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Sustainable Dreams, Overlooked Realities: Closing the Design–Outcome Gap in Sustainable Business Models

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ABSTRACT

Sustainable business models (SBMs) are enablers of the circular economy (CE) and sustainability. However, its adoption does not always improve environmental performance. This study investigates the conditions under which SBM design does (or does not) produce the expected environmental benefits. We conducted a secondary cross-case analysis of three use-oriented product–service–system (PSS) business model (BM) implemented by three distinct Swedish companies that previously had been assessed using business model life cycle assessment (BM-LCA). Across the cases, environmental performance outcomes were not primarily determined by BM main property (i.e., reuse, sharing, or rental) as such, but by a set of conditions (e.g., product return rates, enabling infrastructure, location, and consumer behavior). Overall, the results show that sustainability benefits are not inherent to SBM archetypes. A key learning is that the singular design focus, institutional pressure to "show" sustainability, and lack of quantitative assessment contribute to the poor environmental performance of the SBM in the studied cases. We also show that the absence of empirical validation can foster a wishful thinking that well-intentioned environmental efforts are enough. The study contributes by specifying conditions that shape SBM's environmental performance, clarifying when and why environmental performance outcomes of SBMs can diverge from their design expectations. We further show how BM-LCA can be integrated into SBM analysis to operationalize and test the sustainability assumptions embedded in BM design. This positions BM-level, life cycle–based assessment as a structured decision-support and learning tool for assessing and refining SBMs.

1 | Introduction

Business models (BMs) are often described as the "engines" of the economy (Mackenzie 2008), articulating how a company creates, delivers, and captures value, organizing activities within the company and across its value network (Richardson 2008). Sustainable business models (SBMs),[1] are configurations in which those activities are redesigned to serve sustainability purposes (e.g., improve resource efficiency, avoid waste), and in which value is extended to environmental and social dimensions (Stubbs and Cocklin 2008; Schaltegger et al. 2015; Lüdeke-Freund et al. 2024). The premise is that changing how business is done changes what the business does to the environment and society. Research has supported this premise with archetypes and patterns (N. M. P. Bocken, Short, et al. 2014; Lüdeke-Freund et al. 2018), BM canvases (Joyce and Paquin 2016), value mapping (N. M. P. Bocken, Rana, and Short 2014), and guidance on innovation and experimentation (Geissdoerfer et al. 2017; N. Bocken et al. 2019).

These tools generate, structure, and communicate SBM configurations effectively, but they do not establish whether that configuration improves environmental performance once implemented (Filippi et al. 2025; Johnson and Mont 2025). They focus attention on what the company offers its customers such as reuse, shared access, and rental. However, delivering that

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offer usually requires supporting activities, where the environmental impact is often concentrated. Their qualitative and prescriptive nature can reinforce design optimism, whereby sustainability intent is implicitly treated as improved environmental performance (Nosratabadi et al. 2019; Mignon and Bankel 2023). We call this phenomenon the design–outcome gap, that is, the difference between where a company expects its environmental benefit to come from and where assessment shows the impact is.

Prior research has recognized that sustainability-oriented organizing can create tensions among environmental ambitions, economic viability, and operational requirements (Smith and Lewis 2011; Brown et al. 2015). However, a discrepancy between intended and realized environmental performance is not necessarily an organizational paradox. At the BM level, limited attention has been given to where and how supporting activities, user practices, and configuration choices cause expected environmental benefits to weaken or disappear.

Environmental performance assessment research has developed through product-level tools, such as conventional life cycle assessment (LCA) that quantify impact at the product level, and firm-level approaches, such as sustainable value added (SVA) that connect environmental performance to value creation (Figge and Hahn 2004) but aggregated across a firm's several value creation logics. Relatively few studies assess environmental performance at the BM level as shown in the study of Johnson and Mont (2025). Prior research provides limited explanation of why sustainability-oriented configurations deliver their expected environmental benefits in some conditions but not in others.

The consequence of leaving this unmeasured can result in greenwishing, which, according to Austin (2019), is the good-faith belief that sustainability-oriented efforts produce meaningful environmental improvements even in the absence of evidence that it does. Greenwishing occurs when the environmental logic of an SBM is treated as evidence of environmental benefit before the outcome has been assessed. Despite the widespread assumption that SBMs generate environmental gains, quantitative assessment of these outcomes remains limited and underdeveloped (Lüdeke-Freund and Dembek 2017; Bhatnagar et al. 2022; Johnson and Mont 2025), risking overreliance on design rhetoric and constraining the potential contribution of SBMs. As a result, companies may overestimate the environmental benefits of an SBM and underestimate the need for empirical validation (Böckin et al. 2022; Marrucci et al. 2022).

Whether an SBM delivers environmental benefits depends on the fit between its configuration and the operating context rather than the archetype adopted. Two organizations can adopt the same archetype and reach different environmental performance outcomes. The feasible configurations are bounded by institutional rules, infrastructures, technologies, and market (Huijben et al. 2016), and within those boundaries, the BM works as a mediation space through which sustainability innovation becomes specific activities and relationships (Lüdeke-Freund 2020). This reasoning leads to our research question (RQ): Under what conditions does sustainability-oriented BM design (not) translate into superior environmental performance?

The aim of this paper is to explain the design–outcome gap by identifying the conditions under which SBMs do and do not create environmental benefits and to connect that explanation to greenwishing. Answering the RQ requires evidence at the level where configuration choices are made, which is why we used the business model life cycle assessment (BM-LCA) for the three empirical cases. BM-LCA quantifies environmental performance with the BM as the unit of analysis (Böckin et al. 2022), which makes supporting activities and behavioral parameters part of the assessment. We use it as an analytical instrument for making the gap observable and not as the object of study.

The paper makes two contributions. First, it specifies the design–outcome gap by identifying the conditions through which BM configurations determine environmental performance outcomes. Second, it develops the connection between outcome validation and greenwishing, showing how BM assessment validates whether an SBM's environmental logic holds under the conditions required to operate. The paper proceeds with a theoretical background, the methodological approach, the results and analysis, the discussions, and the conclusions.

2 | Theoretical Background

2.1 | SBM Design

SBMs emerged in academic literature relatively recently (Stubbs and Cocklin 2008), and the field has rapidly expanded. Despite conceptual heterogeneity (Lüdeke-Freund et al. 2018), SBM generally emphasizes the understanding of value to include environmental and social outcomes alongside economic returns, engagement with stakeholders beyond shareholders, and prioritization of long-term impacts and system resilience (Stubbs and Cocklin 2008; Boons and Lüdeke-Freund 2013; Lozano 2018).

SBMs operate within systems of complementary, competing, or enabling BMs and are shaped by institutional and socio-technical conditions (N. Bocken et al. 2019; Schuit et al. 2017).

These conditions, together with firm capabilities, shape the opportunities and constraints for innovation across BM components and influence firms' strategy (Huijben et al. 2016; Thomson et al. 2025). Thus, BMs act as a mediation space between sustainability innovations, organizational value creation, stakeholder relationships, and broader system outcomes (Lüdeke-Freund 2020).

Tools, frameworks, innovation strategies, and SBM patterns have been key to advancing SBMs in practice. Among the most influential frameworks, N. M. P. Bocken, Short, et al. (2014) outline eight innovation strategies. Lüdeke-Freund et al. (2018) extended these to 45 patterns. Considering design as purposive change (Simon 1996) and the BM as both vehicle and subject of innovation (Teece 2010; Zott et al. 2011), these frameworks help teams reconfigure how business is done. Process approaches follow a common sequence from framing, through option generation and testing, to implementation and iteration (e.g.,

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Geissdoerfer et al. 2017; N. Bocken et al. 2019; Lüdeke-Freund et al. 2024) with experimentation connecting design intent with operating reality through iterative build–assess–learn cycles (Baldassarre et al. 2017; Weissbrod and Bocken 2017).

These design cycles would benefit from systematic assessment approaches that connect BM configurations to environmental (and social) performance outcomes (Schaltegger et al. 2015; Mignon and Bankel 2023; Krassnitzer et al. 2025) and support iterative refinement. This motivates the research on assessment approaches that can identify which design and mediation conditions drive the environmental performance of SBMs.

