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RESEARCH ARTICLE

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Towards sustainable business models with a novel life cycle assessment method

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Abstract

Business model (BM) innovation for sustainability is hampered by a lack of tools for environmental assessment and guidance at the BM level. Conventional life cycle assessment (LCA) neglects the economic and socio-technical mechanisms within a BM, and tools based on the BM canvas (BMC) cannot provide recommendations substantiated by environmental data. Here, a new method, BM-LCA, is applied to a case comparing the selling and renting of jackets, using profit as basis of comparison. Results identify how business parameters influence environmental performance, permitting analysis for decoupling within a business practice. This is made possible by the unique way the method links physical life cycle and the monetary flows of a BM. Usefulness of BM-LCA is discussed relative to BM innovation, business strategy and similar tools. BM-LCA provides insights into a broad range of BM elements and emerges as useful for business strategy. By measuring BM environmental performance, it helps determine what BM to compete with and support critical analysis of business against greenwashing. BM-LCA also enables identification of BM elements in greatest need of environmental innovation. BM-LCA appears as a promising tool for guiding business companies towards sustainability, filling a space between LCA and BMC. The method offers a practical way for business and LCA experts to merge their respective knowledge.

KEYWORDS

business model, business model canvas, business model innovation, business strategy, decoupling, life cycle assessment

1 | INTRODUCTION

Companies are expected to play a key role in the transition towards sustainability, for example, via innovations for sustainability at the business model (BM) level (Evans et al., 2017; Loorbach et al., 2017; Schaltegger et al., 2016). A BM can be defined as 'a description of the different parts of a business or organization showing how they will work together successfully to make money' (www.dictionary.cambridge.org). A BM geared towards sustainability will still capture economic value by competitively generating value to customers, but it

Abbreviations: ABC-LCA, activity-based costing life cycle assessment; BM, business model; BMC, business model canvas; BM-LCA, business model life cycle assessment; CBM, circular business model; dtex, decitex (grams per 10,000 metres of yarn); ILCD, International Reference Life Cycle Data System; LCA, life cycle assessment; LCI, life cycle inventory; LCIA, life cycle impact assessment; O-LCA, organisational life cycle assessment; PSS, product service system; RISE, Research Institutes of Sweden.

will do so in a way that contributes positively to the environment and society (Pieroni et al., 2019).

Several BMs for sustainability have been proposed; two types are circular BMs (CBMs) and product service systems (PSS) (Linder & Williander, 2017; Tukker & Tischner, 2006). Although these are recognised as promising sustainability solutions (Bocken et al., 2019; Kerdlap et al., 2021; Martin et al., 2021; Tukker, 2015), it is not guaranteed they lead to reduced environmental impacts. In their reviews of assessment studies of such BMs, Blüher et al. (2020) and van Loon et al. (2021) found that while they seem to reduce certain types of environmental impact (e.g., the use of natural resources or climate change), the overall evidence is still weak due to a lack of quantitative assessment (Nosratabadi et al., 2019). Blüher et al. (2020) also identified methodological challenges for sustainability assessment of PSS from a lack of systematic and standardised assessment approaches.

In the absence of robust quantitative methods for BM innovation for sustainability, a multitude of qualitative tools have been developed. However, few of these meet the needs and expectations of companies (Rossi et al., 2016). Prominent examples include the BM canvas (BMC) developed by Osterwalder and Pigneur (2010) and its derived tools such as the circular BMC (Nussholz, 2018) and the triple-layered BMC (Joyce & Paquin, 2016). These enable companies to represent elements of a BM visually and systemically, thereby facilitating discussion of potential innovations at the BM level (Joyce & Paquin, 2016). However, these BMC tools only provide qualitative information and base their recommendations on rules of thumb (Pieroni et al., 2019). Quantitative tools are needed to test their efficacy. In response, many call for tools that can evaluate the environmental performance of BMs (e.g., Bocken et al., 2021; de Giacomo & Bleischwitz, 2020; Schaltegger et al., 2016).

Life cycle assessment (LCA) is a well-established tool for the environmental evaluation of product or processes. However, in its current form, it is not well suited to assess BMs since it does not take into account the socio-technical mechanisms implied by BMs, such as economic interactions between the company and its value chain (Costa et al., 2019).

A novel form of LCA, BM-LCA, has been developed to address the lack of a systematic environmental assessment approach for BMs. Its purpose is the assessment and comparison of the environmental performance of BMs. Thus, companies seeking to enhance sustainability could find BM-LCA useful for design and innovation of more sustainable BMs based on quantitative environmental results and evidence. The methodology of BM-LCA is presented in a separate article (Böckin et al., 2022).

The aim of this paper is to present a study in which BM-LCA was applied in an environmental comparison of two different BMs of a real company. Although BM-LCA methodology is here applied to a single comparative case, the study indicates the usefulness of BM-LCA more generally. Therefore, an additional aim is to provide an analysis and discussion of the ways in which BM-LCA may contribute to sustainable BM transformation.

2 | METHOD

To demonstrate the application and usefulness of BM-LCA, the method was applied in a comparative case study in a real company. The findings were analysed relative to a framework for BM innovation and further discussed to evaluate the usefulness of BM-LCA for business companies. The discussion develops understanding on BM-LCA by drawing on relevant literatures on life cycle methodologies, BM innovation and business strategy.

2.1 | The case study

The comparative case study was conducted for a Swedish apparel company with high sustainability aims. In addition to eco-design of products and incentivising product recycling and reuse, the company is also taking action at the BM level to improve their environmental performance. The study uses BM-LCA to compare the company's current sales BM for one of its staple products with a contemplated rental BM. The goal is to critically investigate the expectation that sustainable BM innovations lead to improved environmental performance.

In the apparel sector, there have been several attempts to develop innovative BMs oriented towards sustainability, including rental and sharing systems (Adam et al., 2017; Camacho-Otero et al., 2019; Day et al., 2020; Lang & Armstrong, 2018). The few LCA studies of these models indicate that they contribute to an overall reduction in environmental impacts (Bech et al., 2019; Piontek et al., 2020; Roos et al., 2015; Zamani et al., 2017). These studies provide a basis of comparison between previous LCA and the new BM-LCA findings and can be used to observe whether the latter can provide new valuable information.

2.2 | The BM-LCA method

The BM-LCA method, presented in Böckin et al. (2022), aims to assess and compare the environmental impacts of (at least) two BMs. The BMs themselves are taken as the object of analysis, and their economic performance is taken as the basis of comparison, since the purpose of a BM is to make money (Böckin et al., 2022). In LCA terms, this means using an economic indicator as a functional unit (the unit of comparison in LCA), such as profit or rate of return, instead of product functionality as in conventional LCA (Baumann et al., 2022).

In more detail, BM-LCA expands conventional LCA methodology by elaborating the goal and scope stage, dividing it into two phases: 'descriptive' and 'coupling'. In the 'descriptive' phase, the key features of each compared BM are described. In particular, the types of customer transactions involved in each BM are specified (e.g., whether product ownership is retained or transferred to customers) and how product stocks (if any) are maintained. Any products associated with the BMs are also defined and described in terms of their function, lifetime, weight, material composition and other relevant characteristics. In the 'coupling' phase, a functional unit is defined and quantified based on a stated level of economic performance. Subsequently, so-called coupling equations are set up. These connect the physical flows to the monetary flows related to the economic performance level defined in the functional unit. The equations are solved to find the number of customer transactions and the required production. This procedure is repeated for each BM compared.

Subsequently, mainstream LCA methodology is applied, starting with life cycle inventory (LCI) analysis. This entails the collection of data and the creation of an inventory of environmentally relevant flows scaled to the functional unit. In the subsequent life cycle impact assessment (LCIA) phase, the quantified flows are aggregated into scores indicating the potential environmental impact in different categories. All potential impacts can also be aggregated into a single score by weighting the different types of impact according to their perceived relevance (Pizzol et al., 2017). Different weighting methods emphasising different aspects of the LCI (Hauschild & Potting, 2005) can be used to filter the results and identify key indicators to be analysed in depth (Tillman et al., 1998).

Lastly, the results are analysed and interpreted in order to provide useful insights and recommendations to the company.

