Beyond ESG: Rebuilding Environmental Measurement Around Material Reality

White Paper

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Executive summary

Environmental, Social and Governance, or ESG, is now widely used as a shorthand for corporate sustainability. It is used by investors, index providers, companies, consultants, public bodies and customers, and has become part of how firms communicate non-financial performance. On the best day, it creates visibility, gives firms a reporting structure, and helps external audiences make some sense of complex environmental, social and governance claims (Amel-Zadeh and Serafeim, 2018; Eccles and Stroehle, 2018; Rau and Yu, 2024). But ESG has also become far too trusted for what it currently is.

The problem is not simply that ESG is imperfect but rather that ESG often presents itself as more disciplined than it is. Many ESG scores combine different types of evidence, including emissions data, policies, management systems, disclosure quality, controversies, sector averages and risk estimates. These are then weighted and aggregated through provider-specific methods that are often difficult to inspect. The result is a score that looks precise but is not always clear, comparable or environmentally meaningful. ESG rating divergence is now well documented, with different providers often reaching different judgements about the same firms (Chatterji et al., 2016; Berg et al., 2022).

This is especially damaging for the environmental pillar. Environmental ESG systems still focus mainly on carbon, energy, water, and waste. These are important, but they do not tell us enough about material use. They do not show whether firms are producing too much, using too much virgin material, designing short-lived products, failing to repair or reuse products, or losing material value through low-grade recycling, incineration or landfill. This is on top of the fact that data are very hard to verify and depend on companies' disclosure practices (and whims).

This is where dematerialisation becomes important: Decarbonisation is about emissions; dematerialisation is about the amount and type of material needed to deliver products and services, and what happens to that material across the product life cycle. A product is not environmentally sound simply because its carbon profile is improved. It also needs to be considered in terms of whether it should have been produced in the first place, how long it remains useful, whether it can be repaired or reused, and whether and how its material value is retained or destroyed.

This white paper argues that ESG environmental measurement needs a dematerialisation layer. This should not be another composite score but rather be a practical measurement layer based on physical flows, product life, circular pathways, retained value and final material loss. It should make the environmental pillar more serious by asking what is actually happening to products and materials.

Let us consider textiles: Global fibre production reached 132 million tonnes in 2024, with polyester accounting for 59% of total fibre production (Textile Exchange, 2025). Synthetic materials, including polyester, made up 68% of global fibre production in 2023, while cotton accounted for 21% (Staub, 2025). At the same time, recycled polyester's share of overall polyester use reportedly fell from 15% in 2021 to 12.5% in 2023 (Staub, 2025). This is a useful warning as circularity language (and unfortunately often, greenwashing, whereby companies mask wasteful practices as green) can expand while actual material substitution remains weak.

Textiles also show why recycling is not enough. Reuse usually preserves more value than recycling, provided it extends product life and displaces new production (Sandin and Peters, 2018; Fois et al., 2025). Recycling can help, but only where it reduces primary material demand and produces usable secondary material. In the EU, 73% of discarded textiles and shoes still went to landfill or incineration in 2022 when textiles in mixed household waste are included (European Environment Agency, 2025).

Wales is well placed to lead a better approach. Our Beyond Recycling strategy already frames circular economy around keeping resources and materials in use for as long as possible, reducing waste, improving resource efficiency and moving beyond a narrow recycling focus (Welsh Government, 2021). The first step to pursue this policy ambition is to create a fit-for-purpose measurement system, building from Wales's credibility in recycling to facilitate the move from recycling performance to circular value performance.

Beyond ESG: Rebuilding Environmental Measurement Around Material Reality

Why ESG needs to measure dematerialisation, circular value and material retention

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1. ESG has become too credible for its own evidence base

ESG has influence because it simplifies a complex problem: It turns a wide set of environmental, social and governance issues into ratings, dashboards, benchmarks and rankings. Investors use it to screen firms and build funds. Companies use it to signal responsibility. Index providers and data vendors use it to create products. Public bodies and customers increasingly use it to judge corporate behaviour.