SBM design and experimentation can also be understood as an organizational learning process. We understand here that organizational learning can occur when discrepancies between expected and observed outcomes become inputs for revising action and the assumptions governing that action. Single-loop learning adjusts practices within existing goals and decision rules, whereas double-loop learning questions the underlying assumptions and goals themselves (Argyris and Schön 1978). In BM innovation, trial-and-error learning enables firms to revise BM configurations as evidence about their operation accumulates (Sosna et al. 2010).

Applied to SBMs, changing, for example, return incentives, infrastructure materials, logistics, or locations represents learning within an existing BM logic; questioning whether reuse, sharing, or rental should be presumed environmentally superior represents learning about the sustainability logic of the BM itself. Assessment, however, should not be equated with organizational learning. Quantitative evidence can reveal a design–outcome mismatch, but learning requires that this evidence be collectively interpreted, incorporated into redesign decisions, and eventually embedded in organizational routines.

2.2 | Assessing the Environmental Performance of SBMs

Environmental performance is treated here as a multidimensional construct including management and operational dimensions (Trumpp et al. 2015; ISO International Organization for Standardization 2026). The management dimension concerns the policies, systems, capabilities, and decision processes through which a company governs its environmental activities. The operational dimension covers the consequences such as resource consumption, emissions, waste, and other environmental impacts. The first shapes how an SBM is configured and operated; the second is what that configuration produces across the associated product system.

Current practice captures this relationship only partially. At company level, tools such as the Sustainability Balanced Scorecard (SBSC), translate environmental and social objectives into strategy maps, indicators, and targets but generally aggregate performance across different activities and BMs (Searcy 2012, 2016; Maas et al. 2016). SVA provides a connection between environmental and social impacts as forms of capital and evaluates whether firms create value more efficiently than a benchmark, measured against the opportunity costs of resource use (Figge and Hahn 2004). Neither, however, shows which value-creation logics or configurations choices produced the environmental performance.

At the product/system level, LCA quantifies potential environmental consequences relative to a defined function (Filippi et al. 2025) and is considered a key method for assessing circular strategies (Schulz-Mönninghoff et al. 2021; Van Loon et al. 2021; Marrucci et al. 2022) and capturing rebound effects (Alfarisi et al. 2022; Metic and Pigosso 2022). Its functional unit and system boundaries, though, are set by the product not considering the BM. Several studies have tried to connect LCA to BMs (Goodman et al. 2023; Roci and Rashid 2023; D'Adamo et al. 2025), but the problem remains unresolved.

The challenge is not a lack of indicators or assessment methods, but a weak connection between specific BM configurations and measured life cycle outcomes (Böckin et al. 2022). This is what sustains the design–outcome gap. Unlike an implementation gap, the design–outcome gap assumes that the intended BM practices are in place. In addition, the design–outcome gap provides the empirical basis for examining greenwishing. Following Austin (2019), greenwishing[2] is a good-faith epistemic condition in which actors treat an SBM, or a recognized circular strategy, as evidence of environmental improvement before it is validated.

BMs also involve multiple stakeholders with divergent goals and unequal capacities to create and capture value (Evans et al. 2017), which shapes both the configuration of the BM and its performance. Given this, no single method can cover all dimensions of sustainability, and a combination of methods is likely needed. Assessment nonetheless remains both necessary and feasible (Rauter et al. 2019). It makes sustainability goals tangible for different stakeholders (Waas et al. 2014; Bhatnagar et al. 2022), identifies which issues matter most (Waas et al. 2014; Sala et al. 2015), builds a shared language across internal and external actors (Sala et al. 2015; Maas et al. 2016; Schoormann et al. 2018; Bhatnagar et al. 2022), and supports accountability for design and strategic choices (Lüdeke-Freund and Dembek 2017; Breuer et al. 2018). Its core function is to verify whether SBM goals are met and by how much (Bhatnagar et al. 2022).

Closing the design–outcome gap therefore requires an assessment method that keeps the life cycle perspective but takes the BM as its unit of analysis.

2.3 | BM-LCA

Introduced by Baumann et al. (2022), first applied by Goffetti et al. (2022), and systematized by Böckin et al. (2022), BM-LCA takes the BM itself as the unit of analysis. A key innovation of BM-LCA is its shift in the functional unit from product function to BM profit, reflecting the primary purpose of a BM that is to generate profit (Böckin et al. 2022) and enabling comparison between BMs with equivalent financial outcomes (Baumann et al. 2022).

Under a product functional unit, such as in LCA, the question is the impact per product or unit of function delivered. Under a

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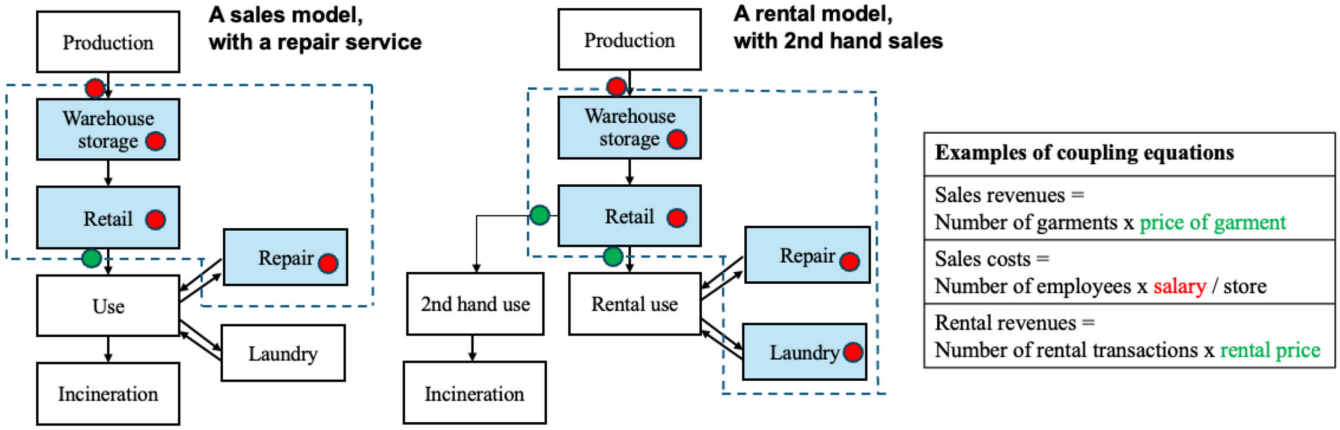


FIGURE 1 | Illustration of the BM-LCA methodology. The figure illustrates the BM-LCA approach for comparing two BM: sales with repair services (left) and a rental with second-hand sales (right). Solid black arrows indicate physical product flows, whereas red and green dots represent monetary costs and revenues, respectively. Example coupling equations (right) show how key monetary variables—such as price of garment, salary, and rental price—are linked to physical flows and used for impact calculations. *Source:* The authors.

profit functional unit, it is how many transactions are required so the BM remain economically viable, and the environmental impacts associated to that. Product-level gains may disappear once BM's required transactions, services, and throughput are accounted for. For example, if two BMs (BM1 and SBM2) generate the same profit, BM-LCA can show which does so with a lower environmental footprint. This is useful for identifying trade-offs, as a BM designed for sustainability (e.g., SBM2) may, in practice, perform poorer or equally (environmentally) as a conventional model (e.g., BM1), considering the same economic output.

The method identifies intersections between the monetary flows of a BM and the physical flows of its associated product system, formalized through coupling equations. Because these equations represent the whole BM and its operational configurations, they can be used almost as a simulation tool that allows testing different parameters and their influence on the BM's environmental performance.

As illustrated in Figure 1, monetary values are not converted directly into environmental impacts. The BM's economic relationships determine the scale and composition of the physical system, for example, the number of products produced or rented and the associated requirements for retail, storage, repair, laundering, transport, and end-of-life treatment. These physical flows scale the calculated environmental impacts. Holding an economic outcome constant while allowing transaction volumes, physical throughput, and enabling activities to vary is what reveals environmental performance differences arising from alternative BMs.

