain incommensurable (Raz, 1986, pp. 326–329).

We acknowledge, and do not wish to understate, the practical challenges of measuring the replacement cost of natural capital, associated for example with location-specificity, ecosystem interdependence and intertemporal variation (Cuckston, 2013; Milne & Grubnic, 2011; Tregidga, 2013). Also, our "solution" is necessarily limited in cases where direct substitution is infeasible. This arises most obviously for non-renewable natural capital, which can be understood practically as including the infeasibility of the immediate replacement of (for example) ancient ecoystems. In practice, replacement is rarely an immediate like-for-like substitution, and when the passage of time is involved, there is an implied need for an ongoing evaluation both of the ecosystem services that are actually achievedand of the revised cost of their provision. In turn, this raises questions of whether future effects are ever actually knowable, or indeed ever usefully known ex post. Finally, a limitation of a different type is that of unavoidable ethical

[21]Such an approach precludes reporting gains from net positive externalities. In practice the "problem" of not capturing corporate investments made purely for the public good is unlikely to be material.

issues in assuming that "replacement" legitimises the termination of non-human life to serve human ends (Vinnari & Vinnari, 2022).

Yet a replacement cost approach should be evaluated not against some unrealistic ideal but instead against feasible alternatives, and here it brings several practical benefits. By means of its focus on replacing currently depleted natural capital, a replacement cost approach is anchored in the observable state of nature at the present time. It thereby avoids the core problem in valuation of making unavoidably speculative assumptions about economic benefits expected to arise in future periods (Barker & Schulte, 2017; Kaspersen & Johansen, 2016). This locates environmental accounting with an appropriate immediacy, helping to avoid the pitfall of implicitly assuming that long-term environmental effects call for long-term-oriented reporting, overlooking the need for collective action in the present (Tregidga & Laine, 2022). There is no need to confront the widely-cited difficulties, in valuing natural capital, of value allocation and unit of account (Barton, 1999; Coulson et al., 2015; Unerman et al., 2018), difficulties which increase with increasing system complexity and/or value plurality (Frame & O'Connor, 2011). The approach therefore also diminishes managerial discretion in reporting, reducing the opportunity to (mis)represent economic gain, thereby responding to the agency problem described earlier (Barker and McGeachin, 2013). This is not to suggest an absence of subjectivity and complexity (Gibassier & Schaltegger, 2015), and of opportunistic measurement with respect to sustainability performance (Chen et al., 2014), but instead to stress accounting's anchor in *relatively* reliable, observable measurement, precluding an interpretation of full-cost accounting as embracing inherently subjective, prospective estimation (Bebbington & Larrinaga, 2014). Further, and because the (relatively straightforward) informational need concerns the income statement only, being the difference between financial profit and full-cost profit; it is the change (or flow) that is represented, and not the level (or stock). There is no need to place a value on nature, but instead only to engage in incremental costing. In all of these respects, a replacement cost approach is consistent with the increasing endorsement and use of net positive biodiversity targets, suggesting that the approach is not only in principle feasible but that in substance the underlying methods and data required to implement our approach in corporate reporting are largely already under development (FFI, 2014; IUCN, 2015; OECD, 2016).

Overall, the approach lends itself to an operational, single income statement, which clearly delineates the gain or loss on financial capital from that on natural capital, and which consistently applies an underlying logic of accounting for the performance of the reporting entity; this is illustrated in Figure 2.

While externality accounting in this form concerns reporting on incurred externalities, this leaves open the question of material disclosures with respect to any future depletions of natural capital that are expected to be externalities. This can be seen by returning to Figure 1. We have so far argued that the information provided by financial accounting can be complemented in one of two ways, either by means of sustainability-related financial disclosure (which provides investors with a more comprehensive set of information with which to make investment decisions), or by means of externality accounting (which extends the concept of profit from a shareholders' perspective to include the hypothetical cost of maintaining natural capital, so yielding a fully-costed measure of profit). Yet, from a natural capital perspective, neither of these additional disclosures addresses possible future depletions of natural capital, where the

SUSTAINABLE INCOME STATEMENT		
Revenue		950
Expenses	Consumption of renewable natural capital	(80)
	Consumption of non-renewable natural capital	(60)
	Other expenses (cash outflows)	(660)
Financial Profit under IFRS		**150**
Adjustment for changes in unrecognised net assets		10
Adjusted Financial Profit		**160**
Externalities – upstream		(15)
Externalities – own operations		(35)
Full-Cost Profit		**110**