The difficulty is that this influence has grown faster than the quality of the measurement system. ESG is often treated as if it provides a robust assessment of sustainability performance. In practice, many ESG scores are built from a mixture of physical data, company disclosures, policies, risk estimates, management systems, controversies and provider judgements. These inputs do not all measure the same thing. A policy is not a physical outcome. A disclosure is not a verifiable reduction in material use. A risk score is not evidence of environmental improvement.

The above are widespread issues in this arena. ESG rating divergence shows that the system is not yet methodologically mature. Different providers can assess the same firm differently because they use different indicators, scopes, weights and normalisation rules (Chatterji et al., 2016; Berg et al., 2022). In some cases, the problem is not just small variation around a common result. Ratings may point towards different interpretations of the same company or sector. This weakens confidence in ESG as a serious measurement system.

The environmental pillar is then weakened further when it is folded into a composite ESG score. Combining environmental, social and governance indicators into one overall number may be convenient, but it often obscures what the score means. A firm can look strong overall while still performing poorly on material throughput, product durability, repairability, circular pathways or final material loss. Conversely, a firm may be penalised for weak disclosure even where some operational practices are environmentally stronger than the score suggests.

There is also a transparency problem. Many ESG models remain proprietary. Users may see the score but not the full scoring logic. This makes it difficult to understand how missing data are treated, how weights are applied, how estimates are produced, and how much of a score reflects actual environmental performance rather than disclosure quality or provider assumptions.

ESG has become a powerful reputational and financial language, but it is not yet a sufficiently trustworthy environmental measurement system. That does not mean ESG should be abandoned but rather that the environmental pillar needs to be rebuilt around harder evidence. If ESG is to support investment, procurement, policy, customer communication and corporate improvement, it must be linked more directly to physical outcomes.

For the environmental pillar, the basic test should be simple: can the system show what is happening to energy, emissions, water, materials, products, components and waste? At present, ESG is stronger on some of these than others. It is much stronger on carbon, energy, water and disclosure than on material throughput, product life, retained value and higher-order circular strategies. That is the gap this white paper addresses.

2. Environmental ESG is too carbon-heavy and too weak on materials

Environmental ESG measurement is still shaped mainly by carbon, energy, water, waste and disclosure. These measures are not wrong. Carbon accounting is essential. Energy and water use matter. Waste data matter. The problem is that these indicators do not, on their own, show whether firms are reducing material dependence or retaining product value.

A company can reduce emissions intensity while increasing total material use. It can improve packaging metrics while selling more short-lived products. It can report recycling rates while increasingly depending on virgin inputs. It can divert waste from landfill while still losing most product and component value. These are exactly the cases that a carbon-heavy and waste-heavy ESG system struggles to judge.

Dematerialisation provides a way to correct this. Cleveland and Ruth (1998) define dematerialisation as the reduction in the quantity of materials used, or waste generated, per unit of economic function. The phrase "economic function" is important. It means dematerialisation should not simply ask whether a firm uses fewer tonnes of material. It should ask whether less material is needed to deliver the same or better function.

This distinction between relative and absolute dematerialisation is also important. Relative dematerialisation occurs when material intensity falls. Absolute dematerialisation occurs only when total material use falls. A firm, sector or economy can become more efficient per unit while still increasing total material use and disregarding products at end of life or use. One way in which we see this in the textile industry is that the absolute amount of recycled polyester used has increased year over year, but so has the absolute amount of virgin PET used in the textile industry. This is why ESG systems that rely too heavily on intensity ratios can overstate environmental progress.

The denominator is therefore not a technical detail: It defines the meaning of the indicator. Material use per unit of revenue may improve because prices rise. Material use per unit produced may improve while total production increases even for products with no circular treatment. Waste per unit may fall while total waste increases. For dematerialisation, stronger measures should connect material inputs to the service delivered. Depending on the sector, this might mean material input per year of use, per operating hour, per delivery kilometre, per wash cycle, per garment wear or per functional lifetime.

Life Cycle Assessment and Material Input per Service Unit approaches are useful because they require the analyst to define the functional unit and the lifecycle boundary (ISO, 2006; Liedtke et al., 2014). They are not perfect and can be data-heavy, but they help shift ESG away from broad claims and towards the physical relationship between material input and useful output.