BM-LCA can be seen as connected to the SVA logic by operationalizing BM value creation and capture through life cycle–based quantification. It can support comparison between alternative configurations within the BM design space when they provide an equivalent product-service function and are assessed using consistent boundaries, timeframes, geographical scopes, and impact methods. Moreover, it supports analysis of how specific conditions (e.g., customer behavior, utilization rates, infrastructure constraints, energy mixes, and reverse logistics performance) shape realized environmental performance outcomes.

3 | Method

3.1 | Research Approach

To investigate and explain under what conditions SBM design does (or does not) translate into superior environmental performance, we adopted an exploratory multiple-case study design based on a secondary analysis of prior BM-LCA applications. The underlying empirical work in each case was conducted primarily to develop and validate case-specific BM-LCA models (Böckin et al. 2022), requiring detailed primary operational and financial data and iterative validation of modeling assumptions with company representatives. Building on these BM-LCA applications, the present research draws on a secondary cross-case analysis of BM-LCA outputs and associated project materials to identify recurrent mismatches between design intentions and quantified environmental performance outcomes.

The present study did not reproduce or rerun the original BM-LCA models. The complete coupling equations, life cycle inventories, parameter assumptions, allocation procedures, and sensitivity analyses are documented in the original case studies (Goffetti et al. 2022; Claesson and Skogum 2023; Holzhausen and Troedsson 2023). Here, these models and their outputs constitute the empirical basis for a new cross-case analysis of the conditions shaping the relationship between SBM design and environmental performance outcomes.

Although our empirical engagement involved semi-structured interactions with participants, these were primarily data-elicitation and model-validation sessions rather than interviews designed for standalone qualitative theorizing. Accordingly, qualitative material is used here as contextual evidence to support the interpretation of BM-LCA results and cross-case

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TABLE 1 | Overview of the case studies.

	Case 1	Case 2	Case 3
Business model	Use-oriented PSS (N. M. P. Bocken, Short, et al. 2014; Lüdeke-Freund et al. 2018) with sharing business logic (multiple people using at the same context) (Lüdeke-Freund et al. 2018)		
Access type	Event-bounded access: short-, high-turnover use cycles tied to a specific event and immediate return/collection	Membership-bounded access: recurring rights to borrow assets from a shared pool under defined borrowing rules	Time-bounded access: customer-selected rental duration (days/weeks) for a specific garment
Product	Cup and lid	Toolbox (e.g., power drill)	Outdoor jacket
Goal	Improvement	Improvement	Comparison
Unit of analysis	A certain amount of profit over an event season, modeled as up to ten events	A certain amount of profit (allocated to a power drill) over a business period of one year and its share of the common infrastructure	A certain amount of profit over a business period of 30 days for sell or rent the same jacket

Note: This table summarizes the three case studies that were investigated via BM-LCA. The cases represent use-oriented PSS, applied for different products and access types.
Source: The authors.

pattern identification. Given the emergent nature of the phenomenon, we followed an inductive logic to develop theoretical insights from empirical observation (Corbin and Strauss 2014). The multiple-case study approach allowed us to identify cross-case patterns and move toward an analytically transferable understanding of the studied phenomenon (Eisenhardt 1989; Eisenhardt and Graebner 2007; Eisenhardt 2021).

3.2 | Research Context

This study was triggered by unexpected findings observed during early applications of the BM-LCA method. Since its conceptualization, BM-LCA has been applied in eight cases across diverse sectors as can be consulted in the following: Goffetti et al. (2022); Sandqvist and Westberg (2023); Holzhausen and Troedsson (2023); Claesson and Skogum (2023); Norin and Reenbom (2024); Solér and Sivengård (2024); Bohlin and Sandberg (2025); and Malmqvist and Tiveskog (2025).

Initially, we aimed to apply BM-LCA to test the method on well-known and established SBMs. For that reason, we selected cases focusing on sustainability front-runner companies, which exemplified SBM configuration, because they were expected to have good environmental performance and could provide the reliable (quantitative) data needed for testing the method. We defined front-runners as companies that (i) publicly commit to sustainability and SBM, (ii) have a product-level LCA or equivalent evidence, and (iii) could provide primary data for BM-LCA. However, the BM-LCA results for three of the eight studied cases revealed unexpected environmental hotspots, trade-offs, and performance sensitivities instead of the anticipated environmental benefits.

These findings were not treated as evidence of greenwashing. The companies voluntarily participated in the assessments and provided access to operational, economic, and environmental data to assess their BMs. In addition, the low environmental performance could not be called greenwashing because the companies had no intention of sharing deceiving information or misleading their consumers by calling their BM sustainable. Also, the results indicated that SBM configurations could generate conditional benefits or overlooked environmental burdens that were not evident from their intended sustainability logic. Moreover, despite the growing research on the environmental gains associated with SBM (Karuppiah et al. 2023), there is still a lack of ways to empirically validate when SBMs are delivering the environmental gains (Filippi et al. 2025; Johnson and Mont 2025). This background reflects the challenges that companies face in implementing SBMs and the difficulties in assessing the environmental performance of SBMs.

3.3 | Case Selection

The selected cases were theoretically useful cases—that is, cases likely to replicate or extend theory by filling conceptual categories or illustration contrasting manifestations of the studied phenomenon (Eisenhardt 1989). From the eight cases in which BM-LCA was applied, three were selected for in-depth analysis because they provided the clearest evidence of a mismatch or contingent relationship between an intended SBM design and the quantified environmental performance outcome.

Selection was based on two criteria: (i) The original study provided sufficiently detailed BM-LCA results and contextual material for secondary analysis; and (ii) the results revealed identifiable environmental hotspots, trade-offs, or sensitivity thresholds that could make an SBM have a poor environmental performance. The selection was therefore purposive to support the understanding of the design–outcome gap.

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TABLE 2 | BM-LCA modeling steps.

Phase	Description
Goal and scope: Descriptive phase	General description of each BM to be analyzed and of the related product(s) and state the relevant time period under analysis Define system boundaries and environmental impact categories of the assessment. Map actors in the product system Find the connection of how the amount of production, depends on the number of transactions for each BM
Goal and scope: Coupling phase	Step 1: Define the functional unit as the profit that each BM must achieve Step 2: Identify all the business' costs and revenues associated with running of the BM for the stated period. Find conversion factors to couple costs and revenues to customer transactions. Set up an equation for the profit as revenues minus costs Step 3: Solve the equations to find the transactions required to reach the profit. Derive the required amount of production Step 4: Repeat Steps 2 and 3 for every BM being analyzed
Life cycle inventory (LCI)	Construct a system model and quantify all environmentally relevant flows, scaled according to the functional unit
Life cycle impact assessment	Aggregate all the flows from LCI and quantify their effects on the chosen environmental impact categories
Interpretation	Analysis of the results and scrutinize their robustness (sensitivity analysis) to identify the pros and cons of the analyzed BM

Note: This table outlines the key steps applied in the BM-LCA methodology across the case studies.
Source: Böckin et al. (2022).

The cases are summarized in Table 1. They represent Swedish companies operating in the apparel, consumer goods, and consumer services sectors. Their configurational diversity and contextual contrast allowed us to investigate whether similar conditions recurred in shaping SBM environmental performance across different configurations (Eisenhardt 1989, 2021).

The cases represent companies with strong sustainability commitments and that voluntarily participated in the BM-LCA research, granting access to business and environmental data as part of their efforts to validate their SBMs. It is worth noting that the outdoor clothing case results have been published previously in a peer-reviewed article, whereas the other two cases were conducted as master's thesis projects under the supervision of two of the authors of this paper. The original case studies are cited throughout to enable access to the complete modeling procedures and data documentation.

3.4 | Data Collection

Data collection in the original studies was organized around the requirements of BM-LCA modeling (Böckin et al. 2022), as shown in Table 2,[3] and aimed to build credible case-specific parameter sets for the coupling equations, life cycle inventories, and scenario definitions. Primary data were obtained through iterative, semi-structured data-elicitation and model-validation sessions with company representatives. These sessions served as the main vehicle to collect and verify quantitative BM-LCA inputs (e.g., volumes and utilization rates, resource and energy use, labor time, cost and revenue components, pricing logics, logistics set-ups, and infrastructure specifications) and to reconcile inconsistencies across sources.

