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Can rental platforms contribute to more sustainable fashion consumption? Evidence from a mixed-method study

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ABSTRACT

This study presents a case study of fashion rental platforms in Canada, drawing upon two unique, yet complementary, datasets: a qualitative analysis based upon semi-structured interviews with the rental platform entrepreneurs and a life cycle assessment (LCA) of 11 garment designs simulating garments offered by the platforms. Fast fashion has not only made garments more accessible to all parts of society, but also made them more disposable. To counteract the sustainability issue of fashion, rental platforms are emerging as a potential solution. While fashion rental platforms are often described as being "sustainable alternatives", their business practices and the quantitative impact remains largely untested. This study posed four research questions to address this gap: 1) How do fashion rental platform entrepreneurs see their contribution to enhance sustainability with their provided service?,2) What are the item purchase criteria of rental platforms and their relation to environmental sustainability of fashion consumption?, 3) How do factors such as garment type, season, fabric composition and style influence the greenhouse gas (GHG) emissions of a garment when owned versus rented?, 4) What are the research gaps between business practices and evidence of environmental impact? To answer these questions, we combined semi-structured interviews with rental entrepreneurs and an LCA. The interviews provided basic understanding in fashion rental operations and their reasons, which assisted in modeling the environmental impact of rented garments using LCA. As a result, qualitative findings indicate that rental entrepreneurs recognize provision of rental service itself contributes to sustainable fashion. From the LCA, the embodied GHG of garments varied significantly depending on the design and fiber content. When owning and renting were compared, rented garments had a greater life cycle GHG per piece when the garment is dry-cleaned. Also, the GHG emission per wear is tremendously reduced for garments that increase lifetime wear through renting such as dresses. Our mixed-method study suggests the need to further analyze the role of the garment category to consumer behavior, rebound effects, and garment design for rental platforms.

1. Introduction

Fast fashion is currently dominating the market environment, which implies that more garments are purchased than ever before, but worn for far fewer times. For example, in Canada an average of CAD$3430 are spent on clothing annually (Bedford, 2020), which equates to approximately 70 new items yearly or a 400% increase in garment purchases than only two decades earlier (CBC, 2017; Duggan, 2018; Lavin, 2020). The fast fashion phenomenon has not only made garments more accessible to all parts of society due to its cheap price points, but also made them more disposable, which is one reason why it is nicknamed 'throwaway fashion' (Bick et al., 2018; Blazquez et al., 2020; Chua, 2019). As a result, we have observed an increased underutilization of garments whereby 10 million tonnes of textiles end up in landfill in North America annually (37 kg per consumer), of which 95% could have been either recycled and/or reused (Sun, 2018), which is a significant and growing problem.

In order to overcome the challenges of the fast fashion paradigm, a range of collaborative fashion consumption (CFC) models have been proposed as potential solutions to this problem, claiming to be more

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sustainable options (e.g., Armstrong and Lang, 2013; Henninger et al., 2019; Iran and Schrader, 2017; Matthews and Hodges, 2016; Philip et al., 2015). CFC provides consumers with a range of alternatives to 'acquiring' garments, including swapping, sharing, and renting (Armstrong et al., 2015; Camacho-Otero et al., 2019; Iran et al., 2019). This article focuses on the latter, fashion rental platforms as one type of CFC. A growing range of relatively new online industry intermediaries which facilitate short-term access to garments as an alternative to ownership by renting garments to customers on a short-term basis, whether that be for a few days or for a month (Mukendi and Henninger, 2020). These platforms have gained popularity globally in recent years,[1] with notable examples including Rent the Runway in the US, My Wardrobe HQ in the UK, MsParis in China, GlamCorner in Australia (Lieber, 2020; Patterson, 2019), and airCloset in Japan (Henninger et al., 2021).

Industry commentators are increasingly reporting that "renting is a great way to be sustainable" (Horton, 2019), thereby echoing the rental platforms' ethos. To explain, many fashion rental platforms insist on supporting sustainable fashion through offering access to, rather than ownership of garments. While fashion rental platforms have the potential to reduce physical assets (garments) circulating in society by meeting consumer desires to access a variety of clothing without the need to own those items, thus far, the sustainability claims of rental platforms are largely untested (Armstrong et al., 2015; Piontek and Müller, 2018; Wahlen and Laamanen, 2017). One leading reason is the complexity of environmental impact of rental platforms, where both the business practices and consumer behaviors decisively influence the resulting impacts. For example, "intensifying the use of goods", "lifetime extension", and "use durable goods" are key criteria to environmental impact reduction via product rentals (Retamal, 2017; Tukker, 2004). These criteria can only be met when the platform operation and the platform users are aligned.

In the case of garments, fashion rental platform entrepreneurs' (thereafter, entrepreneur) selection of garments and consumer behavior have a direct implication on environmental sustainability. The life cycle environmental impact of garments is dominated by the manufacturing of garments that vary greatly by design, material composition, and thickness of the fabrics (Roos et al., 2016). Within fashion rentals, garment use may only be intensified when the entrepreneurs successfully select garments that as many consumers are interested in renting, and consumers wear them frequently with care. To clarify the environmental sustainability of fashion rentals, we need to understand entrepreneurs' perspective in the business operation with a focus on garment selection and quantify the environmental impact of garments that are offered on these platforms.

This research addresses this gap by posing the following research questions (RQ):

- RQ1: How do fashion rental platform entrepreneurs see their contribution to enhance sustainability with their provided service?
- RQ2: What are the item purchase criteria of rental platforms and their relation to environmental sustainability of fashion consumption?
- RQ3: How do factors such as garment type, season, fabric composition and style influence the greenhouse gas (GHG) emissions of a garment when owned versus rented?
- RQ4: What are the research gaps between business practices and evidence of environmental impact?