2.3 | Framework for BM innovation

To describe the usefulness of the BM-LCA method, the findings of the BM-LCA study are analysed using Sommer's (2012) analytical framework for BM transformation. This framework was chosen because of its comprehensive and systemic representation of the elements related to BM innovation. It can thus be used to analyse the business logic of a company seeking to manage its BM innovation for sustainability. In the present case, it is used to identify the elements of a BM to which BM-LCA provides input. The framework is a synthesis of the work of Osterwalder (2004), Osterwalder and Pigneur (2010), Johnson et al. (2008), Johnson and Lafley (2010) and Sommer (2012).

On a conceptual level, the BM can be disaggregated into five interconnected components, illustrated in Figure 1.

The first component is the value proposition, which represents the functionality of the offered products or services and their competitiveness in terms of price or value compared to existing alternatives in the market.

The second component is the target groups, that is, the company's potential customer segments, the relationships between the company and the customer, and the channels through which value is delivered.

The third component is key resources, that is, all the assets owned or controlled by the company, including properties, equipment, employees and their skills and acquired knowledge, and partnerships with external partners.

Key resources are managed via the fourth component, namely, key processes that include primary activities (e.g., inbound and outbound logistics and operations), support activities (e.g., procurement, technology development and human resource management) and steering mechanisms that represent means of influencing the business practices or the decision-making process.

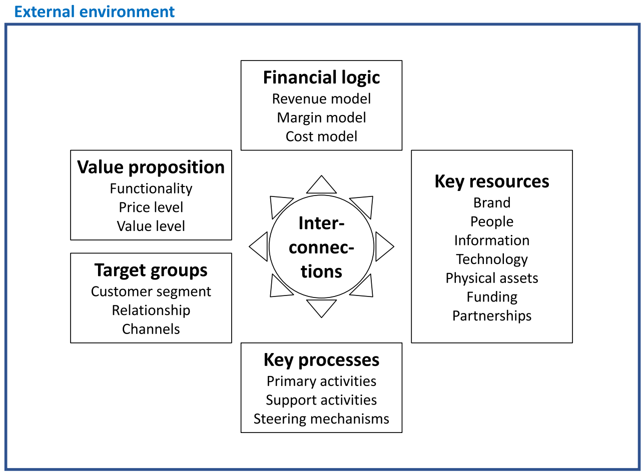

FIGURE 1 The composition of a business model as five interconnected components (modified from Sommer, 2012) [Colour figure can be viewed at wileyonlinelibrary.com]

The fifth and last component, financial logic, includes financial considerations such as revenue streams, pricing methods and cost structure.

The BM unit and its components are also connected with the external business environment, which affects them and is, in turn, influenced by them.

3 | THE BM-LCA STUDY

This section describes the BM-LCA study assessing the environmental impacts of two BMs, renting and selling.

3.1 | Goal and scope: Descriptive phase

The objective of the assessment was to compare the company's sales BM with a rental BM for polyester jackets by answering the following specific questions:

1. Can a rental BM for jackets reduce environmental impacts while maintaining profitability compared to the sales BM?
2. What are the environmental hotspots in the rental and sales models?
3. Is there any burden shifting between types of impact or different parts of the life cycle?
4. What are the most significant parameters affecting the performance of the rental BM?

3.1.1 | The sales and rental BMs

The sales model assumes that every garment produced is sold to a customer at an established price. Consequently, the number of transactions during a certain period equals the number of garments that need to be produced. The company also offers customers a free repair service.

In the rental model, the company retains ownership of the garments while customers pay a price to access them 1 day at a time. The company maintains the garments, including laundering them between customers and repairs. When garments are deemed too worn after repeated rentals, they are sold second-hand at a reduced price.

In both BMs, the company accepts old jackets returned by customers for recycling.

3.1.2 | The product system

The jacket investigated is made of polyester and has the same design in both BMs. It is composed of (i) an outer face fabric (with a fluorocarbon-free water repellent), (ii) an interior backing fabric, and (iii) an intermediate waterproof membrane laminated to the face fabric that enables humidity to escape from the wearer. The face fabric is made of recycled polyester, while the backing, membrane and zipper are made of virgin polyester. Data for the weight of the different components were derived from the total weight of the product combined with an estimate (from the company) of the face fabric's share of the total weight, as summarised in Table 1.

Figure 2 shows the jacket life cycle in the sales and rental BMs, the technical system with indications of the monetary flows connected to interactions between the actors involved that generate costs or revenues for the company. Colours represent different actors responsible for each process: orange for external suppliers (in Japan and Estonia), blue for the case company and yellow for customers. Not depicted in the figure are background systems like electricity and water production, which are modelled according to the location where each process takes place.

TABLE 1 Material composition of the jacket, with data sources

Component	Weight	Source
Face fabric	0.550 kg	Derived from data provided by company
Waterproof membrane	0.118 kg	Derived from data provided by company and estimates from Holmquist et al. (2020)
Backing	0.118 kg	Derived from data provided by company and estimates from Holmquist et al. (2020)
Zipper	0.030 kg	Estimate based on similar jacket's zippers
Total	0.815 kg	Data provided by the company

Figure 2 also indicates that the company collects economic data for related processes, including revenues and costs from the company's perspective. A simple cost structure of direct and indirect costs was used, where direct costs depend on the volume of production while indirect costs are represented by fixed costs. Revenue streams were divided into input-based revenues, generated when customers take ownership of a product, and usage-based revenues, generated when customers access or use a product. The main technical processes in the system are briefly described in Table 2.

3.1.3 | Data collection methods and sources

Regarding data quality for the product specifications, the use phase and the BM set-ups, the goal was to represent the real situation of the case company as closely as possible. Hence, specific data were gathered from the company via personal communication. These data were based either on empirical observations or on estimations, both for the economic and environmental modelling. LCA databases and relevant sources from literature were used for the rest of the life cycle. These data were complemented by using online tools (e.g., Google Maps and marine cargo rates) and personal communication with experts (including a researcher on chemical polyester recycling and a specialist employee at a repair shop). Table 3 summarises the data sources used for each process of the system. For details on all processes and sources for all data, see the full LCI in Appendix S1.

3.1.4 | Impact categories for the environmental assessment

The impact categories recommended by the International Reference Life Cycle Data System (ILCD) (Hauschild & Huijbregts, 2015) were used to assess the environmental performance of the sales and rental BMs. In order to identify the most important type of impact, a filtering process was applied based on two separate weighting methods that emphasise different aspects of the LCI. The most important types of impact were identified and used for dominance analysis.

One of the weighting methods used was the endpoint ReCiPe (H,A) method (Goedkoop et al., 2013), in which a panel of experts had set weighting factors. The sensitivity analysis was based on results weighted by this method. The other method used was ecological scarcity (2013) (Frischknecht & Büsser Knöpfel, 2013), where the weighting is based on the distance to politically or scientifically defined environmental targets (Hauschild et al., 2018).

3.2 | Goal and scope: Coupling phase

In the coupling phase, the relationships between monetary and material flows were modelled and expressed through a number of coupling equations. These, together with the functional unit, are used to derive