In most cases, sessions began with sustainability managers/analysts to define the goal and scope of the BM-LCA application and clarify the BM configuration and intended sustainability mechanisms. Subsequent sessions involved finance/accounting staff (to parameterize economic flows, revenues, and costs) and operations/purchasing/logistics staff (to parameterize operational processes and physical flows). Most interactions were conducted online and were complemented by follow-up clarification calls and e-mail exchanges to validate specific data points and modeling assumptions.

In addition to primary inputs, we used secondary and observational materials to triangulate quantitative data and contextualize interpretation (Patton 1999). These included internal documents made available by the companies (e.g., operational spreadsheets, contracts, memos, and process descriptions) and public materials (e.g., websites, sustainability reports, and press releases). Notes taken during data-elicitation sessions and during model validation were retained as contextual material capturing participants' design intentions, expectations, and rationales; in this paper, these materials are used to support the interpretation of BM-LCA results rather than to constitute a standalone qualitative dataset.

3.5 | Data Analysis

Analysis unfolded in three rounds. First, within the original studies, case data were organized and validated for the BM-LCA models,[4] generating quantified environmental performance results for each assessed BM configuration. Second, for the present study, we conducted a within-case (re)analysis of the BM-LCA results using contextual case materials (e.g., BM descriptions,

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internal documents, observational notes, and notes from data-elicitation/model-validation sessions). This analysis clarified the sustainability design intentions, key assumptions underpinning it, the key environmental hotspots, and plausible explanations for dominant impact drivers and sensitivity levers. Third, we conducted a secondary cross-case comparison focused on identifying recurring design–outcome mismatches, that is, situations where sustainability-oriented design intentions and assumptions did not produce the expected environmental benefits or where those benefits depended on specific operating conditions. This cross-case analysis contrasted intended sustainability mechanisms (as articulated in case narratives and project materials) with realized BM-level environmental performance patterns revealed by BM-LCA.

To structure the comparison systematically, evidence was organized in a table covering (i) the intended sustainability mechanism; (ii) the assessment goal; (iii) the dominant environmental hotspots; (iv) the configuration, behavioral, and contextual conditions shaping the environmental performance; and (v) the main interpretations that could be taken from the cases. The categories were compared iteratively across cases to identify recurring patterns while retaining case-specific differences.

Because the original BM-LCA studies used different products, timeframes, functional units, environmental scopes, and assessment goals, the cross-case analysis did not compare the numerical magnitude of environmental impacts among the cases. It compared the mechanisms and conditions through which the BM configurations shaped their respective environmental performance outcomes.

Understanding was co-constructed through iterative engagement with BM-LCA outputs, contextual case materials, the researchers' prior knowledge, and relevant theory (Alvesson and Kärreman 2007). We treated theoretical pre-understandings of the topic as analytical lenses that evolved through reflection and dialogue and informed initial interpretations. This process enabled a nuanced interpretation of the recurrent conditions associated with unexpected, mixed, or conditional environmental outcomes while avoiding premature generalization. As noted by Alvesson and Kärreman (2007) and Alvesson and Sandberg (2024), pre-understanding helps researchers identify theoretical gaps and interpret anomalies while enabling the generation of new insights.

4 | Results and Analysis

4.1 | Case 1—Cup'n Lids Rental at Events

Founded in the mid-1990s, this Swedish medium-sized company manufactures compact, outdoor cooking gear and multifunctional utensils. Its products are distributed through thousands of retailers in more than 50 countries. Production occurs in Scandinavia, enabling control over product quality, product development, material selection, and closed-loop material recycling. The company presents sustainability as its primary organizational purpose, particularly through durable product design, localized production, and products intended to strengthen users' connection with nature. These characteristics positioned the company as a sustainability-oriented manufacturer with the technical and organizational capability to experiment with a reuse-based BM beyond its established product sales operations.

In the early 2020s, the company introduced "At Event," a use-oriented SBM supplying reusable tableware sets to event organizers via rental, leasing, or repurchase. The initiative aimed to eliminate single-use plastic items by scaling reusable alternatives across different types of events. A pilot, "Cup'n Lids at Events," was developed in collaboration with a partner company, a university, and an incubator to explore solutions for circular food and beverage systems. The environmental rationale of the initiative was that repeated use would significantly reduce material consumption, waste generation, and the environmental impacts associated with single-use alternatives.

The BM-LCA followed an improvement-oriented assessment, analyzing one event season of up to 10 events and using the profit generated during that season as the functional unit. Empirical observations were carried out at a large event in 2023, where the company supplied 6000 polypropylene cups and 3000 lids. The BM relied on centralized logistics, where cups and lids were delivered in a single truck shipment to the venue, stored on-site, and used throughout the event. After beverage consumption, customers were expected to deposit the items in one of 40 return stations. The collection stations were made of cardboard and plastic bags, which collected liquid residues and stored used products. Although the lids were intended to be optional, most attendees used both cups and lids. After the event, returns were sent back to the company's production and washing facility for cleaning, quality control, and storage for reuse in future events.

The assessment showed that return rates were significantly lower than expected, corresponding to 78.5% for cups (losses of 1293 cups; 21.5%) and 60.4% for lids (losses of 1189 lids; 39.6%). These losses generated a need for replacement production, which became the largest contributor to Global Warming Potential (GWP), accounting for 44.8% of total emissions. Transport activities, including delivery to the venue and upstream material transport, contributed 20.2%, whereas the return stations contributed 14.3%, mainly because the plastic bags required frequent replacement. Washing made a relatively limited contribution to GWP but contributed to other impact categories, including freshwater aquatic toxicity, human toxicity, and eutrophication.

Scenario analysis identified several opportunities to reduce these impacts. For example, increasing the return rate by 6.5% could reduce CO_2 emissions by 23%, whereas relocating storage closer to event venues could reduce transport-related emissions by up to 80%. Other potential improvements include providing facilities for liquid disposal to extend the lifetime of the return stations, adjusting pricing strategies to support product returns, and redesigning products to reduce material use.

Because the assessment did not include a comparison with a single-use BM, the findings do not establish whether the reusable BM performed better or worse than the conventional alternative. Instead, the BM-LCA identified where impacts appeared within the assessed configurations and quantified the

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parameters influencing its environmental performance. The case shows that the outcome of a reuse strategy depends on behavioral conditions, here exemplified by product return, and on the logistics and collection infrastructure required to enable repeated use.

In this case, the company thought that the benefit would be the reuse itself, but the environmental performance was shaped by how many items came back, how far they traveled between storage and venue, and how often the collection stations had to be replaced. Reuse was adopted without defining what would be needed for it to work, and the circular feature was in this sense taken as evidence of improvement in itself.

4.2 | Case 2—Tool Sharing via Access-Based BM

Founded in 2019, this Swedish startup aims to reduce overconsumption by providing access to underutilized goods such as power tools, leisure items, and household appliances. At the time of the study, the company was a seed-stage venture created around an access-based SBM. Its operations depended on collaboration with municipalities, housing associations, property developers, and product providers, reflecting the interorganizational character of the BM.

The company provides subscription-based access to shared products stored in self-service locker depots located in residential or workplace communities. Locating depots near users was intended to promote walking access, minimizing user transportation emissions, and limit individual ownership of infrequently used products. The BM therefore sought to reduce material consumption by increasing product utilization and distributing access to a shared product pool.

The company makes products such as percussion drills available through agreements with producers. Subscriptions included use rights, insurance, and maintenance, whereas revenues are distributed between the company and the product providers. Some infrastructure is co-financed by housing cooperatives, while residents pay annual membership fees. The BM distributes product ownership, service provision, infrastructure investment, and revenue capture across different actors.

The products are stored in lockers weighing approximately 300 kg and made primarily of steel. Although the lockers were designed for outdoor installation, most were installed indoors. Depreciation was calculated over 5 years despite an expected technical lifetime of 10 years. This difference between the intended and actual installation contexts became relevant to the environmental performance assessment because it affected whether the material intensity of the infrastructure was functionally required.