Figure 2. Income statement – from financial profit to full-cost profit. Note: (1) For simplicity of presentation, the line items from revenue to financial profit are intended as a shorthand representation of a conventional income statement, with expenses categorised according to relationship with natural capital. All other line items are concerned with adjustments that reconcile financial profit with sustainable profit. (2) Financial profit is maintained, given its central role in capital markets, but the approach also yields "full-cost profit" as a second bottom line, which serves a different, complementary informational purpose. (3) The adjustment for changes in unrecognised net assets concerns gains or losses on assets that are owned by the company but that are not fully captured on the balance sheet (for example, land carried at historical cost). Accordingly, the subtotal "adjusted financial profit" can be considered to be a "comprehensive" measure of financial profit. (4) Financial profit for the shareholder is adjusted for externalities, and thereby reconciled with full-cost profit. These are "expenses' not actually incurred by the corporation but that would be required to be incurred in order to restore depleted natural capital. (5) Externalities might arise upstream, outside the boundary of the financial reporting entity, or else they might be consequences of activities undertaken by the reporting entity itself. These two categories are presented separately, in order that the source of the externality can be understood. Again, the presentation here is kept simple. In practice, of course, there would be numerous sources of externality, each measured with different levels of complexity. (6) As we define full-cost profit as the (hypothetical) financial profit that the company would make if it internalised its externalities, including those in its supply chain, the possibility remains that natural resources remain depleted. An accounting choice therefore arises over whether to measure replacement cost historically or currently, where the latter would require re-estimation in each subsequent accounting period (similar to that in IAS 37) for the current cost of making good prior damage. This would in turn require some form of (off balance sheet) "liability" accounting, from whichever year is deemed to be the base. There is a simple trade-off here between the costs of maintaining such a system and the increased economic relevance of the data provided .

cost remains external to the entity. The relationship here, between these externality disclosures and externality accounting, is a direct parallel with the relationship between sustainability-related financial disclosures and financial accounting. In the same way that forecasts of future financial profit benefit from information beyond that contained in current financial profit, so too forecasting the cost of future externalities benefits from information beyond that contained in the cost of current externalities. The Hicksian logic of earnings quality again applies here (Hicks, 1946), so that, for example, externality accounting might report on current externalities with respect to an ecosystem, while externality reporting might address the prognosis for that ecosystem, including expected further corporate activity and/or plans or targets for intervention to restore prior impacts.

A complication arises to the extent that, in determining both sustainability-related financial disclosures and externality disclosures, the future is uncertain, making it a matter of speculative judgement whether or not a current externality will be internalised in the future (Knight, 1921). The implication is that the boundaries in Figure 1 are not as mutually exclusive as they might at first appear. Information about the cost of current externalities might *also* be reported as a sustainability-related financial disclosure to investors, because it might provide useful information with respect to prospective mitigation costs that the entity might be expected to internalise. Information about prospective externalities might be material both to investors *and* to other stakeholders, because it cannot be known whether, and if so when and how, there might be an internalisation of cost, for example by means of regulation, taxation, change in consumer preference, or some other mechanism.

4. Conclusion and implications for research

We have explored how externality accounting can extend financial accounting, and how both can be complemented by disclosures that are material to their respective audiences. Drawing from the logic of financial accounting and also from the sustainability reporting literature, we have identified four distinct components of corporate reporting, differentiated according to whether, on the one hand, there is accounting for historical performance or instead informing with respect to expected performance and, on the other hand, whether the materiality lens is either financial or environmental. We argue in favour of measuring externalities by reference to the current replacement cost of depleted natural capital, which enables both current-period accountability for externalities and a single, full-cost income statement that measures corporate performance with reference to the maintenance of both financial capital and natural capital.

Our analysis contributes to the literature by unpacking the notion of sustainability reporting, and in that context separating accounting from valuation, and financial capital from natural capital. In the absence of these distinctions, "sustainability" – in a corporate reporting context – is conceptually vague, because it does not separate the measurement of past performance from the subjective estimation of future outcomes, and it does not clarify whether the sustainability of natural capital is itself important or whether it is instead important only as a means to the end of enhancing financial capital.