To answer these RQs, we applied a mixed-method approach of semi-structured interviews and a life cycle assessment (LCA). This study is contextualized within a broader, qualitative research project investigating the dynamics of fashion rental platforms in Canada.

[1] With the transition to working from home and the cancellation of many events, the first year of the Covid-19 pandemic had a significant impact on the fashion rental platform economy, with declining consumer spending on fashion, including rental (Brydges et al., 2021).

2. Literature review

In the context of increasing interest in sustainable fashion, a range of alternatives to fast fashion have emerged. CFC, which includes clothing libraries, swapping, peer-to-peer lending, and fashion rental platforms, is part of the sharing economy. The latter is based on the idea that idle capacities are shared with the end goal of maximizing the use of idle capacities, which here refer to garments. Technology and increased digitization have led to the development of the platform economy, which facilitates CFC, thereby making idle capacities more accessible (Henninger et al., 2019). The business models emerging as part of the sharing economy have often been described as 'disruptive', seeing as they change the way mainstream companies conduct their business, yet remain rather niche (Markides, 2006).

Although disruptive innovations may not be new *per se,* with prime examples (e.g., Airbnb - tourism industry; Uber - transportation industry) having been discussed in the literature (Botsman and Rogers, 2010), they remain a novel phenomenon within the fashion industry with one of the first fashion rental specific publications emerging in 2010 (Moeller and Wittkowski, 2010). Whilst rental platforms have established themselves in other industry sectors and become real alternative, due to often cheaper price points, local experiences, and locations, within the fashion industry they remain niche, as they are "interesting, innovative and relevant" albeit for "limited target groups" (Iran and Schrader, 2017). This could be explained due to the nature of the product and its associated/perceived risks (e.g., hygiene, health, lack of ownership) (Becker-Leifhold and Iran, 2018; Henninger et al., 2019; Lang and Armstrong, 2018).

A further noteworthy remark is the fact that most research focuses on consumer perceptions of and attitudes towards these rental services. They outline why consumers may engage in collaborative consumption practices and more specifically renting, or what potentially challenges might be that hinder these consumers to actively participate (Becker-Leifhold, 2018; Gnanamkonda et al., 2019; Lee and Chow, 2020; Park and Joyner Armstrong, 2019). Yet, the point of view of entrepreneurs who have set up these rental platforms seems to be lacking.

Within the literature, collaborative fashion business models are highlighted as 'sustainable alternatives', due to the fact they are designed to make use of idle capacities and thus enhance the maximum use of them. In doing so, it is argued that hyperconsumption, which emerged as a result of the fast fashion phenomenon due to low price points, could be overcome, as consumers are no longer owning, here garments, but rather gaining access (Hirschl et al., 2003; Philip et al., 2019). The assumption made here is not only that consumer may shop firsthand less often when changing to rental alternatives, but also that less products may need to be produced, seeing as the idea is to maximize the use of already existing garments.

Yet, a key question here is whether this is the case? Within the literature a majority of studies investigating fashion rental are either conceptual (Armstrong and Lang, 2013; Athwal et al., 2019; Battle et al., 2018; Hu et al., 2014), qualitative (Iran and Schrader, 2017), or quantitative (Becker-Leifhold, 2018; Ertz et al., 2018; Lee and Chow, 2020), with only a minority focusing on mixed methods (Armstrong et al., 2015; Gnanamkonda et al., 2019) and/or LCA of specific garments (Levanen et al., 2021; Piontek et al., 2020; Roos et al., 2015; Zamani et al., 2017).

To further outline the latter, Zamani et al. (2017) explored the environmental performance of clothing libraries through a comparative LCA of baseline (i.e., owning) and clothing libraries scenarios. Their study assessed three garments that are popular in Swedish clothing libraries: jeans, T-shirts, and dresses. With all three garments, their results showed potential environmental benefits (per garment use) of implementing clothing libraries if the garments' service life is

substantially prolonged. Similarly, Piontek et al. (2020) showed that the environmental benefits of fashion rentals vary depending on the extent of the lifetime wear of the garments compared to owning. Their study performed a comparative environmental impact assessment of fashion rentals in Japan and Germany targeting a T-shirt, a coat, a dress, and a kimono. For an infrequently worn and resource intensive garment, such as a silk kimono, renting was found to significantly reduce the environmental impact by the avoided production of new clothing. Moreover, Johnson and Plepys (2021) analyzed the effects of varying consumer behavior on the impacts of a dress rental in Stockholm through three functional units and 14 consumption scenarios. They found that wear time of garments, and whether the consumers use rentals to substitute their purchasing or use needs dictate the environmental benefits.

Previous LCA studies on fashion rentals shine a light on previously ambiguous reality of fashion rentals' sustainability claim; however, their coverage of garment types is limited when considering the diversity of garments in terms of design and fabric use. Table 1 provides an overview of past LCA studies of CFC, which indicates the most popular items explored are dresses, jeans, and T-shirts. Whilst instructive, a key question that emerges here is whether the garments identified are most commonly offered in rental platforms.

Moreover, these studies have investigated 'garments' in more general terms, thereby not made any distinctions regarding garment types (i.e., tops, bottoms, one-piece) and seasonality, which can have an impact on the wear frequency, fabric consumption, fabric used, and thus the overall GHG emissions. For instance, Piontek et al. (2019) assessed 10 distinct garment designs without distinguishing the fabric composition. Their study assumed that all garments have a fiber mix of 40% cotton, 40% polyester and 20% viscose except for jeans, which assumed to be 100% cotton. Fabric composition decisively influenced the environmental impact from its raw material acquisition and how the garments are maintained. Our study addresses this gap through examining garments that rental platforms offer.

Table 1
Overview of the LCA of collaborative fashion consumption.