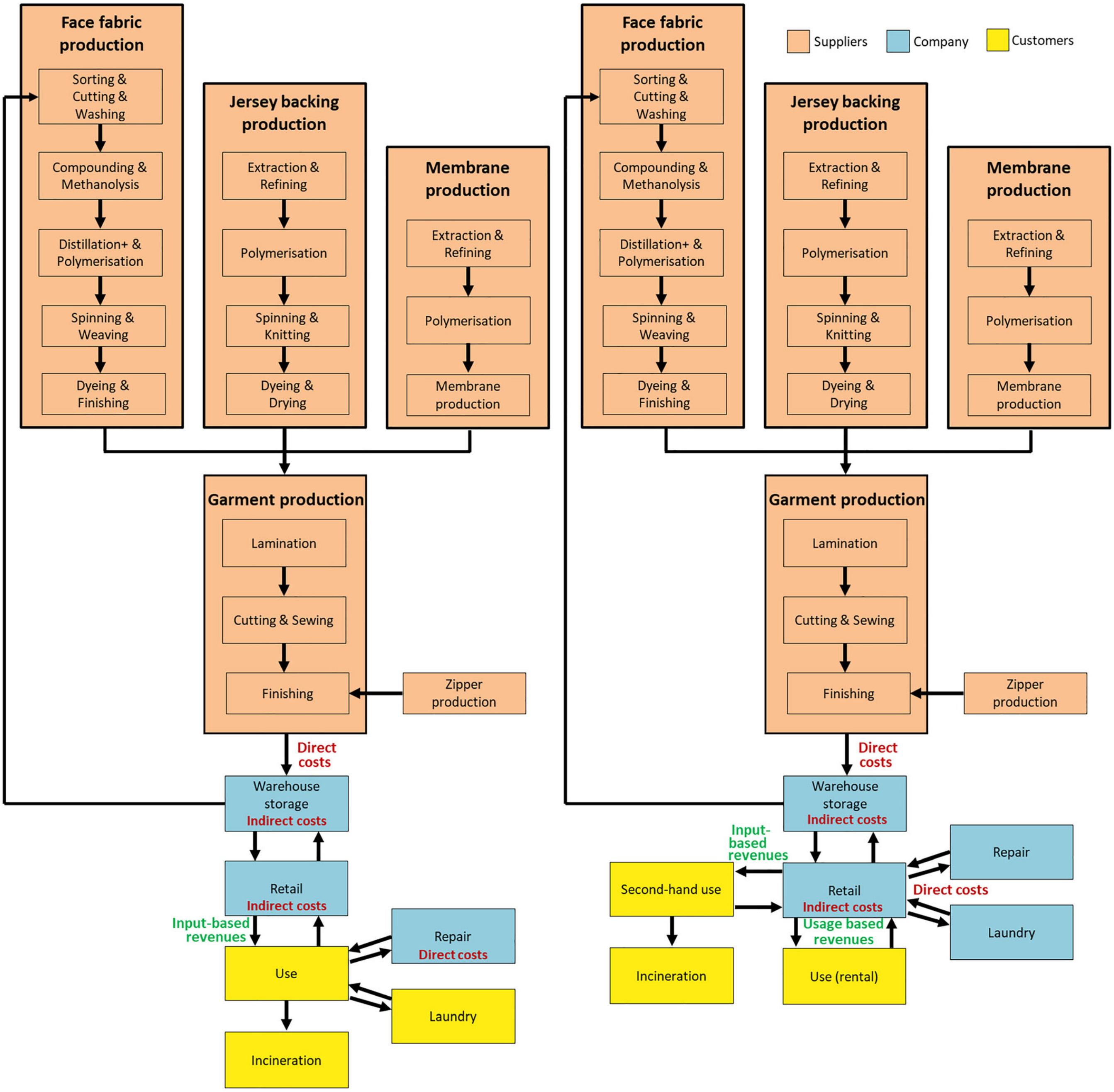

FIGURE 2 The socio-technical product system for jackets, representing a sales business model (left) and a rental business model (right). Arrows represent material flows and colours represent different actors. Costs and revenues for the case company are indicated by red and green text, respectively. Some costs or revenues are associated with running a process like the warehouse, others stem from the exchange of material to/from another actor. In the latter case, they are indicated next to the corresponding material flows [Colour figure can be viewed at wileyonlinelibrary.com]

the required number of transactions and volume of production for achieving a certain level of profitability for each BM. The first step was to define a profit-based functional unit, defined as 'a certain amount of profit, π, over a business period of 30 days, from transactions involving the studied jackets'. To achieve this, the money flows and other economic parameters were defined and calculated or estimated. The adopted cost structure for both BMs is presented in Table 4.

The numerical economic data are summarised in Table 5. Notable parameters include the 'rental efficiency' (E_r), which describes the share of garments in the rental stock rented by customers at any given time. It depends on the time required for maintenance activities and the overcapacity of the stock needed to meet fluctuating demand. Another key parameter is the rental lifetime (*RL*), which is how many use days a jacket can provide before being worn out and removed from the rental stock. The removed jackets are sold second-hand at

TABLE 2 Description of the processes included in the technical system of the jacket represented in Figure 2

Processes	Description
Face fabric production	The polyester face fabric is produced by chemical recycling of used garments. First, collected garments are sorted, washed and shredded; then, the shreds are chemically depolymerised to dimethyl terephthalate (DMT) through a compounding and methanolysis process. A distillation process separates out the DMT, which is then polymerised back to polyester (PET). PET granules are melted, spun into a yarn and woven into a fabric. Finally, the fabric is dyed and finished with a durable water repellent.
Backing production	The knitted jersey backing is made of polyester based on crude oil. Oil is extracted, refined and processed to DMT, which is polymerised to PET granules. Melt spinning and yarn spinning transform the granules into a yarn that is knitted into a fabric and then dyed and dried.
Membrane production	The membrane is made of polyester based on crude oil. Oil is extracted, refined and processed to DMT, which is polymerised to PET granules. Plastic film extrusion produces the membrane.
Other components	The zipper is assumed to be made from polyester, modelled as an amount of virgin polyester granulate input.
Garment production	The face fabric and membrane are laminated together and then, together with the backing, cut and sewn before adding tape and zipper.
Distribution	External distribution includes transport of textile from the producer in Japan to the garment manufacturer in Estonia by freight cargo ship and truck. From there, finished jackets are transported to Sweden by truck and ferry. Internal distribution includes truck transport between warehouse and stores.
Customer transport	For every transaction in the sales model, customers make a round trip to the store by car, bike, walking or public transportation. Two round trips are made in the rental business model, to pick up and return rented jackets.
Laundry	In the sales business model, users launder the jackets in residential washing machines. In the rental business model, the company launders the jackets after every rental transaction, using residential washing machines.
Repair	Repair activities include sewing or replacing faulty components (e.g., the zipper).
End of life	End-of-life jackets are either returned to the company or shipped by freight cargo ship to Japan for recycling, or customers dispose of them through incineration. All collected jackets are assumed to be chemically recycled into new face fabric. Since not all jackets are collected, the recycling has to be complemented by virgin polyester production.

60% of the original price, and the rental stock is replenished by adding a newly produced jacket.

In the study, the functional unit was defined as the monthly profit from the jackets. The functional unit was quantified based on the collected economic data for the sales model, together with the monthly sales volume, estimated at 200 transactions per month ($t_s = 200$ transactions). As shown in Table 6, the monthly profit, π_s, amounts to 319,391 SEK. This translates to a physical flow of 200 jackets per month, since, in the linear model, the number of sold jackets equals the required production ($q_s = 200$ jackets).

Stipulating the same profit for the rental BM allows calculation of the required number of rental transactions (t_r) and thus the number of jackets produced (q_r) in the rental model. Considering that revenues minus costs should add up to the profit, π_r, the following equation can be set up:

$$\pi_r = RE_r + RE_{r,2nd} - C_{prod} - C_{distr} - C_{OH} - C_{emp} - C_{laundry} - C_{repair} - C_{EoL} \quad (1)$$

Some costs and revenues depend directly on the transactions, t_r, while the rest depends on the number of jackets produced (q_r), or the number of stores (N_r). However, each revenue and cost can be expressed in terms of the rental transactions, t_r, by expressing the relations between t_r, q_r and N_r by means of a coupling factor (f) for each cost or revenue. These are derived in Appendix S2 and are summarised in Table 7. The coupling factors enable us to rewrite Equation 1 as the following:

$$\pi_r = (f_1 + f_2 - f_3 - f_4 - f_5 - f_6 - f_7 - f_8 - f_9) * t_r \quad (2)$$

Solving Equation 2 for t_r gives the number of transactions required to reach the profit defined as the functional unit. The corresponding number of new jackets produced, q_r, needed to replace those sold second-hand can be derived via the following relation between t_r and q_r (detailed in Appendix S2):

$$q_r = \frac{U_r}{RL} * t_r \quad (3)$$

The results of the coupling phase are summarised in Table 8. The number of transactions and amount of production for each BM are the parameters fed into the subsequent phase, the LCI.

3.3 | LCI and impact assessment

The number of transactions and the required amount of production in each BM were used to build the LCI, perform the LCIA and interpret the results. Conventional LCA methodology was applied using OpenLCA software.

For the LCI, data were collected as described in Section 2.2. A life cycle model was built by considering all environmentally relevant flows, scaled according to the defined functional unit. Detailed LCI and the related data sources and modelling choices are presented in Appendix S1.