To see why these distinctions matter, consider first a strong and pervasive argument in the literature, concerning the "regulatory capture" of sustainability reporting (e.g. Brown & Dillard, 2014; Humphrey et al., 2017; Milne & Gray, 2013; Van Bommel, 2014). Zappettini and Unerman (2016) contend that "by and large, the term sustainability has been appropriated, mixed with other discourses and semantically 'bent' to construct the organisation itself as being financially sustainable, that is, viable and profitable and for the primary benefit of shareholders." Tregidga et al. (2014) describe this as what the "sustainable organisation" has come to "mean", that sustainability is no longer primarily an environmental issue but instead that it is viewed only through the lens of financial materiality, as adopted by CDSB, IIRC, ISSB, SASB and TCFD (Cooper & Michelon, 2022). Attaching sustainability to financial capital in this way – putting profit before planet – is argued to be subversive, a "rhetorical diversion" (Milne & Gray, 2013, p. 14) that

gives false reassurance that business-as-usual can address the societal challenge of environmental sustainability (Cho et al., 2015a; Deegan, 2013; Norman & MacDonald, 2004; Schneider, 2015).[22] It is consistent, for example, with the delusion that a company can claim to be a sustainability leader if it has low environmental impact *relative* to others in the industry, even while what it *actually* does is subject to the binding constraint of maximising shareholder value (Marshall & Toffel, 2005; Spence & Rinaldi, 2014). Meanwhile, the scope for duplicity is aided by the notion of sustainability being contested (Hueting & Reijnders, 1998; Neumayer, 2013), with definitions often too vague to support the arguments advanced for them (Deegan, 2017; Milne & Gray, 2013; Norman & MacDonald, 2004), and with the notion of sustainable development itself being "full of latent contradictions" (Jones, 2010, p. 128). In short, the challenge is that sustainability has come to be shareholder value by another name. In the language used in this paper, "sustainability" has come to allow – inappropriately – for the advancement of financial capital at the expense of the depletion of natural capital (Gray, 2006; Laine, 2005; Pearce, 1988).

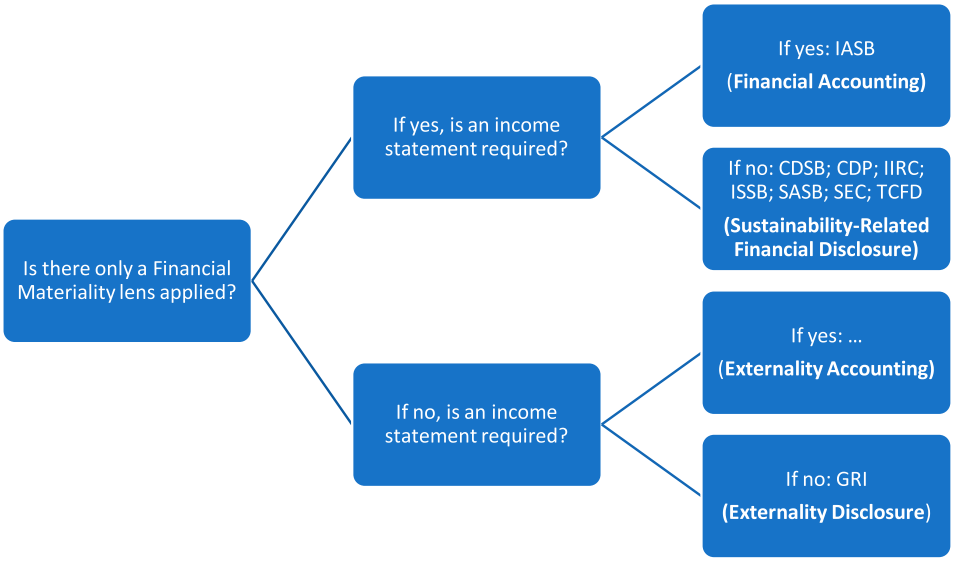
Our analysis is responsive to this critique, while also in disagreement with it. Consider, for example, sustainability-related financial disclosure, which uses the term sustainability, but does so through a lens of financial materiality. This category includes Integrated Reporting, an initiative which sparked early enthusiasm in the literature for a form of corporate reporting that would be sensitive to the social impact of corporate externalities (e.g. Adams, 2015), yet which was explicitly not designed to be sensitive in this way. That there is no inconsistency in reporting guidelines between Integrated Reporting and the IASB's own Management Commentary reinforces that both are premised on financial materiality (Barker and Teixeira, 2020), and that it would therefore be overly wishful to expect Integrated Reporting to "deliver on sustainability" (Flower, 2015; Stubbs & Higgins, 2014). By making a clear distinction between financial materiality and environmental materiality, we separate sustainability-related financial disclosure from accounting and reporting with respect to externalities. Viewed in this way, criticism that sustainability-related financial disclosure fails to meet the demands of sustainability reporting is misplaced. Financial reporting does not, by design, address costs that will never be internalised. It is instead concerned uniquely with current and prospective financial returns, with respect to which investors have a legitimate interest in sustainability-related disclosures that are informative with respect to economic risk and opportunity.[23]

By focusing criticism on financially material information provided to investors, scholarly attention has (ironically) being taken away from the provision of environmentally material information. In this regard, the lack of attention given to externality accounting, and to the determination of full-cost profit, is a remarkable omission in both corporate reporting practice and in the sustainability reporting literature.