	Assessed garment design					Functional unit
	Dress	Overcoat	Jeans	T-shirt	Others	
Zamani et al. (2017)	x		x	x		One average use
Piontek et al. (2019)	x	x	x	x	Jumpsuit, pullover, jackets, shirt/ blouse, skirt, and pants	One year of clothing consumption
Piontek et al. (2020)	x	x		x	Kimono	One average use
Johnson and Plepys (2021)	x					1) One average use 2) 4 years of consumer needs satisfied by purchasing 3) 4 years of consumer needs satisfied by use
Levanen et al. (2021)			x			One piece of garment

3. Materials and methods

This study applied a mixed-method approach of semi-structured interviews and an LCA to holistically examine the environmental implications of fashion rental platforms. Canada was purposely chosen, as the Canadian fashion industry is not only under-researched, but has also made proactive contributions to sustainability in the fashion industry (Brydges and Hanlon, 2020; Brydges and Hracs, 2019; Craig-Bourdin, 2019). Canada provides an interesting case, seeing as the country is connected to the USA and Mexico through the USMCA agreement, which replaced NAFTA (CBP, 2022), whilst at the same has strong connections to Europe (UK), through being part of the Commonwealth (Government of Canada, 2022). Thus, findings from this research could provide unique insights that have merits for both North America and Europe.

3.1. Survey and interviews to rental platforms

We conducted a comprehensive analysis of the fashion rental platform in Canada to assess the range of rental models available in the marketplace (as of spring 2019) as well as the range of garments available to consumers. The data gathering was initially completed through Internet searches. Table 2 shows a summary of the rental platforms surveyed. Parts of the search also allowed us to identify the garments available for rental on these Canadian rental platforms. Subsequently this data was used to determine the type and characteristics of garments to perform LCA, and to formulate consumer behavior scenarios. We identified and examined some of the most common garments available to rent by occasion (e.g., formalwear, workwear, and casual wear), fabric type (e.g., cotton, brocade) and garment type (e.g., dresses, tops, sweaters, outerwear, pants and more).

Secondary data gained was supplemented through conducting interviews with the founders of six rental platforms (a 50% response rate) to gain further qualitative insights into the dynamics hinged to fashion rental platform operations. Following an interview guide (see Supporting Information), interviews included questions pertaining to the business plans underpinning these platforms, the sustainability claims and practices of platforms, purchase criteria for rental items, and the demographics and motivations of platform consumers. Interviews were recorded with permission, transcribed verbatim and coded according to dominant themes (Crang, 2005; James, 2006).

The dominant themes were also analyzed with the six key criteria for environmental sustainability of product service systems (PSS) businesses

Table 2
Summary of the rental platforms surveyed.

Case	Founded	Garment specialization	Subscription or per item?	Physical Location
1	2009	Designer dresses	Per item	No
2	2010	Designer dresses and contemporary womenswear	Subscription and per item	Yes
3	2014	Designer dresses	Per item	Yes
4	2016	Designer dresses	Per item	Yes
5	2016	Designer dresses and accessories rental	Per item	Yes
6	2016	Peer-to-peer rental	Per item	Yes
7	2016	Designer dresses and contemporary womenswear	Per item	No
8	2016	Peer-to-peer rental	Per item	Yes
9	2017	Ethical clothing	Per item	Yes
10	2017	Designer dresses and contemporary womenswear	Subscription and per item	Yes
11	2018	Designer dresses	Per item	Yes
12	2019	Designer dresses and contemporary womenswear	Subscription and per item	Yes

(Retamal, 2017): 1) Use durable, quality goods, 2) Intensify use of goods, 3) Enable repair, take back and recycling 4) Ensure rental replaces product purchase, 5) Minimize transport of goods, 6) Reduce private vehicle kilometers traveled. PSS refers to "produce(s) and service (s) combined in a system to deliver required user functionality" (Baines et al., 2007) where renting a product is one type of PSS (Tukker, 2004).

From the interview results, we characterized a typical fashion rental platform in Canada and used this to set up the context in LCA. In turn, once we conducted the LCA, we interpreted the results through the lens of our qualitative data.

3.2. Life cycle assessment

To assess the environmental performance of fashion rental platforms, we calculated the life cycle GHG emissions of 11 garments when owned and rented using LCA according to ISO 14040/14044:2006 (ISO, 2006a; ISO 2006b).

3.2.1. Goal and scope definition

The goal of this LCA is to comparatively assess the environmental sustainability of various garments in rental platforms. To achieve the goal, we selected 11 distinct garments from the rental platform websites in Canada based on the diversity of the garment type, occasion, season, and fiber content as described in Table 3. These garment properties dictate the cradle-to-gate environmental impact of the garments and the consumer behavior in the use stage. We performed an LCA of 11 distinct garments consumed through fashion rental and the conventional consumption pattern of selling a new garment. The functional unit is to provide garments to the customers of rental platforms in the urban area of Canada with two reference flows: per piece and per wear. As Table 1 shows, past LCA studies used various functional units that provided different perspectives. The analysis based on "one garment [per piece]" provides an environmental perspective at product level, which helps to outline the contributions from the business practices of rental platforms. We also performed the LCA with "one average wear [per wear]" to analyze the influence of interventions to increase use frequency and prolong the service life of the garment through the rental model (Johnson and Plepys, 2021; Zamani et al., 2017).