The practical implication is clear. Environmental ESG should not stop at carbon, water, waste and policy disclosure nor should it take a static view of a product (single product life). It needs to show whether firms are reducing material dependence, extending product life, increasing repair and reuse, retaining product and component value, and reducing final material loss. Without this, environmental ESG remains incomplete.

3. Recycling is necessary, but it is not enough

Recycling is important, but it is often over-promoted. It can reduce virgin material demand and avoid landfill. It can support circular economy goals when it produces high-quality secondary material that genuinely replaces virgin input. But recycling often comes after much of the product value has already been lost.

This is why circular strategies should not be flattened into one generic "circularity" category. Reuse, repair, refurbishment and remanufacturing are not the same as recycling. They preserve different levels of value and require different operational capabilities. Potting et al. (2017) place circular strategies in a hierarchy, with higher-order strategies such as refuse, rethink, reduce, reuse, repair, refurbish and remanufacture generally preserving more value than recycle and recover.

This hierarchy is essential for ESG measurement and its omission is problematic. Current environmental indicators often record waste diverted, recycled content or recycling rates. These indicators can be useful, but they do not show whether firms are preventing material use, extending product life, preserving components, or simply managing waste better after production and consumption have already taken place.

A recycling-heavy company may look strong on waste diversion while still relying on high material throughput and short product lifetimes. Energy recovery should be treated even more cautiously. It may have a place in managing residual waste, but it destroys material value. It should not be treated as dematerialisation.

A better ESG system should distinguish prevention, reuse, repair, refurbishment, remanufacturing, repurposing, high-quality recycling, downcycling, energy recovery and disposal. These are not different labels for the same thing. They represent different levels of material preservation and different environmental outcomes.

This also affects how business models should be judged. Retaining product ownership, leasing, sharing and product-service models can support dematerialisation where they extend product life, increase utilisation and incentivise repair. But they are not automatically better. They may increase transport, over-servicing or replacement if badly designed. The relevant question is whether the model reduces material throughput per unit of service, not whether it sounds circular.

Dematerialisation therefore would also give circular economy claims a harder test. It asks whether the circular strategy actually reduces material demand, preserves value, and avoids shifting the problem elsewhere.

4. What better environmental ESG measurement should capture

The answer is not to add one more vague ESG theme. ESG already has enough broad language. The answer is to introduce a small, disciplined dematerialisation layer that records physical flows and circular outcomes. Such a layer should cover four linked areas.

First, it should measure material input. This includes total material input, virgin material input, secondary material input and material input per functional or service unit. This prevents firms from hiding material growth behind intensity ratios.

Second, it should measure product life. This includes designed lifetime, actual lifetime, repairability, spare-part availability, repair uptake and additional service life gained. A product described as repairable should not receive strong credit unless repair is actually happening.

Third, it should measure circular pathways. This includes take-back rates, reuse rates, refurbishment yields, remanufacturing yields, recycling routes, recovery quality and final material loss. The pathway matters because it determines how much value is retained.

Fourth, it should measure evidence quality. Data provenance, chain of custody, boundary setting, estimation methods and auditability should be part of the measurement system. Weak evidence makes circularity claims too easy.

Existing standards provide parts of this infrastructure. ESRS E5 improves disclosure on resource inflows, resource outflows and waste. GRI 301 records material use and recycled input. GRI 306 records waste generation and diversion. WBCSD's Circular Transition Indicators provide useful material-flow and circular productivity measures. The Ellen MacArthur Foundation's Material Circularity Indicator gives a product-level circularity logic. ISO 14040 and ISO 14044 support lifecycle assessment, while ISO 22095 helps with chain of custody (Ellen MacArthur Foundation, 2015; ISO, 2006; ISO, 2020; WBCSD, 2023).

Yet, these elements are fragmented and do not (cannot readily) form a coherent ESG dematerialisation layer. The practical task is to combine the best parts into something that is simple enough to use, but serious enough to test environmental claims.

The core test should be this: does the metric show that less material is needed to deliver a defined function, while preserving more product, component or material value for longer?