As in the previous case, the BM-LCA used an improvement-led assessment focused on a percussion drill and the share of the locker infrastructure allocated to its provision. The assessment covered the product system from raw material extraction to end of life and focused on climate change impacts (CO_2-equivalent emissions). The functional unit was the annual net profit allocated to the drill, based on an expected 140 subscribers per locker. Revenues were allocated using a 3.5% holding cost factor. Costs included a 40% revenue share paid to the drill producer and proportional allocations of procurement, maintenance, IT, and administrative costs.

The analysis identified the steel locker as a major environmental hotspot. It generated approximately 575 kg CO_2eq, approximately 26 times the emissions associated with the drill itself and accounted for 16% of the annual footprint when allocated over a 10-year lifetime. The result was influenced by the mismatch between the locker's material specification and its use context. A weather-resistant steel structure had been selected for outdoor conditions, although most units were installed indoors.

Scenario analysis showed that extending the drill's lifetime from 3 to 5 years could reduce annual emissions by 40%, although further gains diminished beyond 5 years. Replacing virgin steel with recycled steel could reduce locker-related emissions by up to 65%, whereas lighter materials such as aluminum, wood, or reinforced plastic could be considered for indoor installations. The results were also sensitive to geography. Expansion into regions with more carbon-intensive energy systems would increase use-phase emissions, despite relatively short operating time of approximately 15 min per use. A combined scenario involving extended product lifetimes, lighter and lower-impact materials for the lockers, improved utilization, cleaner energy sourcing, and revenue sharing adjustments produced lower estimated emissions alongside cost reductions.

As in the Cup'n Lids case, no directly individual ownership BM was included as a baseline. The results therefore provide an assessment of hotspots and configuration sensitivities and not really evidence that tool sharing was environmentally superior to individual ownership. The case demonstrates that the environmental logic of shared use did not predict where impacts would appear. Instead, the material specification, lifespan, placement, and utilization of the enabling infrastructure became an important condition shaping environmental performance.

Here, the lockers were fully accounted for in the BM, because they carried investment, depreciation, and revenue-sharing arrangements; however, they did not appear in the company's environmental reasoning, which rested on the shared drill. The same component was therefore visible as a cost and invisible as an impact. It is worth noting that the divergence came from choices the company made itself (the locker's material and placement), so it cannot be explained by the difficulty of predicting how users behave. Second, it only became visible because the assessment included the lockers. Product-level methods would normally leave enabling infrastructure outside the system boundary, and on that basis, the largest source of emissions would not have been counted, and the BM would have appeared to work as intended.

4.3 | Case 3—Rental of Outdoor Jackets

This mid-sized Swedish outdoor apparel manufacturer was founded in the mid-1990s and primarily serves environmentally conscious outdoor consumers. Although it holds a modest share of the Swedish market compared with large multinational

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competitors, the company positions itself as a sustainability pioneer within the outdoor clothing sector. Its sustainability strategy combines eco-design with BM innovation.

The company's garments are designed for durability, repairability, and recyclability. Rental, resale, repair, take-back and subscription services are intended to extend product use and reduce demand for new production. The company also uses product life cycle assessments, planetary boundary analysis, and public sustainability reporting to support environmental decision-making and external accountability.

The BM-LCA assessed the environmental performance of rental BMs for outdoor jackets in comparison with a traditional sales BM. In the sales BM, customers purchase and retain ownership of the jacket, with repair and recycling services available as optional. In the rental BM, the company retains ownership, customers pay a daily rental fee, and the company handles laundering, repair, storage, and the eventual resale of worn garments. Both BMs accept returned jackets for recycling.

The assessed jackets were made of recycled polyester (outer shell) and virgin polyester (lining, membrane, and zipper), treated with fluorocarbon-free repellents. In contrast to the first two cases, this BM-LCA used a comparative assessment. Rental and sales configurations of the same jacket were compared using an equivalent level of profit over 30 days. The product system was held constant where possible, although the parameters constituting the two BMs such as ownership, pricing, transaction volume, laundering, repair, storage, and customer transport vary.

Coupling the financial and physical flows showed that approximately 200 jackets per month were required in the sales BM, compared with 28 jackets in the rental BM, to generate the same profit. This difference is due the revenue and transaction logic of the two BMs and not from differences in the physical jacket.

Under the baseline assumptions, the rental BM reduced climate change impacts by 43% compared to the sales, mainly due to fewer jackets being required to achieve the same profit level. However, rental did not perform better across all impact categories assessed. Laundering contributed to higher freshwater consumption and ozone depletion impacts, whereas logistics and storage requirements increased impacts associated with infrastructure, metals, minerals, and land use.

The comparative result was highly sensitive to customer transport. When customers traveled by bicycle or public transport, the rental BM retained its advantage. When all customers traveled by car to the selected rental location, the emissions of the rental BM more than doubled and exceeded those of the sales BM. The results were also affected by rental duration, pricing, laundering, store location, resale timing, and the number of rental cycles achieved before resale.

Potential improvements included locating stores with rental services close to public-transport connections or places of use, such as ski resorts; adjusting pricing to encourage longer rental periods; increasing the number of rental cycles before resale; and improving garment return and recycling through customer education and incentives.

4.4 | Cross-Case Analysis

The three BM-LCA applications are not directly comparable in terms of numerical magnitude of their environmental impacts. They involve different products, timeframes, functional units, product systems, impact-category coverage, and assessment goals. Cup'n Lids and Tool Sharing used an improvement-oriented assessment, whereas Outdoor Jacket Rental included a direct comparison between rental and sales BM.

BM-LCA established a consistent analytical basis within each case by relating physical flows and environmental impacts to a specified unit of BM profit for the case specific system boundaries and assumptions. The cross-case analysis did not compare the absolute environmental results of the three cases. Instead, it compared the relationship between the intended sustainability mechanisms, the location of environmental hotspots, and the conditions that shaped the results within each BM.

Table 3 summarizes the main analysis. In the Cup'n Lids case, the intended sustainability mechanism was repeated use as an alternative to single-use products. However, the main contribution to climate change came from replacement production caused by product losses. Collection infrastructure, storage, and transport also contributed to the results. Environmental performance was therefore shaped by the interaction between behavioral conditions, particularly return rates, and configuration choices concerning the return system and logistics.

In the Tool Sharing case, the intended mechanism was increased product utilization through shared access. The main environmental hotspot, however, was not the shared drill but the steel locker required to provide access. Locker material, lifespan, placement, and utilization influenced the result, whereas the electricity mix became relevant when geographical expansion was considered. Environmental performance was shaped primarily by the design and deployment of enabling infrastructure rather than by the shared-use principle alone.

In the case of outdoor jackets, rental reduced overall impacts relative to sales, but the result was not consistent across impact categories. Laundering, storage, and logistics introduced additional burdens, whereas customer transport could reverse the comparative environmental performance advantage. The environmental performance of the rental BM depended on the interaction between configuration choices and user behavior.

Across the three cases, recurring environmental performance conditions were identified. First, configuration conditions concerned choices made by the firms and their partners, including infrastructure design, material selection, storage, logistics, pricing, return incentives, service location, and maintenance arrangements. Second, behavioral conditions concerned actions that the firms could influence but not fully determine, including return rates, customer transport, adoption, and utilization. Third, contextual conditions concerned features of the wider setting, including geography, installation context, infrastructure availability, storage distances, and electricity systems.

These categories are comparable across the cases even though the environmental results are not numerically commensurable.

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TABLE 3 | Summary of findings across the cases.