The system boundary considered raw material extraction to the waste disposal of garments and their associated resource consumption. As Fig. 1 illustrates, the LCA considered the baseline scenario of owning and rental platform scenarios. We accounted for fiber and textile loss from the manufacturing of garments, but we excluded contribution from unsold garments due to its high uncertainty. In the baseline scenario, we assumed that consumers travel by car for 10 km roundtrip to purchase garments. According to Environics (2021) shopping centers are usually located between 0 and 20 km from the city center, and can be split into neighborhood, community, and power centers. Seeing as there are also high street shopping alternatives available that are closer than shopping malls, it was assumed that a 10 km roundtrip is a realistic assumption. The rental garments are transported to the doorstep of consumers by a delivery service, which is also assumed to be a 10 km roundtrip, for each, delivery and return, of garments. The waste garments are assumed to be landfilled for all fabric types. We excluded browsing and operation of the platform websites because their contribution is considered negligible to the life cycle of a garment, since individual energy use and carbon footprint of digital technology is generally limited (Itten et al., 2020).

3.2.2. Clothing LCA model and life cycle inventory data

To efficiently perform LCA of garments with distinct design, fiber content, and textile thickness, we developed a clothing LCA model as illustrated in Fig. 2. The model takes in seven input parameters from the life cycle stages of production, supply chain, and use. The garment production is characterized by selecting a garment design from 10 options in Table S1, fiber content from nine options in Table S2 shown in Supporting Information, and season from two options between winter and all seasons. The options of garment design and fiber content were selected from surveying the garment categories in the rental platforms. The season option defines the thickness of textiles, where the options were kept between winter and all season for simplicity. The input values for each garment design in production (i.e., season, fiber content) shown in Table 3 were gathered during phase 1 of the research.

Based on the physical characteristics of garments, we computed fabric consumption for each garment design, which is then used as an input value for LCA. The fabric consumption was calculated from a fabric length estimation guideline for a specific garment design and size by a fabric shop (Tissura, 2022). The size of garments assumed medium. Mathematically, weight of a garment (W) for each design and season was calculated with Equation (1):

$$W_{i,j} = \left(fab_{main,i} + fab_{lining,i}\right) * GSM_j \quad (1)$$

$$i \in \{10 \text{ garment designs}\}$$

$$j \in \left\{ \begin{array}{l} 150, \text{ for all season garments} \\ 250, \text{ for winter garments} \end{array} \right\}$$

Where fab_{main} is the area of main fabric [m^2], fab_{lining} is the area of the lining fabric [m^2], GSM stands for gram per square meter [g m2] and is the density of the textile. GSM was defined to vary depending on the fashion season. Strictly speaking, GSM is determined by the type of fiber, fiber thickness, and how densely the fabrics are woven. For simplicity, we differentiated between fabrics for all seasons and winter, and the values for GSM were set based on reviewing GSM of various fabrics from data collected in phase 1. We also weighed garments with different fiber contents, which suggested that our set GSM value to be in the range for the textiles designed for each season.

The life cycle inventory (LCI) was constructed from a commercial

Table 3
Target garments and their characteristics.

	Garment type	Occasion	Season	Fiber content	Wear-time [wear per lifetime]		Laundry [wear per wash]		Num of rentals [per lifetime]
					Owned	Rented	Owned	Rented	
1	T-shirt	Casual	all season	100% linen	52	105	2	5, dry clean	21
2	Camisole		all season	92% silk; 8% spandex (PE)	52	105	2	5	21
3	Sweater		winter	100% wool	12	105	3, dry clean	5, dry clean	21
4	Maxi dress, silk	Formal	all season	100% silk	2	73	1	1	73
5	Maxi dress, PE		all season	100% brocade (PE)	2	73	2	1	73
6	Trench coat	Work/dressy	all season	93% cotton; 7% spandex (PE)	24	105	6, dry clean	5, dry clean	21
7	Pants	casual	winter	50% wool; 50% PE	24	105	5	5, dry clean	21
8	Blazer jacket		all season	100% wool	104	105	20, dry clean	5, dry clean	21
9	Blouse		all season	100% PE	52	105	3	5	21
10	Midi dress		all season	98% cotton; 2% spandex (PE)	12	105	5	5	21
11	Midi skirt		all season	50% cotton; 50% PE	12	105	5	5	21

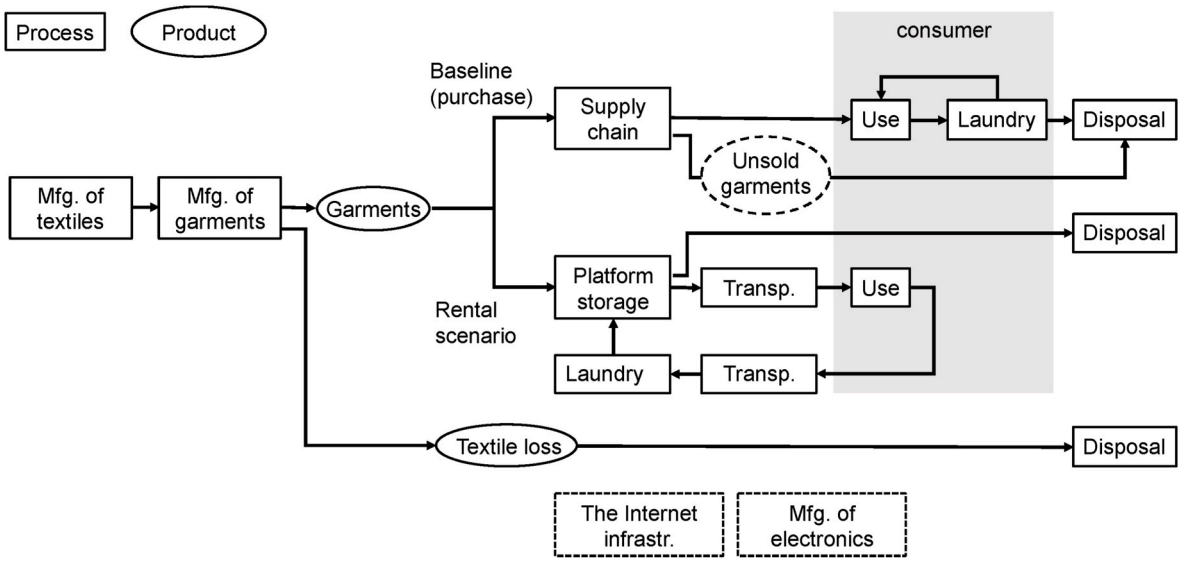

Fig. 1. System boundary of the LCA. The process and products with dotted line indicates that they are outside of the boundary.