5. Textiles show why this is needed

Textiles are a good test case because the sector exposes the weakness of current circularity claims. It is high volume, fast moving and consumer-facing. It involves mixed materials, uncertain garment condition, weak traceability, difficult sorting, uneven resale markets and limited fibre-to-fibre recycling.

Global fibre production reached 132 million tonnes in 2024, a 14% increase from 116 million tonnes in 2022. If current trends continue, it is expected to reach 169 million tonnes by 2030 (Textile Exchange, 2025). Polyester remains the dominant fibre, accounting for 59% of global fibre production in 2024 (Textile Exchange, 2025). Synthetic materials, including polyester, accounted for 68% of global textile fibre production in 2023, while cotton accounted for 21% (Staub, 2025). This is enough to show why textile circularity cannot be treated as a niche issue.

The recycling story is also weaker than much of the language suggests. The share of recycled polyester in overall polyester use reportedly fell from 15% in 2021 to 12.5% in 2023 (Staub, 2025). Much recycled polyester is also sourced from PET bottles rather than old garments. That may support recycled-content claims, but it does not necessarily solve textile waste. It can move material from one recycling stream into another while leaving used clothing without a high-value pathway.

End-of-life outcomes remain poor. In the United States, textile generation in municipal solid waste was estimated at 17 million tons in 2018, with 2.5 million tons recycled and 11.3 million tons landfilled (US EPA, 2017). In Europe, landfill's recorded share of separately collected textile waste fell from 21% in 2010 to 12% in 2022, but incineration rose from 10% to 15%. Once textiles and shoes in mixed household waste are included, 73% of discarded textiles went to landfill or incineration in 2022 (European Environment Agency, 2025).

These numbers are important because they cut through the language. A sector cannot be treated as circular if most discarded material is still being lost, burned or moved through low-value routes. The key issue is not whether a brand has a take-back scheme or a recycled-content line. The key issue is what happens to garments and fibres after collection.

The practical questions are simple but often unanswered by the brands. What type of garments are being collected? What fibres are they made from? Are they mono-material or blended? What condition are they in? Where are they held? Who owns them? What share is suitable for direct reuse? What share can be repaired? What share can be resold? What share can be recycled into apparel-grade fibre? What share is downcycled? What share is incinerated or landfilled? Who will buy the recovered product or material?

Some of these questions are beginning to be answered within the recycling stream itself. For material that genuinely cannot be reused or repaired, the quality of the recycling outcome depends heavily on how that material is processed. Intelligent recycling systems (such as Sixone) use predictive intelligence to sort incoming textiles by processability — how they will behave in recycling — and route them dynamically across multiple processing pathways. This is what separates recycling that yields apparel-grade, virgin-displacing fibre from recycling that downcycles by default, and it generates the physical-flow and recovery-quality data the measurement layer requires.

Upstream, established sorters and collectors already divert significant volumes to global resale markets, so the reuse-first principle is not merely aspirational. But a gap remains: once garments enter the general sorting and resale system, they typically cannot be traced back to the producing brand unless a take-back scheme only collects own-brand products and is directly linked to a specific sorter. Reuse can therefore be real in aggregate while staying invisible at the brand level, where ESG accountability is applied. A measurement layer needs to capture not just how much material is reused, but whether that reuse can be evidenced and attributed.

This is why textiles are useful for this white paper. They show that circularity is not mainly a communications problem. It is an inventory, feedstock, quality, sorting, market and measurement problem.

6. Reuse, resale and repair are not the same as recycling

The strongest textile routes are usually those that keep garments in use. Reuse can preserve the garment in its existing form, avoiding the need for new production and additional processing. Sandin and Peters (2018) find that textile reuse and recycling generally reduce environmental impacts compared with landfill and incineration but reuse usually performs better than recycling. Fois et al. (2025) similarly find that reuse is more beneficial than recycling, while recycling benefits depend largely on reducing primary material demand.

This is exactly the distinction ESG needs to capture. A garment resold and worn for longer is not equivalent to a garment shredded into lower-grade material. A repaired garment is not equivalent to one recycled after little use. A fibre recovered into apparel-grade input is not equivalent to low-grade downcycling. A garment incinerated for energy is not circular value retention.