TABLE 3 Sources for collected data and modelling; (1) Scientific literature; (2) LCA databases; (3) online tools and (4) personal communication with experts (4a, researcher at RISE; 4b, repair shop specialist; 4c, case company representatives)

	1	2	3	4a	4b	4c
Economic data and business model set-up	X					X
Inventory data on face fabric	X	X		X		X
Inventory data on jersey backing		X				X
Inventory data on membrane		X				X
Inventory data on other components		X				X
Inventory data on garment production	X	X				
Inventory data on distribution		X	X			X
Inventory data on use phase	X		X			X
Inventory data on laundry	X					X
Inventory data on repair					X	
Inventory data on end of life		X	X			X
Inventory data on background processes		X				

TABLE 4 Cost and revenue categories and their assigned symbol and description

Monetary flows categories	Symbols	Descriptions
Input-based revenues	RE_s	Total revenues generated by customers paying for a new jacket in order to obtain ownership
	$RE_{r,2nd}$	Total revenues generated by customers paying for a second-hand jacket in order to obtain ownership
Usage-based revenues	RE_r	Total revenues generated by customers paying for the use of a jacket
Production costs	C_{prod}	Total aggregated cost that includes the production of textile fibres, manufacturing and transportation[a] costs
Distribution costs	C_{distr}	Total cost for distributing jackets from the central warehouse to company stores
Laundry costs	$C_{laundry}$	Total cost for washing jackets
Repair costs	C_{repair}	Total cost for repairing jackets in case of damage
End-of-life costs	C_{EoL}	Total cost for the transportation of collected jackets to the chemical recycler in order to recover material for the fibre production for new face fabric
Employee costs	C_{emp}	Total cost incurred to pay employees who operate the stores and to cover social fees
Overhead costs[b]	C_{OH}	Total cost for recurring expenses, e.g., rent, utilities and storage

Note. Purple is relevant only for the sales business model, and blue only for the rental business model.

[a]Refers to transport between the external suppliers and the company's warehouse.

[b]Overhead costs are considered as semi-fixed and independent of sales volume, until a level is reached where, for example, a new store has to be opened.

The LCIA results were generated for all ILCD 2018 midpoint impact categories (Hauschild & Huijbregts, 2015) and are presented in Figure 3. Compared to the sales model, the rental model resulted in lower scores in most impact categories, although some were considerably higher. Among the higher scores were those for the ozone layer depletion impact category, owing to customer transport by car and related petroleum production. Laundry and public transportation in the rental case also resulted in comparatively higher uses of electricity, which in Sweden is largely based on hydropower and nuclear power production, causing a deterioration in the scores for freshwater use and ionising radiation. In addition, scores for resource use in terms of metals and minerals and land use were higher in the rental model, mostly due to the amount of road construction required.

However, it was difficult to determine what impacts were most significant for the overall environmental performance from such detailed results. Moreover, the results did not permit a straightforward ranking of the BMs. Weighting was thus employed. Application of the ReCiPe (H,A) and the ecological scarcity endpoint methods showed that renting reduces overall impacts by 33% and 22% respectively and that the dominant impact category was climate change (for details, see Appendix S3).

Figure 4 shows the impact scores for climate change across different life cycle stages for each BM. When comparing the sales and rental models, major impacts shifted from production to the use phase. Particularly potential impact from energy intense production processes like 'spinning and weaving' and 'dyeing and drying' was reduced in the rental model since fewer new jackets were needed. In contrast, the rental model gave an eightfold increase in potential impacts related to the use phase, mostly due to increased customer transport. Overall, however, the total score for climate change was 43% lower in the rental model, meaning that it represents a more decoupled business.

3.4 | Sensitivity analysis

A sensitivity analysis was performed to investigate the effects of changing selected business parameters, uncertain parameters and

TABLE 5 Values of costs, prices and parameters to calculate total costs and revenues and related physical flows

Symbol	Description	Values/parameters	Sources
k_{prod}[a]	Unit cost of production per jacket	2,500 SEK/jacket	Derived from the sales and an estimated mark-up margin of 50% (Locsin, 2021)
k_{distr}[a]	Unit cost of distribution per jacket	0.14 SEK/jacket	Estimated by referring to Maibach et al. (2006) and by considering the average distance of the stores from the warehouse (approximately 449 km)
$K_{laundry}$	Unit cost of laundry per transaction	70 SEK/transaction	Provided by the company
k_{repair}[a]	Unit cost of repair per transaction	8 SEK/transaction	Provided by the company
k_{EoL}[a]	Unit cost of recycling per jacket	18 SEK/jacket	Estimated by summing the distribution costs and the cost of shipping calculated on worldfreightrates.com by considering the distance between the warehouse and the external supplier
k_{emp}[a]	Unit cost per employee	39,300 SEK/employee	Estimated by considering the average salary of a shop assistant in Sweden (26,200 SEK/month) and adding social costs, estimated at 50% of the salary costs (Business Sweden, 2020)
k_{OH}[a]	Unit cost per store	5,000 SEK/store	Provided by the company
P_s	Price for buying a jacket	5,000 SEK/jacket	Provided by the company
P_r	Price for renting a jacket	600 SEK/rent	Provided by the company
P_{2nd}	Price for buying a second-hand jacket	3,000 SEK/jacket	Provided by the company
N_s	Number of stores	4 stores	Provided by the company
SS[a]	Storage capacity	50 jackets	Provided by the company
EPS	Number of employees per store	1 employee	Assumed
RL	Rental lifetime	200 use days	Provided by the company
R_r	Replacement rate	9.1% jackets per month	Derived
E_r	Rental efficiency	60%	Provided by the company
U_r	Average use days per rental transaction	5 use days	Provided by the company
CR	Collection rate	50%	Assumed
T[a]	Business period	30 days	Established

[a]Parameters valid in both the sales and in rental business model.

TABLE 6 Monthly revenues and costs in the sales model (30 is the conversion factor between months and days)

Revenue or cost category	Connection in equation form	Calculated revenues and costs (SEK)
Revenues from sales transactions	$RE_s = P_s * t_s$	1,000,000
Production costs	$C_{prod} = k_{prod} * q_s$	500,000
Distribution costs	$C_{distr} = k_{distr} * q_s$	28
Overhead costs	$C_{OH} = k_{OH} * N_s * T/30$	20,000
Employee costs	$C_{emp} = k_{emp} * N_s * EPS * T/30$	157,200
Laundry costs	$C_{laundry} = 0$	0
Repair costs	$C_{repair} = k_{repair} * t_s$	1,600
End-of-life costs	$C_{EoL} = k_{EoL} * q_s * CR$	1781
Profit (π_s)		319,391

parameters for dominant life cycle phases. The sensitivity analysis was done on the weighted results from the ReCiPe (H,A) endpoint method. The results for the baseline scenario, presented in the previous section, are shown at the top of Figure 5, while the sensitivity to selected parameters is shown beneath.

Figure 5 shows that results are highly sensitive to the rental price. With a 50% lower rental price, more rental transactions are needed to generate the same profit as the sales BM, reversing the ranking order of the BMs. Conversely, a 50% higher rental price makes the rental BM even more preferable than the sales model compared to the base case.

Also evident from Figure 5, a hybrid BM, where customers are able to buy the rented jacket at a reduced price, is less environmentally preferable than a sales BM. On the other hand, keeping the jackets in the rental business for longer and renting them until they reach the end of their technical lifetime reduce the environmental impact of the rental BM, albeit not significantly. In addition, the rental efficiency (i.e., the average proportion of jackets in the rental business being rented at a given time) significantly influences results by affecting the number of stores required to run the rental model. A low enough rental efficiency may even reverse the ranking between the BMs.