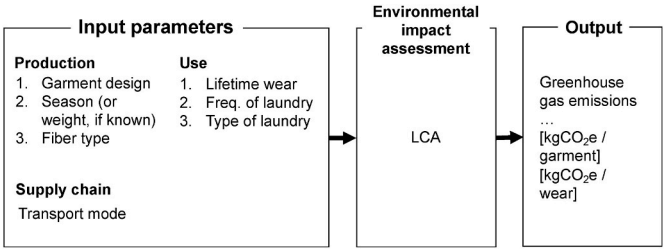

Fig. 2. Clothing LCA model.

inventory database and literature. The background data were obtained from the Inventory Database for Environmental Analysis (IDEA, v. 2.2) (Japan Environmental Management Association for Industry, 2010), which sets its boundary specific to Japan. While the absolute value of the LCA is yet to represent the condition in Canada, our analysis is valid for the purpose of comparing conventional consumption and rental platforms for distinct garment design. The LCI of textile products in IDEA is consistently built based on manufacturing in Japan. For brocade and spandex, we substituted polyester (PE) LCI because their LCI were not available in IDEA. Additionally, based on the nature of IDEA, the system boundaries of the textile LCI were not consistent among the different fibers. We constructed LCI of nine fiber types with a consistent system boundary; the details are explained in Table S3 in Supporting Information.

3.2.3. *Consumer behavior scenarios*

We developed consumer behavior scenarios for the 11 garments through a literature survey and interviews with the rental platforms. We set a specific frequency of wear [wear per lifetime], frequency of laundry [wear per wash], and type of laundry (wet wash or dry-clean) for each garment based on occasion, season, fiber content, and whether the garment was purchased or rented. The lifetime of garments was set as five years when owned, which referred to a study on active life of clothing in Norway (Laitala and Klepp, 2021). For rented garments, the lifetime assumed two years based on the interview in this study that fashion obsolesce typically occurs in 2 years. In the rental scenario, we assumed a 34-day cycle for casual/work clothes and a 10-day cycle for dress rentals because casual/work clothes are typically rented through a monthly subscription model, and dresses are rented for 3–4 days (Mukendi and Henninger, 2020). One cycle represents a flow of one rental including a buffer period. We set that the rented casual/work clothes are worn five times during a 30-day rental period based on an estimation that the rental users are likely to wear different outfits to work on weekdays and therefore the rented casual/work clothes are worn on a weekly basis. The formal wear rental assumed one wearing per rental.

4. Results and discussion

4.1. *Qualitative findings*

4.1.1. *Rental platforms in Canada*

We identified three primary rental models in existence in Canada: short-term dress rental, subscription rental, and peer-to-peer rental. The most popular business models are short-term dress rental and subscription rental platforms, with some platforms evolving over time to offer both models in order to appeal to a broader range of customers. These two business models made up an estimated 90% of the market, with the peer-to-peer rental market being far less common. An explanation could be the issue of monetizing this business model in the long term.

Short-term dress rentals present themselves as a solution to a practical problem: the need to buy an expensive, yet rarely worn, garment for a special occasion. Their service typically allows customers to rent a garment for 3–4 days. The subscription rental platforms have a tiered-membership service, where cost determines the number of garments that can be accessed in a month. These platforms are geared towards providing customers with access to a range of clothing at a lower cost compared to retailers, where the garments are largely casual to business casual styles. Lastly, peer-to-peer rental platforms act as intermediaries between individuals willing to lend their garments and those looking to rent.

In terms of the customer groups, fashion rental platforms in Canada were found to target a similar demographic: middle-class, working professional women between the ages of 25–55. The target customers are characterized by owning both work- and casual-wardrobes. Additionally, even though these platforms can be accessed nationwide, customers were predominantly located in urban areas.

4.1.2. *Platform entrepreneur's perspectives on environmental sustainability*

The interviews found that rental platform entrepreneurs consider their businesses to contribute to environmental sustainability through offering consumers a sustainable alternative to fast fashion. This finding

was consistent among the interviewees, which indicates entrepreneurs' awareness of the environmental problem of fast fashion as well as the current fashion industry. Platform entrepreneur 5 mentioned that *"the goal is to reduce fast fashion consumption"* where provision of fashion rentals would *"give people the freedom to try things without committing to it."* The quotes indicate that the entrepreneur anticipates fashion rentals to replace product purchase while ensuring consumers' freedom to access garments of their choice. Platform entrepreneur 9 made a comparable statement that they aim to make sustainable fashion accessible through pricing their services at an affordable rate. There appears to be a common understanding among the entrepreneurs that fashion rentals themselves can contribute to environmental sustainability.

Additionally, several platform entrepreneurs specified that offering fashion rentals is a way to educate consumers on sustainable fashion, as four platform entrepreneurs mentioned that sustainability is not a major driver for their customers. We found that the fashion rental platform entrepreneurs use the words such as *"responsibility to educate our customers"* (Platform 2) or "supporting *sustainable change in the [fashion] industry has become a mission"* (Platform 6), which indicates their belief that their businesses can educate consumers and disseminate the benefits of rental platforms for sustainability.