Case	Assessment goal	Intended sustainability mechanism	Environmental performance	Conditions shaping performance	Interpretation
Cup'n Lids at Events	Improvement-oriented	Repeated use replaces single-use items and reduces waste	Replacement production accounted for 44.8% of GWP; transport accounted for 20.2%; return stations accounted for 14.3%	Return rates, transport, collection system design, storage location, transport, washing	Reuse performance depended on user returns and the infrastructure required to enable repeated use
Tool Sharing	Improvement-oriented	Shared access increases utilization and reduces demand for new products	The steel locker generated approximately 575 kg CO_2eq, around 26 times the emissions associated with the drill, and accounted for 16% of the annual footprint	Material choice, lifespan, placement, utilization, number of subscribers, electricity mix	Enabling infrastructure, rather than the product, became a key environmental hotspot
Outdoor Jacket Rental	Comparative (sales vs. rental)	Repeated rental reduces the demand for new products and improves the resource efficiency	Rental reduced overall impacts by 43% but increased impacts in other categories; customer car travel could reverse the advantage	Customer transport, rental efficiency, laundering, pricing, service location, resale timing	Rental produced a conditional environmental performance advantage and trade-offs across impact categories

Source: The authors.

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Their recurrence indicates that environmental performance outcomes were not governed solely by the focal circular/sustainable feature. Instead, impacts frequently were connected to enabling activities and user-dependent processes.

The analysis also distinguishes the conditions that shaped environmental performance outcomes from those that influence whether the outcomes became visible. Within the assessed BMs, all three generated positive financial outcomes. However, environmental aspects of some parts of operations were often overlooked or underexamined and were not fully represented by the initial sustainability assumptions. During the first interactions with the participating companies to define the assessment goals, it became clear that their primary reason for applying BM-LCA was that they saw it as an opportunity to obtain quantitative confirmation of the environmental performance of their SBMs.

5 | Discussion

5.1 | Interpreting the Design–Outcome Gap

One swallow does not make it summer! Paraphrasing the adage, one sustainable feature does not make a BM sustainable. Although previous research on SBM offers rich qualitative guidance (e.g., N. M. P. Bocken, Short, et al. 2014; Lüdeke-Freund et al. 2018; Geissdoerfer et al. 2017) for BM design and experimentation, they primarily articulate the sustainability logic of the value proposition. The studied cases show why that logic needs to be distinguished from realized environmental performance, and each does so in a distinct way.

Cup'n Lids showed that the environmental performance of a reuse logic is influenced by the flow of the products in the system. Low return rates made replacement production the dominant hotspot despite the reuse rationale, and the turnover of plastic-bagged return stations further lowered the performance. This reframes reuse from a property of the value proposition into a conditional BMs whose improved environmental performance depends on parameters (return rate, station lifetime) that reside in the user-practice and service-operations layers of the BM and are only partially under the focal firm's control.

Tool Sharing showed that access-based BMs can relocate the material intensity in some cases. Here, material choices and placement of the lockers mattered more than the drill that was being shared itself. In this case, if the enabling layer that makes access possible is excluded from the assessed system, the BM's environmental logic is assessed against the wrong object. Sharing in this case changed product-level intensity for infrastructure-level intensity.

Outdoor Jacket Rental showed that climate gains were contingent on user transport and the location where the rentals were offered, whereas the profit level functional unit meant that fewer jackets were required to generate equivalent profit in the rental BM than in the sales. This case separates two conditions that the SBM literature often brings together: the intensity effect (impact per transaction) and the scale effect (transactions required for economic viability).

Across the three cases, these system-level drivers were rendered visible only when quantified. In other words, sustainability intent resided in the value proposition, but the realized environmental performance was governed by operational parameters that sit outside the focal product/service.

This makes it clearer what we mean by poorer environmental performance. It is not that these SBMs are worse than the linear models they replace; what we want to show is where impacts are in the different BM configurations and how sensitive that is. All three companies held product-level evidence and were correct about it; what that evidence could not show was that the parameters governing the environmental performance lay outside the product it covered.

This lack of environmental performance assessment represents a gap in SBM practice, a conceptual blind spot, and an organizational risk. Quantitative assessment functions not only as an evaluative tool but also as a sensemaking mechanism (Brown et al. 2015), enabling companies to align intentions with operational realities. This is better understood through the lenses of the BM design space, in which the feasible set of configurations is bounded by institutions, policy, infrastructures, market rules, and user practices, and small shifts in these boundary conditions can change what environmental performance is achieved (Huijben et al. 2016). Relying solely on qualitative design frameworks (e.g., Lewandowski 2016; Pieroni et al. 2019; Geissdoerfer et al. 2022) leaves this design space uncharacterized. What is missing is a mechanism that translates sustainability innovations into operable configurations (Lüdeke-Freund 2020) and continuously validates whether those configurations deliver the intended outcomes under real system conditions.

Figure 2 shows that (i) the BM design space constrains and enables what SBMs can realistically deliver in terms of environmental performance and (ii) the BM as a mediation space (i.e., the organizational translation layer between sustainability innovation and business case for sustainability) requires quantitative assessment to prevent design–outcome misalignments. Scenario 1 shows the design–innovation–experimentation cycle without a quantitative assessment step, where iteration continues, but the move from SBM to business case for sustainability is assumed not validated, so the organization cannot quantitatively validate a better environmental performance. Scenario 2 adds "Assess" as a step whose output feeds back into redesign, closing the loop between configuration choices and measured outcomes. Reading against the cases, the two scenarios correspond to the situation the companies were in when we applied BM-LCA to their cases (Scenario 1) and the situation the assessment made available to them (Scenario 2). The conditions that proved decisive in each case are the configuration variables that Scenario 1 leaves unexamined.

As presented in Figure 2, greenwishing can be a result from the lack of quantitative assessment, and it is most likely to happen when the design and experimentation cycle is incomplete. Design iterations (e.g., changes in users, operations, or revenue logic) do not guarantee better outcomes; without quantitative

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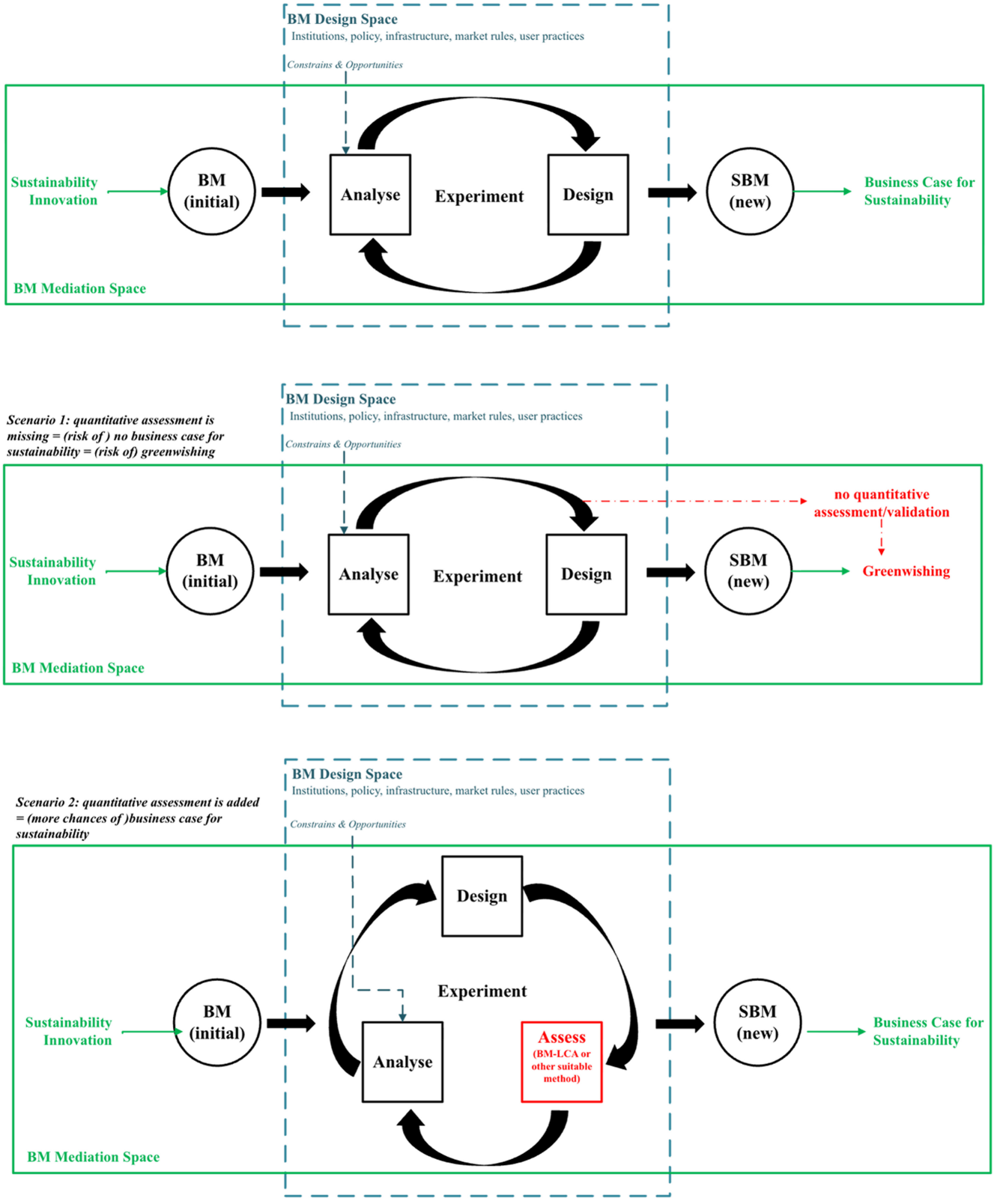