TABLE 7 Revenues and costs in the rental model (according to the cost structure presented in Section 3.4), connected to the number of transactions (t_s) by using the coupling factors derived in Appendix S2

Revenue or cost category	Revenue or cost expressed in terms of t_r	Coupling factor
Revenues from rental transactions	$RE_r = f_1 * t_r$	$f_1 = P_r$
Revenues from second-hand sales	$RE_{r,\ 2nd} = f_2 * t_r$	$f_2 = P_{2nd} * U_r/RL$
Production costs	$C_{prod} = f_3 * t_r$	$f_3 = k_{prod} * U_r/RL$
Distribution costs	$C_{distr} = f_4 * t_r$	$f_4 = k_{distr} * U_r/RL$
Overhead costs	$C_{OH} = f_5 * t_r$	$f_5 = k_{OH} * (T/30) * U_r/(E_r * T * SS)$
Employee costs	$C_{emp} = f_6 * t_r$	$f_6 = k_{emp} * (T/30) * EPS * U_r/(E_r * T * SS)$
Laundry costs	$C_{laundry} = f_7 * t_r$	$f_7 = k_{laundry}$
Repair costs	$C_{repair} = f_8 * t_r$	$f_8 = k_{repair}$
End-of-life costs	$C_{EoL} = f_9 * t_r$	$f_9 = k_{EoL} * CR * U_r/RL$

TABLE 8 Basis of comparison (profit level), number of customer transactions and jackets produced in each business model

	Sales	Rental
Profit (π)	319,391 SEK	319,391 SEK
Transactions (t)	200	1,108
Jackets produced (q)	200	28

Supplier choice can make a large difference in the sales model. If textile production is moved from Japan to Sweden, with a lower share of fossil fuels in the electricity mix, production impacts are reduced. If, conversely, textile production uses a high fossil electricity mix, in this case exemplified by production in China, the environmental impacts from production are increased. This is turn has a negative effect on both BMs, but to a larger extent on the sales model.

Another business-related aspect is the number of employees per store. Increasing the number from 1 to 1.5 employees per store has a moderately negative effect on the results for the rental model. Conversely, a decrease only slightly reduces impacts.

In addition to BM choices, the company can alter the product design, for example, by altering the quality of the textile. A fabric with a higher fibre density (75 dtex instead of 150 dtex) increases the environmental scores for the sales model, since more energy is required to achieve the higher density fabric. The rental model is only slightly affected because of the lower production volume. Using less energy-efficient laundry in the rental BM (washing twice as often, at 60°C with electricity with a high share of fossil fuels) has a moderately negative effect.

In summary, several internal aspects that the company can directly control significantly affect the results. Some of these were related to the BM set-up, such as rental price or supplier choice, while others related to product design and maintenance.

In addition to factors that the company can directly control, there are relevant external aspects that can only be indirectly influenced. Figure 5 shows that the results were highly sensitive to the customer's mode of transportation. This is much more important in the rental model, which involves twice as much transportation by customers as the sales model. When all customers drive cars (instead of the 20% in the baseline model), the impact scores for the rental model more than double, reversing the ranking between the BMs. Contrarily, when all customers use bikes (instead of the 20% in the baseline model), the environmental performance of the rental model is significantly superior to the sales model. In addition, the rate at which jackets are collected for recycling at end of life is under direct control of customers and can only be influenced by the company. As shown by Figure 5, the outcome of both the rental and the sales BMs are influenced by the collection rate to a limited degree.

3.5 | Recommendations for the case company

In answer to the questions posed in Section 3.1, the results of the BM-LCA show that the rental BM can lead to an overall better environmental performance compared to the sales BM while maintaining the company's profit level.

The environmental hotspot in the sales BM is the production phase, due to energy-intensive processes related to the large production volume, particularly regarding the face fabric. In the rental BM, the environmental impact is instead dominated by the use phase, mainly caused by the increase in customers' transport to pick up and return jackets.

The sensitivity analysis showed that the rental model does not unambiguously perform better, since some parameters strongly affect the environmental performance of the rental BM. While some of these are outside the company's control, they can still be managed. An example includes efforts to influence customer transportation habits towards sustainable transport modes. For the same reason, store location is an important factor within the company's control. Stores could, for example, be located close to public transportation.

Other business factors within company control include the option to offer hybrid forms of rental services (selling rented jackets). This option should be avoided since it leads to loss of potential revenues from repeated jacket rentals. The company should also set the rental price as high as possible, finding a balance between market considerations (e.g., demand and customers' willingness to pay) and sustainability ambitions. Similarly, the rental efficiency should be maximised.

4 | ANALYSIS

The results from the BM-LCA study are analysed and matched against the BM elements in Sommer's (2012) framework (see Figure 1) in

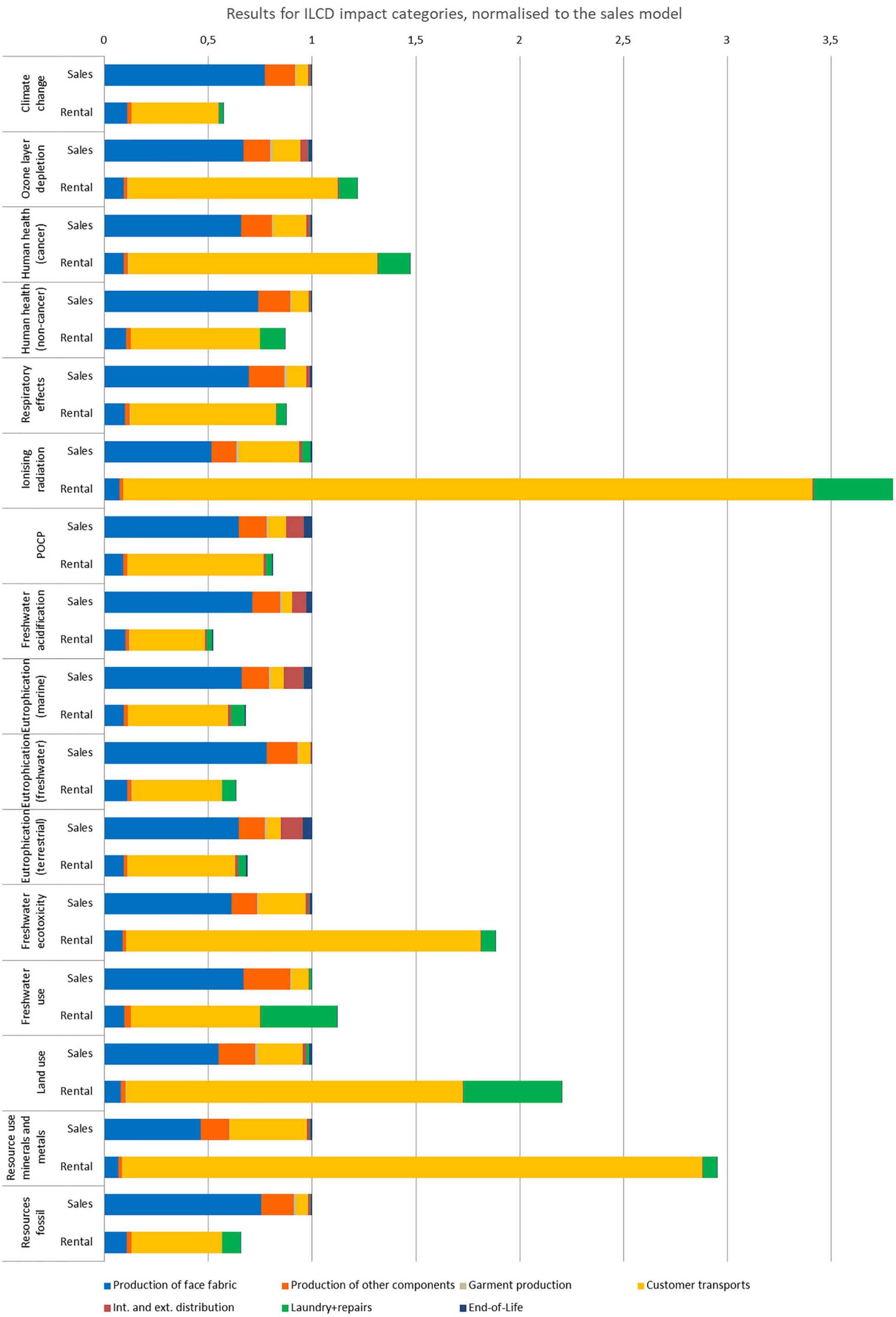

FIGURE 3 Impact scores per functional unit for eight different ILCD impact categories, normalised to the sales business model [Colour figure can be viewed at wileyonlinelibrary.com]