4.1.3. Business practices for environmental sustainability

Among the key criteria for a sustainable PSS, we found that the fashion rental platforms consider "use durable, quality goods" and "intensify use of goods/lifetime extension" in their business practices, but other criteria appeared to be overlooked. Our finding is comparable to that of the study by Retamal (2017), who analyzed PSS business models in Southeast Asia.

The first criterion is rather obvious for fashion rental platforms to meet because it has an immediate impact on their profit. The voices of rental platform entrepreneurs implied that they focus on renting durable and quality goods through selecting designer brands, and some entrepreneurs offered detailed characteristics of the garments that they select for rentals. Designer brands were believed to be more durable with higher quality, which could potentially withstand being worn by multiple users as well as being dry cleaned more frequently than when they are owned by a single consumer.

Offering designer brands also set themselves apart from fast fashion brands and position themselves in opposition to them, whilst also cultivate exclusivity and value. One dress platform entrepreneur (Platform 11) noted that designer labels are important in marketing, but what consumers care the most for is the fit, the quality, and the uniqueness of the garment; this rental platform provides access to *"something unique, that someone else isn't going to be wearing [at their event]."* Another platform entrepreneur (Platform 12) mentioned that while designer labels and fashion forward pieces are attractive for customers to consider fashion rentals, what people rented were in fact more classic-style pieces. Whether observation was made in other platforms is unknown, but we recognize the difference in the type of garments for marketing and to have consumers rent. Additionally, one rental platform (Platform 5) noted that frequently rented casual/workwear pieces have a retail price range between $150 and $350, which is above typical fast fashion brands but less than a designer luxury brand, and around $800 for formalwear. These price ranges of garments appear to incentivize consumers to rent.

In addition to selecting durable and quality goods for rentals, there were qualitative arguments that platform entrepreneurs discussed in regard to intensifying the garment use through rentals. "Intensify the use" for fashion rentals involve increasing the number of wears through the garment's life cycle relative to when the garment is owned. Such arguments were key for dress rental platforms, which several platforms point out how dresses are garments that are rarely worn when owned. Also, we found operational practices that would encourage consumers to rent and wear frequently during its rental period. Platform entrepreneur 11 explained about their styling services: *"I will help show someone how to wear the same dress seven days a week."* Another platform entrepreneur stressed that "offer[ing] garments that can fit a number of bodies, are seasonless, and can be styled from day to night" is important (Platform 12). Several platform entrepreneurs also sell previous stock at a discount, which provides an opportunity for garments to extend their lifetime.

Other criteria for environmental sustainability of PSS businesses were not explicit from the interviews. For instance, the interviewed platform entrepreneurs repair garments for normal wear and tear as needed but it is not an explicit service of the platform. We were also unable to identify how often such repairs occur. Moreover, platforms were generally not transparent about the disposal of rented garments; no platform entrepreneurs mentioned recycling their used garments. Another criterion that had limited discussion in the interview was in relation to transport of packages. The fashion rental platforms in Canada offer digital services, with few platforms also having physical retail locations where users can try on the clothes. Transportation is discussed in terms of making a rental platform cost efficient and ensuring delivery times. This point is particularly important for dress rental platforms where rentals are timed (typically 1–3 days) and need to ensure delivery. Canada is a geographically large country where punctual delivery can be challenging. Consequently, most rental platforms are in a major urban area (typically Toronto, Montreal or Vancouver) and cater to an urban clientele.

4.2. Life cycle assessment of rental platforms

4.2.1. Fiber types and design

Based on our LCA, we found a range of influences that the fiber types and garment designs have on the life cycle GHG of garments. Firstly, the cradle-to-gate GHG per kg-textile was found to vary greatly among the fiber types, as shown in Fig. 3. Silk and cotton have the greatest and the smallest GHG emissions, respectively. Our results are in alignment with past studies that animal-derived fibers have a higher environmental impact than other fiber types (Wiedemann et al., 2020). These fibers have distinct durability and calorific value, which influence the end-of-life emission and lifetime of the garment.

Furthermore, fabric consumption of garments exhibited a wide range. As shown in Fig. 4, the fabric consumption of garments has a range between 1.3 m^2 (T-shirt) to 4.6 m^2 (Maxi dress). Based on our estimates, the fabric loss of garments was between 15% and 40%. Dresses, skirts, and outerwear have a higher loss than others, which is understandable because those pieces are typically curvy and have complicated constructs that require a large fabric area. One study performed by textile manufacturers in Japan reported the fabric loss to be 20–30% (Ministry of Economy, Trade and Industry, 2003), and another study in Sweden reported that fabric cutting generates 15–20% of waste from the incoming material (Roos et al., 2015). Our results may be overestimated for mass produced garments since they would seek patterning efficiency. Nevertheless, we learned from our interviews that rental garments are dominated by designer brands, which implies a smaller scale of production than that of fast fashion. Our results also

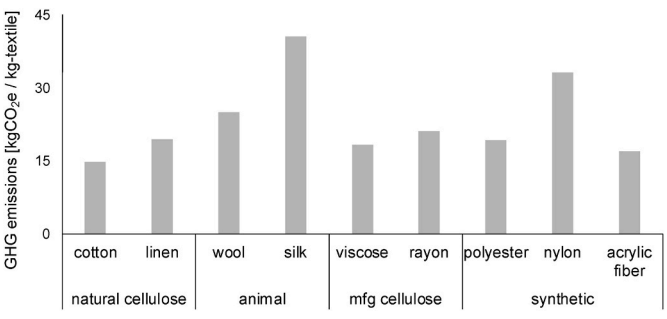

Fig. 3. GHG emissions of textiles by fiber types.