FIGURE 2 | Design–measurement–outcome gap. *Source:* Adapted from N. Bocken et al. (2019). We used the EBME framework proposed by N. Bocken et al. (2019) to exemplify the consequences associated with the lack of quantitative assessment when designing SBM. We chose this framework because it is simple enough to facilitate comprehension but also complete enough to comprehend the key steps for the SBM design, innovation, and experimentation cycles. EBME is positioned as the experimentation core; BM design space defined the contextual feasibility boundaries; and the BM mediation space captures the mechanisms through which sustainability innovations are translated into viable SBMs and business cases while highlighting that, without assessment/empirical validation of environmental performance outcomes, this translation may fail to substantiate a business case for sustainability and instead culminate in greenwishing.

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evidence, claims risk remaining symbolic (Marrucci et al. 2022; Rosati et al. 2023; Bernini et al. 2024).

Greenwishing differs from greenwashing in intent. Greenwashing entails deliberate deception (Delmas and Burbano 2011), whereas greenwishing arises in good faith from aspirational strategies combined with insufficient assessment and vague implementation roadmaps (Austin 2019). Nonetheless, their consequences can converge unless mechanisms for validation and adjustment are in place. This risk is captured by "Scenario 1" in Figure 2: When quantitative assessment/validation is missing, organizations can keep iterating on design while remaining unable to evidence environmental performance gains or substantiate a credible business case for sustainability.

In the studied cases, the divergence between design and outcome was associated with overlooked limitations and configuration misalignments and thus could not be labeled greenwashing. The cases reflected genuine, good faith attempts to implement SBMs without sufficient mechanisms for assessing the complete BM configuration. We interpreted this as resonating with an unresolved design–outcome tension and a potential organizational paradox. Paradox theory concerns persistent and interdependent contradictions that organizational actors need to address simultaneously (Smith and Lewis 2011; Hahn et al. 2015). Our data do not trace how managers experienced or managed these tensions over time and therefore do not demonstrate paradox management. However, they do show that BM-LCA made previously overlooked interdependencies among sustainability aspirations, economic viability, and operational requirements visible, providing an evidential basis for subsequent learning and adjustment.

5.2 | Conditions for the Poorer Environmental Performance Assessment

The studied cases showed that although the companies adopted SBMs emphasizing access, reuse, rental, and circularity, unintended negative environmental impacts emerged. In these cases, we identified six conditions that explained these environmental performance outcomes. These are conditions observed across three cases in one national context (Sweden) and one SBM family (product as a service), not general determinants of SBM performance.

The first is a *systemic oversight and cognitive myopia*. The singular focus on core SBM features (e.g., reuse or access) led these companies to neglect contextual, logistical, or behavioral factors that were highly influencing the environmental performance of their BMs. This singular focus or lack of systemic view in sustainability-oriented innovation has been raised as a concern in the literature (e.g., Goodman et al. 2023). In Tool Sharing, for example, the environmental burden of the enabling locker infrastructure exceeded that of the shared drill, whereas Cup'n Lids showed that replacement production and return-station turnover could dominate the reuse logic.

A second condition is *institutional pressures to signal sustainability credibility*, which may reinforce overconfidence in symbolic sustainability strategies, even when operational feasibility and system-level trade-offs have not been examined. All three companies approached BM-LCA primarily as a legitimation and confirmation tool, expecting to confirm "good" performance and to generate quantitative evidence that could be communicated to customers and other stakeholders. The evidence supports this condition primarily through the companies' initial expectation that BM-LCA would confirm environmental gains; it does not independently establish that institutional pressure caused the outcomes. An alternative explanation is that the assessment was simply not perceived as decision-relevant at that stage.

The third is related to the required *shift in the unit of analysis*. At the product level, the company may see a good environmental performance; however, this same product can represent a much larger environmental footprint when scaled to the transactions needed for a BM to be profitable. Thus, if the assessment is not done at the BM level considering this unit of analysis shift, then it does not guarantee that a product with a better environmental performance will translate into a BM with a better environmental performance. The Outdoor Jacket Rental case illustrates this when fewer jackets were required to generate equivalent profit under rental than under sales, but the result depended on the activities included.

The fourth reflected the *additional infrastructure and consumer behavior* often required for an SBM to work. From the business perspective, the required ancillary services and additional infrastructure are considered because there are costs/revenues associated with them. However, when the product-level environmental assessments are made, these factors are disregarded even though they contribute to the environmental performance. Assuming automatic alignment between users and sustainability goals can be associated with greenwishing. Companies need to actively foster behavioral change through education, incentives, and supportive infrastructure to ensure alignment between design intentions and realized environmental performance (Marrucci et al. 2022). Within the BM design space lens these factors are boundary conditions (infrastructure availability, user practices, and institutional arrangements) and within the BM mediation space lens, they are mechanisms that need to be actively configured (incentives, service design, and governance).

The fifth is the *lack of knowledge to perform environmental assessment* of BMs. These assessments are complex and require a high degree of expertise that companies often do not have, which restricts how organizations navigate their design space with evidence and learn through experimentation. This relates to the last condition: the company's *belief system*. If they have a sustainability-by-design (only) mindset, then empirical validation might not seem so important. The coexistence of strong sustainability intentions and unintended poorer environmental performance reflects a well-documented tension (Smith and Lewis 2011; Brown et al. 2015). SBMs operate within competing logics (e.g., economic viability, ecological sustainability, and social responsibility). Without empirical validation, companies risk drifting into greenwishing by maintaining sustainability legitimacy through symbolic signals while not delivering meaningful environmental performance (Torelli et al. 2020; Huang et al. 2025; Ruggeri et al. 2025).

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The combination of these conditions can significantly affect the environmental performance of SBMs, sometimes outweighing intended benefits. A life cycle perspective during BM design and empirical validation (i.e., quantitative assessment) can avoid this (e.g., Filippi et al. 2025; Johnson and Mont 2025). Integrating "Assess" into the design and experimentation cycles helps companies use evidence to identify which SBM configuration conditions dominate impacts, redesign within the feasible boundaries of the design space, and strengthen the mediation pathway from sustainability innovation to a substantiated business case for sustainability, thereby reducing the likelihood of greenwishing. BM-LCA can make these dependencies visible, but improved realized performance still depends on whether the organization acts on the results and verifies the redesigned configuration.

5.3 | Implications and Propositions for Theory and Practice

The findings support life cycle–based assessment as a necessary complement to qualitative design, innovation, and experimentation frameworks. In the studied cases, BM-LCA exposed decision thresholds, beyond which the environmental advantage flips, turning assessment into a sensemaking and learning mechanism. As proposed in Figure 2, companies that use a BM-level life cycle–based assessment gate before scaling up SBM are more likely to achieve superior environmental performance outcomes and create a business case for sustainability (**Proposition 1**).