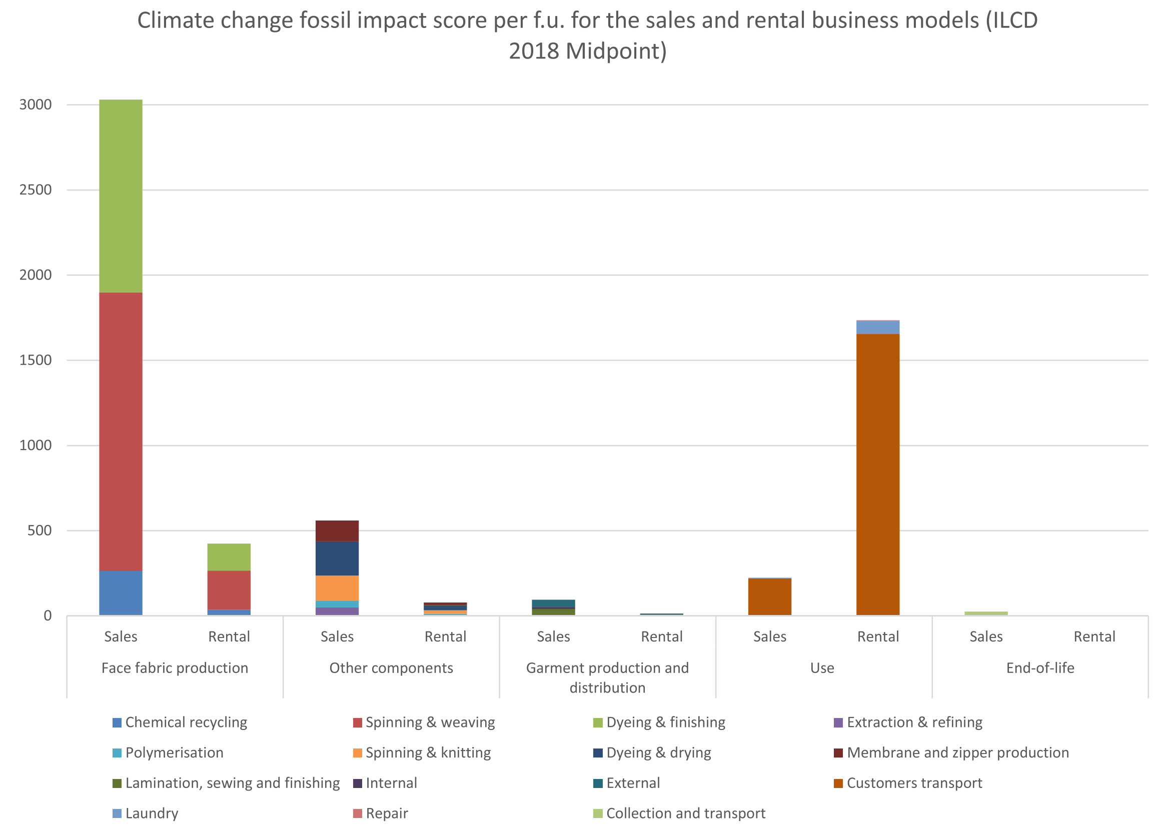

FIGURE 4 Impact score per functional unit for climate change, divided per life cycle phase [Colour figure can be viewed at wileyonlinelibrary.com]

order to identify the elements on which BM-LCA can provide information and guidance.

Pertaining to the target group component, the study showed that customer behaviour represents the major share of the environmental impact in the rental BM. Consequently, the choice of which customer segment should be targeted is of great importance when innovating a rental BM where customers have to travel to access the products. Alternatively, the company may need to develop channels and delivery systems that can prevent or indirectly reduce customer environmental impacts by influencing customer's transportation habits.

The BM-LCA study also provided information to the key resources and process components by indicating options for creating value. For the partnership and the technology elements, the BM-LCA identified and quantified the environmental impact of different external suppliers and associated electricity sources during textile production. Product features were also investigated in terms of fibre density, yielding different environmental outcomes. This relates to product design and the technological element in Sommer's framework. The BM-LCA also showed BM environmental performance was sensitive to key factors such as human resources: Additional employees strongly increased costs, which in turn affected the number of customer transactions necessary to achieve the same profit level, and consequently the number of garments produced. Primary activities such as laundry or repair were explored through analysing different efficiencies, for these activities can affect the overall environmental performance of the rental BM.

Considering the financial component of the framework, it should be mentioned that BM-LCA is a tool for environmental assessment and it is not meant to generate a financial analysis. However, the financial logic of a BM is built into the modelling via the quantification of revenues and costs and the coupling equations linking business and product systems. Moreover, pricing was found to be interconnected with other BM components.

More than addressing individual elements in Sommer's (2012) framework, the BM-LCA study enabled an investigation of interconnected BM elements. Two parameters that stood out were the price of the rental transaction and the rental efficiency. The price is commonly seen as an element of a BM value proposition. However, as demonstrated in the BM-LCA study, the rental price had cascading effects on other BM elements. For example, an excessively low rental price required a considerably higher number of customer transactions to achieve the same profit level. This, in turn, had knock-on effects on elements of product creation, that is, more jackets need to be produced, thus affecting the production volume as well as physical assets like the number of stores and personnel. Hence, the price level became a parameter that revealed the interconnections in the BM-LCA study between financial components and other BM elements. While the price level is commonly related to competitiveness within the business field, the BM-LCA showed that it also was relevant in relation to the environmental performance of the studied BM. Therefore, it could be an option for the company to consider new pricing methods aiming at both competitiveness and sustainability goals.

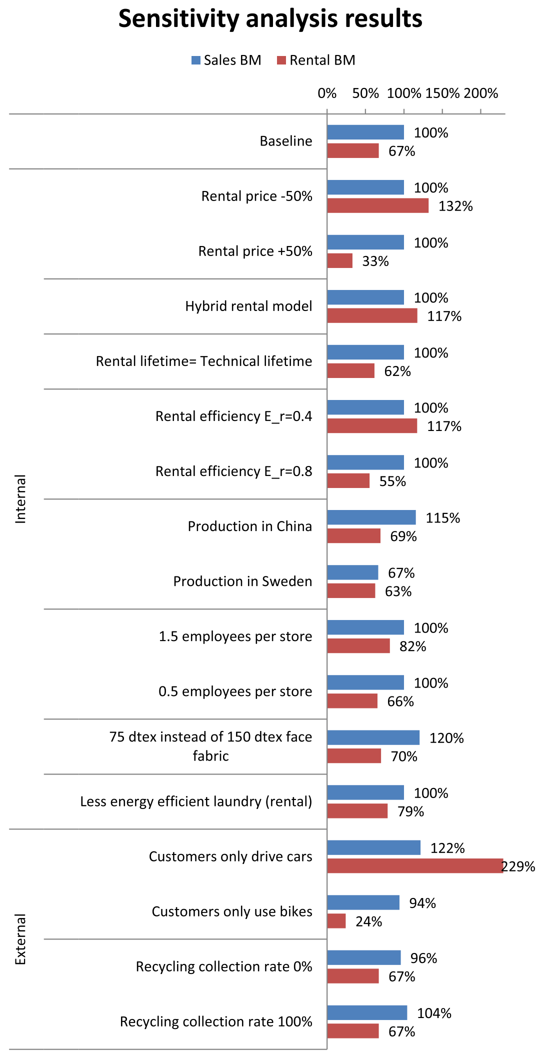

FIGURE 5 Sensitivity analysis with respect to selected parameters, shown as a single score from results from ReCiPe (H,A) endpoint and normalised to the baseline sales business model. The tested parameters are shown on the vertical axis, divided into internal and external factors, reflecting parameters that can be directly managed or only influenced by the company [Colour figure can be viewed at wileyonlinelibrary.com]

An analogous observation can be made about the rental efficiency. This parameter simultaneously affected several elements within key resources and key processes. A low rental efficiency entails more stores to achieve the same rental revenue. To compensate for added store costs, more rental transactions are required, which can in turn be translated into greater storage needs, more employees and more maintenance activities. Rental efficiency thus directly affects the key resources and processes in terms of physical assets, people, technology, and primary and support activities. It is thus also a parameter that revealed model relations between various BM elements.

From an understanding of interconnectedness between BM elements through a BM-LCA study, the method may guide innovation on the steering mechanisms element, that is, on the business logic so it can be adjusted for better environmental performance.