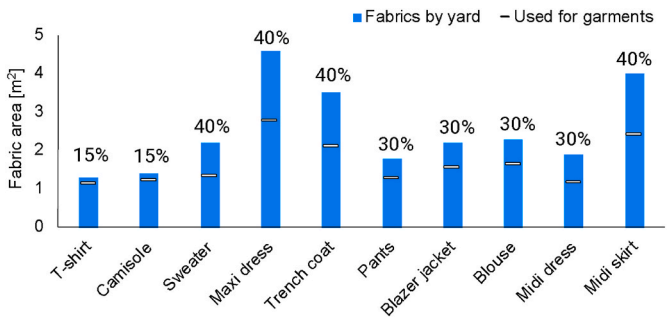

Fig. 4. Fabric consumption estimates. Percentage shows fabric loss estimates.

suggest that rental garments may have a greater cradle-to-gate GHG because the rental platforms offer design-oriented pieces that require greater fabric consumption than a basic piece.

4.2.2. Owning vs. renting

Our LCA results indicate that distinct conclusions for the environmental sustainability of rental platforms can be drawn with the functional unit of one garment and one wear. The result based on one garment in Fig. 5 (a) shows that garment designs requiring dry-cleaning (e.g., sweater, pants, and blazer jacket) have greater life cycle GHG emissions when rented than owned. The reason is because the impact from dry cleaning is 25 and 36 times greater than wet washing for chlorinated solvent and petroleum-based solvent, respectively, and the rentals often choose dry cleaning to maintain their garments. One exception was observed with the T-shirt. The T-shirt results between owned and rental are comparable even though it is dry cleaned in rental because the T-shirt was set to be worn and laundered frequently when owned; thus, the impact from domestic laundry became comparable to the dry-cleaning impact when rented. Additionally, garments with high fabric consumption showed significant life cycle GHG emissions. Specifically, the maxi dress with silk fabric was the largest owing to the high impact from textile production; the dress consumes a significant amount of silk fabric. We note that the truck delivery in rental service is more efficient than individual consumers driving their cars to purchase garments; thus, the impact from transportation is smaller when rented.

When the GHG emissions between owning and renting garments were compared in terms of GHG per wear in Fig. 5 (b), the GHG was smaller for renting than owned in all garments. The reason is because the lifetime wear count was assumed to be greater when rented compared to owning the garment. The GHG reduced significantly from owning to renting with the maxi dresses. For formalwear such as maxi dresses, its GHG during the production is greater than that of other pieces, and its wear frequency can increase tremendously when they are rented. As a result, we convey that garments that have a high GHG emissions during its production and are worn infrequently when owned have the greatest potential to reduce the GHG emissions through offering them in rental platforms.

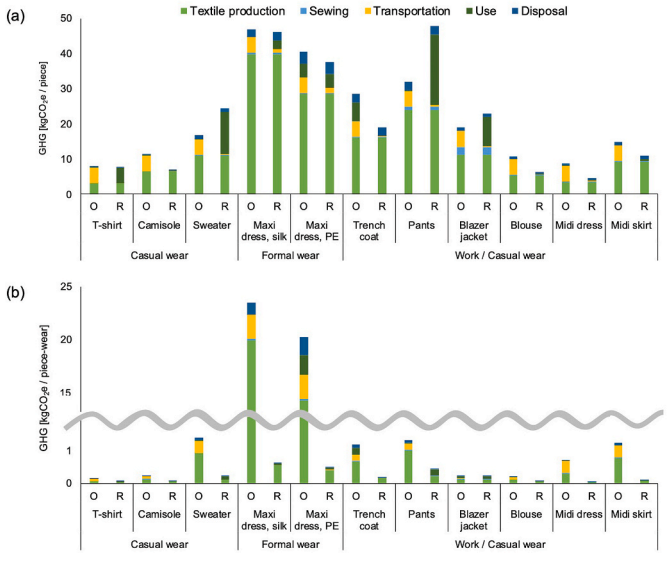

Fig. 5. Comparative life cycle GHG emissions (a) per piece and (b) per wear of 11 garments when owned (O) and rented (R).

4.2.3. Uncertainty

LCA is a data-driven methodology, where conclusions are often sensitive to specific parameters, assumptions, and data quality. We recognize three major uncertainties that may impact the quality of our findings. Firstly, consumer behaviors in terms of number of wears, laundry frequency, garment lifespans, and transportation modes have a potentially significant uncertainty. Past studies have reported a wide range of clothing use behaviors across the world (Klepp et al., 2020). The uncertainty is especially high for the processes that differ between owned and rental scenarios such as transportation mode and laundry method, which have one or more magnitudes of difference in the GHG emissions. For example, the transportation mode of owned and rental assumes car and truck delivery, where the GHG [per km] of a car is roughly four times greater than that of a truck. Certainly, consumers could choose to walk or bike to shop for garments or even rent garments as some of the rental platforms own a physical location. These assumptions about consumer behavior could significantly fluctuate the result (Amasawa et al., 2020). The second uncertainty involves the fabric consumption calculation method, which may not represent mass produced garments. We employed the method presented by a fabric shop and the fabric loss percentage from patterning was comparable to a past study (Ministry of Economy Trade and Industry, 2003); however, garment production efficiency has likely improved in the past two decades, where the fabric loss could have reduced further. The third uncertainty lies in overlooking the volume of garments that rental platforms own to run their businesses. Clothing rental platforms own a stock of garments with size and sometimes color variation of the same garment design to secure customers. Our LCA only modeled rented garments and was yet to account for the garment stock. If rental platforms owned more garments than the volume of garments consumers own, the quantitative conclusion on the environmental sustainability of rented garments could be amplified. This study was unable to obtain quality data on garment stock, which should be explored in the future study.

4.3. Further analysis based on gaps between business practices and LCA evidences

While we have identified several qualitative and quantitative factors shaping the environmental sustainability of fashion rental platforms, further study is needed to bridge the gap between business practices of rental platforms and their resulting environmental impact. We present future study ideas through recognizing the gaps.