We illustrate these points in Figure 3, which applies our analysis in a broad mapping of the institutional landscape of standard-setters and similar bodies in corporate reporting. We identify these actors from frequent, corroborating references to them across

[22]Corporations in the fossil fuel industry, for example, have remained financially profitable for decades, yet in the process they have contributed to carbon emissions beyond levels regarded as safe for continuing human existence on the planet (IPCC, 2022).

[23]Historically, sustainability reporting has arguably not met this need (Cho et al., 2015b).



CDP	CDP, formerly 'Carbon Disclosure Project'
CDSB	Climate Disclosure Standards Board
GRI	Global Reporting Initiative, and Global Sustainability Standards Board
IIRC	International Integrated Reporting Council
IASB	International Accounting Standards Board
ISSB	International Sustainability Standards Board
SASB	Sustainability Accounting Standards Board
SEC	Securities and Exchange Commission
TCFD	Task force on Climate-Related Financial Disclosure

Figure 3. Corporate reporting taxonomy.

several sources, including the research literature (e.g. Andrew & Cortese, 2013; Humphrey et al., 2017; Milne & Gray, 2013), and prominent, self-selecting groups in which the actors themselves are represented, such as the Corporate Reporting Dialogue (CRD) and the Impact Management Project (IMP).[24] We structure Figure 3 around our earlier discussion of financial accounting which, at the risk of oversimplification, identified two critical, conceptual steps that underpin the design of IFRS.[25] These are the lens of financial materiality, and a recognition, measurement and presentation structure that yields an income statement (and so a single measure of performance) that is grounded in historical transactions and events (Camfferman & Zeff, 2015; Storey & Storey, 1998). In Figure 3, we apply these two steps in filtering, and so mapping out, leading institutional actors. The algorithm in Figure 3 leads to the same four categories identified in Figure 1.

[24]Subsequent to CRD and IMP, the CDSB, IIRC and SASB have ceased to be independent entities and have been consolidated within the IFRS Foundation.
[25]They also lead, equivalently, to US GAAP, or indeed to any generally accepted set of financial accounting standards.

Applying both of the filters, we arrive at financial accounting (described as "IASB" but equally US GAAP or other). If the first of these filters applies, but not the second, we arrive at sustainability-related financial disclosure. Meanwhile, environmental materiality, combined with either accounting or broader disclosure, leads to either externality accounting or externality disclosure, respectively.

Several observations can be made using Figure 3. First, the financial accounting category is relatively stable, in the sense that standard-setting authority is clear and generally accepted practice is well established. This is consistent with taking IFRS as the institutionally embedded starting point for our analysis. Second, and consistent with related evidence from the research literature of an investor-oriented "appropriation" of the concept of sustainability reporting, discussed above, a plethora of actors has occupied the sustainability-related financial disclosure category (Laine, 2005; Milne & Gray, 2013; Tschopp & Nastanski, 2014; and see also Unerman et al., 2018). This space has been neither stable nor uncontested; it is where much of the debate around sustainability reporting has been taking place, concerning for example the legitimacy of investor-oriented sustainability-related disclosures, and of the IFRS Foundation's role in providing them. In its comment letter to the IFRS Foundation, on the subject of creating the ISSB, the GRI advised on a need to "clarify the term 'sustainability reporting' and its underlying concepts, as we believe that the term as used in the Consultation Paper does not reflect established practice" GRI (2020). Consistent with this need for clarification, the institutional structure of sustainability reporting has since mostly aligned with the underlying logic in the structure of Figure 3. In recognition of the inherent alignment in purpose for actors seeking to standardise sustainability-related financial disclosures, there has been considerable consolidation, evident in CDSB, IIRC and SASB being formally subsumed within the ISSB, with the work of the ISSB explicitly building upon the structure laid down by TCFD, with CDP committing to base its reporting requirements on the ISSB climate disclosures standard, IFRS S2, with IOSCO endorsing ISSB for capital market disclousre, and with TCFD ending its operations in favour of these being continued by the ISSB. And there is now also recognition of the distinction between materiality for investors and for others, and of the importance of distinct sustainability-related disclosures in each domain.[26] This is most evident in a 2022 memorandum of understanding between ISSB and GRI, which states that the two can be viewed as "interconnected reporting pillars that address distinct perspectives, which can together form a comprehensive corporate reporting regime for the disclosure of sustainability information".[27] It is also evident in the EU's Corporate Sustainability Reporting Directive, which requires reporting of both "the impacts of the activities of the undertaking on people and the environment, and on how sustainability matters affect the undertaking" (CSRD; EU, 2022). Yet, finally, and consistent with our earlier analysis and with the motivation for our paper, the externality accounting category remains an empty set. This is again consistent with the research literature, albeit in the negative sense that this category has been overlooked both in practice and in academia. Neither GRI nor the EU

[26]The notion of "double materiality" in European Sustainability Reporting Standards (ESRS) is explicitly intended to embrace both perspectives. Its reporting requirements apply to both sustainability-related financial disclosure and to externality disclosure, without distinction between the two. The algorithm in Figure 3 therefore cannot readily be applied to ESRS; for this reason, ESRS is not included.