A systems perspective further revealed how enabling infrastructure (e.g., depot networks, materials, and siting) can dominate impacts if not well planned and considered in the assessments. LCA scholarship has long shown that environmental burdens frequently materialize in indirect or downstream stages (Baumann and Tillman 2004), and BM-LCA makes these hidden dynamics visible by tracing emissions and resource use across interconnected processes and thereby identifying hotspots and leverage points (Baumann et al. 2022; Goffetti et al. 2022; Filippi et al. 2025). Consequently, SBM's environmental performance can be superior when the additional infrastructure required for operation is explicitly included in design choices and accounted for in quantitative assessment (**Proposition 2**).

The assessment process matters as much as its quantified outputs. In our cases, boundary-setting and cross-functional data collection required assumptions held by sustainability, operations, finance, and logistics actors to be made explicit and confronted with BM-LCA results. This created conditions for reflective learning, particularly when unexpected results challenged the assumption that a sustainability-oriented configuration would necessarily improve environmental performance (Sosna et al. 2010). Such reflective learning is consistent with organizational scholarship on revising assumptions and learning based on empirical feedback (Alvesson and Kärreman 2007; Smith and Lewis 2011; Brown et al. 2015; Alvesson and Sandberg 2024). We therefore propose that BM-level assessment is more likely to contribute to SBM redesign, improvement, and/or innovation when its results are collectively interpreted and used to revise both operation and underlying design assumptions (**Proposition 3**).

Timing also conditions usefulness. BM-LCA is most decision-relevant when applied post-pilot (when credible operational and financial data exist) but pre-scale-up (before choices are locked in). Whereas simplification is often valuable, over-simplified assessments risk missing the very tipping points that govern environmental advantage (**Proposition 4**). Because we lack cases assessed earlier or later, this proposition is an extrapolation from a single timing condition and would be tested by comparing the decision relevance of assessments conducted at different venture stages.

Orientation toward assessment conditions whether this learning opportunity is used. An assessment pursued primarily as confirmation may lead organizations to focus on evidence supporting their existing sustainability narrative, whereas a learning orientation makes unexpected results legitimate inputs for reconsidering design assumptions. The three companies in our study initially sought confirmation, although BM-LCA revealed environmental dependencies and improvement levers that had remained outside their original environmental reasoning. This represents a change in the knowledge available for decision-making, but it does not demonstrate that organizational learning or redesign was subsequently institutionalized. Companies that treat assessment as a means of testing and revising assumptions, rather than only confirming expected benefits, are less likely to sustain greenwishing and more likely to identify relevant SBM redesign priorities (**Proposition 5**).

For managers, our analysis pointed to practical priorities. First, treat enabling infrastructure and other mechanisms as a core part of the BM and size it appropriately (e.g., use defaults/incentives to increase return rates and reduce car-based transport; place service close to use points or public-transport hubs; and sequence market expansion based on factors such as grid carbon intensity). Second, introduce an assessment gate before scaling, so that expansion decisions are based on quantified performance rather than assumptions; and use assessment as a structured, cross-functional exercise that couples business variables with material and energy flows, thereby aligning the business case with environmental realities. Third, assess early and repeatedly, and base decisions on empirical evidence, scaling only when the data indicate superior environmental performance. Because such assessments can be time consuming, this is a practical drawback; however, it reduces the risk of scaling SBMs that do not deliver the expected environmental gains.

For theory, these results contribute to SBM scholarship around conditions and motivate comparative tests across sectors/geographies; integration with organizational learning (measurement orientation as an antecedent of redesign); and the development of BM-level monitoring infrastructures that keep assessment "live" as BMs scale (Baumann et al. 2022; Böckin et al. 2022; Goffetti et al. 2022). In a context of rising stakeholder expectations and regulatory pressures (Ioannou and Serafeim 2019; Santos et al. 2024), inadequate assessment is a strategic risk that can erode credibility and slow down sustainability transition.

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6 | Conclusions

This study examined under what contextual, configuration, and behavioral conditions SBM delivers, or fails to deliver, improved environmental performance. It makes two contributions that follow from this objective. First, the study specifies the design–outcome gap in the context of SBM. Across the cases, the sustainability mechanism embedded in the value proposition did not predict where environmental impacts would appear. The assessment redirected attention from reuse, sharing, and rental as general design principles to the operational conditions governing their outcomes, such as return rates, user travel patterns, siting and material choices for enabling infrastructure, and the geography in which services were offered. The findings therefore show that the environmental performance of SBM configurations was contingent on parameters and thresholds that were not evident from the BM archetype alone.

Second, the study connects the design–outcome gap to the need for environmental performance validation. We then present greenwishing as the risk that actors treat the sustainability logic of an SBM as sufficient evidence of environmental improvement before its operational consequences have been properly assessed. The evidence from the cases shows that BM-level assessment can make such assumptions testable by linking the revenue and operating logic of a BM to the life cycle impacts of the physical activities required for it to function. The study therefore positions BM-LCA as a potential method and mechanism for detecting and examining design–outcome gaps. Together, the two contributions explain both why intended environmental benefits may remain conditional and how those conditions can be made visible before sustainability claims are treated as established outcomes.

This highlights the importance of life cycle thinking and reveals how easily companies can end up on the "wrong" side of environmental performance when systemic dynamics are overlooked. Without assessment, organizations risk unintentionally contributing to environmental harm despite their best intentions. Assessment approaches that expose hidden trade-offs and guide decision-makers from design to data-informed decisions are therefore needed. For scholars, our work encourages deeper theorization on the empirical validation of SBMs and on the role of performance assessment in closing the gap between design and outcomes. For practitioners, it serves as a cautionary note that sustainability-by-design needs to be accompanied by system-level and empirical validation. Ultimately, we argue for a shift toward more reflexive, data-informed approaches to SBM innovation, ones that can align good intentions with credible, quantifiable environmental progress.

Although our study offers meaningful contributions, it also has limitations. The cases are based in Sweden and reflect context-specific organizational, regulatory, and infrastructural conditions. BM-LCA can involve assumptions that may not fully represent complex real-world dynamics. Only one case includes an explicit comparison between the SBM and a linear counterpart; in the other cases, the BM-LCA focused on understanding environmental performance drivers rather than comparing against a conventional alternative. The cases represent only one type of SBM, use-oriented PSS, leaving other SBM configurations untested.

Future research should develop sector-specific guidance for identifying decision thresholds, examine organizational and cognitive barriers to using assessment as a learning mechanism, and investigate how digital data infrastructures can enable BM-level monitoring with faster feedback cycles. In addition, future studies should further conceptualize and characterize greenwishing as an emerging phenomenon. Finally, future studies should replicate and extend this analysis across a broader range of SBM archetypes and include more comparisons against linear counterparts.

Author Contributions

Ana Carolina Bertassini: data curation, writing – original draft, writing – review and editing, conceptualization, formal analysis, methodology, investigation, visualization, validation. **Henrikke Baumann:** funding acquisition, writing – review and editing, project administration, conceptualization, formal analysis, methodology, validation. **Thomas Zobel:** funding acquisition, writing – review and editing, project administration, formal analysis, methodology, validation.

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Ethics Statement

The authors have nothing to report.

Consent

All the data collected with companies that are included in this paper for publication was authorized by the companies.

Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

Data used from the BM-LCA cases can be found in the cited studies in the manuscript.

Endnotes

[1] Although some scholars use the terms sustainable and circular business models interchangeably, this paper adopts the SBM terminology to encompass business models aiming to address environmental, social, and economic concerns. Examples of sustainable business models

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are product-service systems, remanufacturing, subscription models, and rental models.

[2]Differs from greenwashing where there is deliberate deception (Delmas and Burbano 2011; Lyon and Maxwell 2011). It also differs from rebound effects, because they occur regardless of what anyone in the company believes (Alfarisi et al. 2022; Metic and Pigosso 2022) and are better understood as one way an unfounded assumption gets exposed than as the condition itself.

[3]Table 2 presents the general BM-LCA procedure; the complete case-specific equations and inventories are reported in the original studies: Goffetti et al. (2022); Claesson and Skogum (2023); and Holzhausen and Troedsson (2023).

[4]The procedures used to build up and validate these models are reported in the respective primary publications: Goffetti et al. (2022); Claesson and Skogum (2023); and Holzhausen and Troedsson (2023).

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