To summarise, BM-LCA applied in a comparative case of renting versus selling provided insights into individual BM elements, as well as their interconnectedness. Also, business parameters like price level and rental efficiency were shown to have direct consequences for the environmental performance of the BMs.

5 | DISCUSSION

The BM-LCA method was able to provide guidance on many BM elements (Sommer, 2012) for the case company. To further outline the usefulness of BM-LCA, the findings from the BM-LCA study are compared to relevant literature on related studies and tools and on sustainable BM innovation and business strategy.

5.1 | Environmental assessment results: BM-LCA versus LCA

The results from the comparison of renting and selling of jackets corroborate some findings from other LCA studies comparing renting and selling, but also add new ones. Here, the BM-LCA study shows that a rental BM can lead to decoupling of environmental impacts from profit, which represents a novel observation in the literature. Previous studies have found that rental BMs provide environmental benefits (Kerdlap et al., 2021; Martin et al., 2021; Roos et al., 2015; Zamani et al., 2017), but without considering profitability in their assessments.

Previous studies have also shown burden shifting from the production to the use phase due to differences between a sales and a rental BM. Different authors identify different key factors behind burden shifting. Bech et al. (2019) and Piontek et al. (2020) pointed to the importance of prolonging the lifetime of products for better environmental performances. Kerdlap et al. (2021) and Martin et al. (2021) highlighted more efficient maintenance operations. Martin et al. (2021), Roos et al. (2015) and Zamani et al. (2017) found customer behaviour key for determining environmental benefits from use-based PSS. What is different with the present study is that it identified business factors as key for environmental performance. While our findings agree that customer behaviour is an important factor, alongside product design choices and efficient processes, we found that factors relating to business parameters, such as rental price and rental efficiency, had greater significance. The greatest impact reduction occurred when revenues were increased by repeated transactions involving fewer products and when reducing the impact of customer transportation. The BM-LCA method is thus less sensitive to product characteristics on their own because the significance of business parameters is also shown.

The novel findings were made possible by the fundamental methodological difference between LCA and BM-LCA: BM-LCA integrates the monetary flows of a BM and the physical life cycle flows of the product through a profit-based functional unit (Böckin et al., 2022). Conventional LCA lacks this methodological feature. Even so, several LCA studies are presented as environmental assessments of BMs. We found these to be conventional (product-centred) LCAs, and the explored differences in BMs were differences in product designs assumed as consequences of the BMs. These studies still take product function, not BM, as the basis for comparison and are without quantified business economic analyses.

This comparison of results from LCAs and BM-LCAs points to a need for understanding how different life cycle methodologies differ in scope and meaning.

5.2 | BM-LCA versus other life cycle methods in a company context

Life cycle methods have an important role to play for companies, especially when most environmental burdens occur outside firm boundaries, with outsourcing rendering them nearly 'environmentally weightless' (cf. Welford, 2003). Since the introduction of LCA in the early 1990s, different life cycle methods have been developed to support efforts in companies towards environmental sustainability, each with a different purpose. What they have in common is that they link a company to its use of natural resources and polluting emissions, but do so from different perspectives (product, BM, company) and with different analytical possibilities (technical, economic). Here, we discuss BM-LCA relative to three other life cycle methods. However, we exclude life cycle methods that build on monetarising environmental impacts in LCA as these capture externalities and have little to do with private costs (Baumann et al., 2022).

First, conventional LCA can, for example, be used as internal management tool for product innovation (Buxel et al., 2015; Moro Piekarski et al., 2013). Another method called organisational LCA (O-LCA) can be described as an aggregation of the LCAs for all the products of the company. It produces a compilation and evaluation of all inputs and outputs of a company and their potential life cycle environmental impacts (UNEP/SETAC, 2015) and is intended for future implementation of the life cycle concept in environmental management systems and the development of organisational footprint metrics (Martínez-Blanco et al., 2020). This means that O-LCA can be used for describing the life cycle environmental performance of a company, but without the economic component found in BM-LCA. It is thus less suited for environmental analysis of BMs even though it can provide valuable insights for a company. A third method is activity-based costing LCA (ABC-LCA) (Jourdaine et al., 2021). It links LCA to economic parameters but is not a business-centred approach since its object of analysis is on the product and, consequently, focuses on product-related costs. In comparison, such costs are part of BM-LCA, but alongside revenues and profit levels.

The current study provided several insights that clarify the relationship between conventional LCA and BM-LCA, both strategically, analytically, and perhaps also practically. Although conventional LCA can be used for product innovations and BM-LCA for BM innovation, the two are related strategically. Product design strategy is a key element of a company's business strategy, but not the only element. The business-related scope of BM-LCA therefore increases its relevance to business strategy compared to conventional LCA. Analytically, BM-LCA could be seen as an extension on conventional LCA. A BM-LCA could be modelled by building on a conventional product LCA by adding the BM around the product to it. Also, while LCA describes product environmental impact from the functional perspective of a user, BM-LCA switches perspective to that of the business company by calculating the number of products needed for a BM to be economically viable. BM-LCA thus scales a conventional LCA to the required profitability level of a BM. Practically, BM-LCA could be conducted through constructive collaboration between business and LCA analysts. Where the LCA analyst contributes with a conventional LCA and the business analyst with data on cost and revenue streams, the two can join forces for working out the coupling equations that link monetary and physical flows for BM-LCA. Such collaboration aligns with observations of successful innovation of CBMs in incumbents (Santa-Maria et al., 2021): These were developed in multidisciplinary teams where a life cycle perspective was common.

Conventional LCA, O-LCA and ABC-LCA may represent methods that are simpler than BM-LCA to work with. However, out of these life cycle methods, only BM-LCA takes the BM as object of analysis and has greatest capacity to produce insights for decoupling within a business practice. For a more exhaustive account of the use and practicality of each life cycle method, further systematic comparative research is needed.

5.3 | Comparing guidance to BM innovation from LCA, BMC and BM-LCA

In Section 4, the findings from the BM-LCA study were related to the framework of Sommer (2012). Here, using the same framework, we compare BM-LCA with conventional LCA and the BMC.

Figure 6 shows the type of contribution from the three methods to different BM elements. The range of elements on which LCA provides guidance is limited. This is because, as discussed in Section 5.1, conventional LCA attempting to analyse BMs still focuses on the technical system. Consequently, LCA can only provide guidance for BM elements relating to product design choices and related technical processes (e.g., production, distribution, transport and use), which only affect the key resources and the key processes components of the framework.

Compared to LCA, BM-LCA provides guidance on a broader range of BM elements, including their interconnections. Moreover, BM-LCA can provide quantitative guidance to BM innovation since the method quantitatively can test parameters (e.g., price levels) to identify intervals within which the parameter can vary without compromising the overall environmental performance of a BM. In other words, the method can guide a company towards environmental sustainability based on quantitative evidence and in relation to the company's profitability goals. This ought to be a welcome possibility for LCA experts since life cycle work is often in search for a business case (Nilsson-Lindén et al., 2019).