[27]GRI – IFRS Foundation and GRI to align capital market and multi-stakeholder standards (globalreporting.org).

have interpreted their (multi-stakeholder) materiality perspective to include externality accounting. In contrast with financial reporting, which now seeks to provide material information in the form of both financial accounting and sustainability-related financial disclosure, the reporting of externalities conspicuously fails to make a comparable distinction. Figure 3 suggests that, instead of contesting whether the IFRS Foundation has a legitimate interest in setting standards for sustainability-related financial disclosure, the more pertinent question is "who should be setting standards for externality accounting, and why is this not happening?" We see in this a contemporary illustration of the celebrated insight of Hines (1988), that accounting choices construct reality, in this case that accounting remains ontologically anchored as an inherently financial concept. The possibility of environmental accounting, of a fully inclusive income statement, is neither seen nor represented by standard-setters, and this absence of representation ensures that neither is it seen by users of corporate reports. Hines (1988) asked this question directly: " … pollution, for example: what if that is included in the picture?" Her question remains a good one.

In this regard, our analysis suggests that the concept of the "monetisation frontier" (Bebbington et al., 2007; Frame & O'Connor, 2011; O'Connor, 2006) has not been sufficiently developed in the realm of sustainability reporting. The notion here is one of a border, within which monetisation is feasible, yet beyond which a purely economic calculation is problematic, for reasons of either physical system complexity and measurement uncertainty, or of conflicting values over the use of natural resources. We would argue that our notion of externality accounting helps to locate the monetisation frontier, conceptually at least, and in practice subject to the measurement limitations discussed above. Our focus on (*ex post*) cost, rather than (*ex ante*) valuation, reduces measurement uncertainty. This approach, by design, parallels the frontier between financial accounting and other financially material disclosures: the IFRS recognition and measurement criteria serve to separate the relatively objective and verifiable measurement that is required for inclusion in the financial statements, from the less certain disclosures that are made more generally in financial reporting. So, too, our approach to the monetisation of externalities is limited to the sphere of accounting, leaving broader externality reporting on the other side of the monetisation frontier. In this regard, the use of replacement cost as a measurement attribute grounds monetisation in the physical maintenance of natural capital, thereby not raising the question of alternative use of natural capital, and of associated conflicting values, as would arise for example in the felling of rainforest to allow road construction.

In qualifying this conclusion, however, we identify three important limitations of our analysis, each of which we suggest is an avenue for further research. First is the practical question of measurement. Our argument is conceptual, and while its practical application is arguably straightforward in cases such as carbon credits, we readily acknowledge much more substantial measurement challenges in, for example, replacement cost with respect to the partial depletion of an ecosystem (Cuckston, 2013; Milne & Grubnic, 2011; Tregidga, 2013). Second, we have defined full-cost profit as the (hypothetical) financial profit that the company *would* make *if* it internalised its externalities, including those in its supply chain. In contrast with the "reality" of the financial accounts, there is therefore a form of misrepresentation in our externality accounts, and the possibility of a "hyperreality", representing as "expenses" transactions and events that have not actually

taken place, perhaps creating the (false) perception that sustainability is "achieved" (Macintosh et al., 2000; Tregidga et al., 2014). Third, in "wishing" for externality accounting and reporting, our analysis is perhaps insensitive to human agency, and to institutional reality. In practice, as evidenced in the literature reviewed above, what corporations "ought" to do in this regard is commonly subverted by, in effect, making the claim that sustainability-related financial disclosure is sufficient to meet the demands of sustainability reporting for all stakeholders (Kitzmueller & Shimshack, 2012). In this regard, we acknowledge both the institutional challenge in willing accounting to construct a fully-costed "reality" (Hines, 1988; Larrinaga & Garcia-Torea, 2022) and the evidence that economic self-interest, rather than a direct concern for externalities, is the better description of practice (Deegan, 2014; Deegan et al., 2002; Higgins & Larrinaga, 2014; Patten, 1992).

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