Of course, recycling has a role. It is needed for material that cannot be reused or repaired. But it must be judged by output quality and avoided virgin input, not by collection volume alone. Polyester recycling, for example, can reduce primary material demand, but may also increase water depletion depending on the process (Fois et al., 2025). Cotton recycling can face quality and fibre-length constraints. Mixed fibres create sorting and recovery problems when handled through today's static recycling systems. These are precisely the barriers that intelligent recycling systems aim to address, where mixed and blended materials are sorted by how it will actually process, rather than treated as a single low-value stream (an approach being developed by companies such as Sixone). These trade-offs do not make recycling irrelevant but do allow us to judge it relatively to other circular strategies.

Textile ESG KPIs should therefore be more specific. Useful indicators would include collected garments by category, fibre composition by weight, share suitable for direct reuse, share repaired, share resold, additional life gained, share recycled into apparel-grade fibre, share downcycled, share incinerated or landfilled, recovered material quality, avoided virgin fibre, verified buyer or end market, material input per year of wear, and value retained per tonne. These indicators would make circular claims more testable: A high collection rate would no longer be enough and a firm would need to show what happened next.

This also changes how brands should think about circularity. For high-volume fashion businesses, incineration, landfill, export dumping and low-grade recovery are not only waste-management issues but critically also brand credibility issues. A brand that claims circularity but cannot show what happens to collected garments is exposed to legitimate criticism. Patagonia-style examples are useful because they show a different logic around durability, repair, resale and accountability, but the lesson is not that one company solves the problem. The lesson is that the relevant practices must be measured: product longevity, repair uptake, resale, traceability, avoided virgin input and material finally lost.

7. Wales is perfectly positioned to lead this shift

Wales already has the policy platform to spearhead developments in the field. Beyond Recycling defines a circular economy as one that keeps resources and materials in use for as long as possible and avoids waste. It links circular economy to reducing raw material use, improving resource efficiency, supporting repair and reuse, developing remanufacturing, improving procurement and investing in infrastructure (Welsh Government, 2021).

The strategy is more than a waste agenda, explicitly stating that Wales needs to move beyond recycling. It also identifies textiles as one of the priority material streams requiring better handling, sorting and reprocessing infrastructure (Welsh Government, 2021). This makes textiles a credible pilot area for a dematerialisation measurement layer.

A Welsh textile pilot could test whether organisations can report garment categories, fibre composition, condition grades, reuse routes, repair activity, resale routes, recycling quality, end markets and avoided virgin fibre. It could also test whether such reporting is proportionate for SMEs. This is important because a measurement layer that only works for large firms with sophisticated data teams will not be useful for much of the Welsh economy.

The output should not be a final universal ESG index. It should be a tested protocol, a small core KPI set, evidence-quality tiers, textile-specific reporting guidance and a pilot data model.

The wider point is that Wales can move from recycling performance to circular value performance. That would fit the policy direction in Beyond Recycling and would also challenge ESG systems to take materials more seriously.

8. Conclusion: ESG needs material discipline

ESG environmental measurement should not be trusted unless it can develop to evidence material reality. Current systems are too inconsistent, too opaque, too dependent on disclosure, and too weakly linked to physical outcomes. They can make environmental performance appear measurable without showing whether material pressure is actually falling.

Dematerialisation gives the environmental pillar a harder test. It asks how much material is used, how much is virgin, what service is delivered, how long products remain useful, what circular route is followed, what value is retained and what material is finally lost.

Textiles show why this is necessary. A brand can claim circularity while knowing too little about garment condition, fibre composition, reuse, recycling, end markets and avoided virgin material. A recycler can have good process capability but lack feedstock or buyers. A take-back scheme can collect material without retaining much value. A recycling metric can improve while product turnover and total fibre production continue to rise.

The aim should not be another ESG label. It should be better evidence: less material used, less virgin input, longer product life, more retained value, verified circular pathways and less material lost.

That is the environmental measurement system Wales should help build.

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