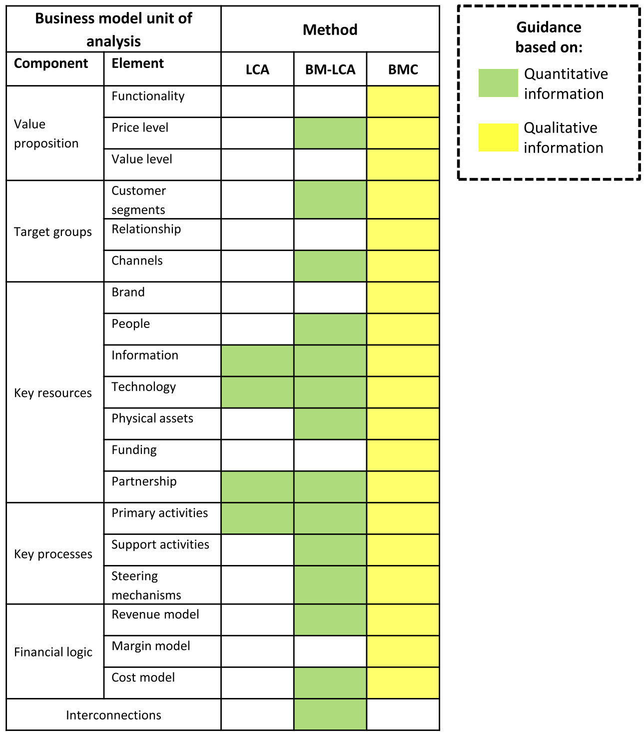

FIGURE 6 Overview of how LCA, BM-LCA and the BMC can support business model innovation for sustainability by providing guidance related to different business model elements. Guidance can be based on quantitative or qualitative information [Colour figure can be viewed at wileyonlinelibrary.com]

The BMC and its derived tools are commonly used in early stages of BM innovation for sustainability to systematically and conceptually consider all components of a BM unit and identify potential innovations. In contrast to BM-LCA, the BMC tools enable companies to pursue innovations for sustainability through qualitative analysis of the components and elements of a BM. However, the BMC tools seem to be limited with regard to identifying interconnected BM components and evaluating the consequences of these interactions. This limitation is partly due to the qualitative nature of BMC tools but is also related to the approach being intended for the design phase. BMC tools may provide a systematic approach by taking into account all BM elements, but lack in terms of being systemic, which is fundamental for identifying interconnections and feedback loops between different BM components. In other words, while all BM components are considered by BMC tools, they are treated in a disaggregated manner as if they were independent of each other. In comparison, the BM-LCA covers fewer components of the BM unit but instead identifies and quantitatively measures and models the magnitude of the interconnections.

In summary, as indicated by Figure 6, BM-LCA fills a place between conventional LCA and BMC tools. On one side, BM-LCA expands the capabilities of LCA to investigate BMs and provide guidance on a broad range of elements. On the other, compared to BMC tools, BM-LCA can provide recommendations based on quantitative modelling instead of qualitative considerations.

5.4 | BM-LCA supporting BM innovation and business strategy

BM and business strategy are inextricably linked, and simultaneous attention to both is needed for the long-term success of a company (Braun et al., 2019; Shafer et al., 2005). A discussion about the usefulness of BM-LCA for BM innovation has thus bearings on business strategy.

The BM captured by BM-LCA is, in the words of Timmers (1998), the 'architecture' of how a company makes money, while business strategy is about how the company stays competitive on the market (Magretta, 2002). Business strategy adapts to market trends and societal changes, and the BM 'structures' the value process so that it provides value to customers and collects a portion of this in revenues to the company. A company's BM is thus never finished (Teece, 2010). Companies use business strategy when they select what BM to compete with and when to change or innovate their BM. Vice versa, a BM can be used for testing strategic options for the company (Braun et al., 2019; Shafer et al., 2005; Teece, 2010). Because of their interplay, BM-LCA emerges as useful to business strategy too.

If a business strategy builds on competing with environmental qualities, there is need to check how the BM performs environmentally to ensure that excessive green claims (greenwashing) are not made inadvertently. Many have called for methods that measure and validate the environmental performance of BMs (Bocken et al., 2021; de Giacomo & Bleischwitz, 2020; Schaltegger et al., 2016). We claim that BM-LCA addresses this need. The method can not only produce an overall measure of the environmental performance of a BM (see Figures 3 and 4) but can also provide strategic insight in two additional ways: via the sensitivity analysis and the actor analysis.

In the current study, the company had a strong sustainability profile. At the outset, there was a notion that a rental BM was environmentally preferable to their linear sales model. However, this notion got called into question since the sensitivity analysis showed results to be highly sensitive to how customers transported themselves to the stores (see Figure 5). Since customers' transportation is outside the company's direct control, it becomes difficult to credibly promote the rental model as environmentally superior. To continue with the rental model, further BM innovation was found necessary. Several tactical choices are made when developing a BM (Reim et al., 2021), and BM-LCA can analyse many of these to see if they effectively result in better environmental performance. Many such choices, for example, rental lifetimes, rental price levels and sourcing choices, were explored in the current study, and findings were fed into the company's innovation and strategic processes.

Options for a more sustainable BM are numerous, but not all have strategic fit (Santa-Maria et al., 2021) and choices made should aim for the BM best suited to the prevailing situation (Reim et al., 2021). When considering how the company can influence environmental impacts from customer transportation, business managers could draw on the actor analysis inherent in BM-LCA. It identifies the company and its interactions with other actors in the life cycle model (see Figure 2) and enables business managers to see if options are within the company's direct control or within a sphere of influence in the product system. Instead of solely letting customer behaviour determine transportation environmental impact, business managers could influence these impacts by considering location choices for stores and market communication to customers.

With increasing societal demands for environmental sustainability and for decoupling, all BMs are called into question. Paraphrasing Shafer et al. (2005), the probability for a company's long-term success with the greening of its business strategy likely increases when it systematically analyses the environmental impacts of its strategic and tactical choices through its BMs. BM-LCA provides a means for such systematic analysis. The method can direct BM innovation by identifying the parts of a BM in greatest environmental need of innovation and the options within the company's control, but determining which options have best strategically fit is outside the scope of the method. Even so, the method can assist with an environmental evaluation of choices and validate the environmental performance of a preferred BM configuration.

5.5 | Future research

BM-LCA is a new, yet promising method, and the current study is the first of its kind. There is thus considerable scope for more research. To begin, BM-LCA need to be further applied and tested on different types of BMs and in different industry sectors. This could be combined with studies of how the method contributes in practice to different business processes and comparisons with related methods.

More methodological research is also wanted. Better understanding of how the method behaves, for example, in relation to longer timeframes or different forms of decoupling could help develop simpler tools appropriate for business practice. Also, how social sustainability is reflected in BM-LCA is welcome since sustainable BMs are expected to create value not only for customers and business but also for society at large.

BM-LCA represents a complex multidisciplinary synthesis, and business and LCA scholars could merge their expertise through it. We hope the method will attract collaborative efforts and inspire new research on the environmental sustainability of business and economy.

6 | CONCLUSIONS

This article presents the first application of a new business-oriented LCA method, BM-LCA, and discusses benefits and usefulness of the method for BM innovation for sustainability. We contend that BM-LCA is a response to frequent calls for methods that can measure and validate the environmental performance of BMs.

BM-LCA was applied to a case comparing rental and sales BMs. The assessment showed that a rental model can lead to decoupling of environmental impacts from profit compared to a sales BM. This is the first time, to our knowledge, that decoupling has been shown at business level. Application of BM-LCA provided relevant and important insights for BM innovation for the company since the method was able to identify both key business and technical parameters affecting the environmental performance of BMs. Particularly rental price level and rental efficiency together with customer transport behaviour proved to be critical for ensuring an environmentally sustainable BM and should be managed carefully in the innovation process. This represents an important contribution since previous similar LCA studies have emphasised technical factors.

BM-LCA is a methodological innovation on LCA. The essential innovation is a coupling of the product system to the business system around the product, thereby switching the perspective taken in an LCA, from a product and user perspective to a business and company perspective. This methodological innovation has relevant implications for business strategy and BM innovation.

Using BM-LCA, a company can assess a BM to identify whether or not it effectively improves the environmental performance without losing profitability and determine if it selects that BM to compete with. In an economic environment where many companies compete with green intents, BM-LCA can be used to validate the sustainability of a particular BM for a specific company, thereby help avoiding greenwashing and strengthening the credibility of its environmental claims.

With increasing societal demands for environmental sustainability and for decoupling, all BMs are called into question. The method enables a company to identify the parts of a BM in greatest need of environmental innovation and evaluate the environmental effectiveness of the options within the company's control. This means that a company can test its strategical and tactical options through the BM and innovate it for environmental sustainability.

Analysis showed that BM-LCA produced insights on both individual and interconnected BM elements. This makes BM-LCA a useful tool for companies pursuing BM innovation for sustainability. Its capacity to provide quantitative information on a wide range of BM elements places it between conventional LCA and BMC. In comparison with other company-oriented LCA tools, only BM-LCA provides environmental evidence on BMs.

Although BM-LCA shows promise as a missing link for win–win solutions, more research is wanted. Especially, application and test of BM-LCA on different BMs is needed. We envision the practical application of BM-LCA through joint efforts of business and LCA analysts, who could merge their expertise through it. Hopefully, the method will inspire new research that supports the environmental transformation of business and economy.

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