The first gap appeared between the entrepreneurs' perspective on the environmental sustainability of fashion rental platforms and its quantitative implication. We discussed that rental platform entrepreneurs recognize that provision of rental service itself offers a sustainable alternative to fast fashion. Our comparative LCA results between owned and rented showed that rental platforms can reduce the GHG emission per piece and per product, provided the number of wears increases from owned to rented and the use of dry cleaning is minimized. In our consumer behavior scenarios, we assumed no rebound effects in terms of the number of wears; we assumed how many times that a consumer wears a specific garment remains unchanged between owned and rented. However, rebound effects are recognized as a risk of sharing economy that stimulates additional consumption (Böcker and Meelen, 2017). We

suggest future studies to empirically measure the consumer behavior changes from purchasing to renting a garment.

The second gap is recognized in the entrepreneur's purchasing criteria and the GHG emissions of the garment designs. Our LCA conveyed that the GHG emission per piece significantly varies depending on the garment design and fiber types. Therefore, whether a rental service offers a sustainable alternative to fast fashion depends on the characteristics of garments offered. In our interview analysis, platform entrepreneurs were found to select garments with designer labels and fashion forward pieces. We performed an LCA on various garments that simulated garments in rental platforms, but they are yet to represent the exact garments that are offered in the rental platforms; thus, further study is needed to conclude whether the type of garments that the rental platforms offer contribute to environmental sustainability. Additionally, "designer labels" and "fashion forward pieces" define a category of garments, but they have an indirect relationship with the environmental impact parameters. For instance, designer label garments are expected to be more durable than fast fashion considering its price range, but it is still unclear whether this holds true. The number of wears and lifespans are also likely to be connected to designer label and fashion forward design; they could have both positive and negative influence on the environmental impact. Further study is needed to understand how consumers interact with different categories of garments.

The third gap involves key criteria for sustainable PSS, where the interview results implied that use of durable goods and increasing use frequency are practiced through their garment selection and service provision. We have reflected changes in use frequency in the LCA, but durability of owned and rented garments were set to be the same. While products offered in rental platforms and for purchase are generally the same, platform entrepreneurs are beginning to design and implement products suitable for rentals such as increased durability (Amasawa et al., 2020). Also, intensified use of products is prone to degradation effect (Pouri, 2021). Our LCA suggested that formal dresses have a greater potential to reduce the environmental impact through fashion rentals because use frequency intuitively increases when they are offered in rental platforms. Through intensified use of formal dresses, they may degrade quicker than expected. Exploring the environmental sustainability of rental platforms from a product design perspective is a fruitful research topic.

5. Conclusions

This study analyzed environmental sustainability of fashion rental platforms through the combination of qualitative data from platform entrepreneurs in Canada and LCA of 11 garments with distinct design and fiber contents. Qualitative findings indicate that rental entrepreneurs recognize provision of fashion rental service itself contributes to sustainable fashion. The entrepreneurs also select designer labels and fashion forward pieces for their offering and some platforms provide services that could increase the use frequency. From the LCA, the embodied GHG of garments were found to vary significantly depending on the design and fiber content; thus, garments with high fabric consumption (i.e., skirts, dresses) and use of high embodied GHG of fibers (i.e., silk) could be targeted for rentals to reduce their inherent GHG emissions. When owning and renting garments were compared, we found that rented clothes could have a greater life cycle GHG per piece when the garment is dry-cleaned (e.g., blazer jacket). The functional unit of one wear suggested that rental platforms can indeed reduce the GHG emissions through increasing the lifetime wear. The combination of qualitative and quantitative suggests the need to further analyze the role of the garment category to consumer behavior, rebound effects in renting garments, and sustainable garment design for rental platforms.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.clrc.2023.100103.

References

Amasawa, E., Shibata, T., Sugiyama, H., Hirao, M., 2020. Environmental potential of reusing, renting, and sharing consumer products: systematic analysis approach. J. Clean. Prod. 242, 118487 https://doi.org/10.1016/j.jclepro.2019.118487.

Armstrong, C.M., Lang, C., 2013. Sustainable product service systems: the new frontier in apparel retailing? Res. J. Text. Appar. 17, 1–12. https://doi.org/10.1108/RJTA-17-01-2013-B001.

Armstrong, C.M., Niinimäki, K., Kujala, S., Karell, E., Lang, C., 2015. Sustainable product-service systems for clothing: exploring consumer perceptions of consumption alternatives in Finland. J. Clean. Prod. 97, 30–39. https://doi.org/10.1016/j.jclepro.2014.01.046.

Athwal, N., Wells, V.K., Carrigan, M., Henninger, C.E., 2019. Sustainable luxury marketing: a synthesis and research agenda. Int. J. Manag. Rev. 21, 405–426. https://doi.org/10.1111/ijmr.12195.

Baines, T.S., Lightfoot, H.W., Evans, S., Neely, A., Greenough, R., Peppard, J., Roy, R., Shehab, E., Braganza, A., Tiwari, A., Alcock, J.R., Angus, J.P., Basti, M., Cousens, A., Irving, P., Johnson, M., Kingston, J., Lockett, H., Martinez, V., Michele, P., Tranfield, D., Walton, I.M., Wilson, H., 2007. State-of-the-art in product-service systems. Proc. Inst. Mech. Eng. Part B J. Eng. Manuf. 221, 1543–1552. https://doi.org/10.1243/09544054JEM858.

Battle, A., Ryding, D., Henninger, C.E., 2018. Access-based consumption: a new business model for luxury and secondhand fashion business?. In: Vintage Luxury Fashion, pp. 29–44. https://doi.org/10.1007/978-3-319-71985-6_3.

Becker-Leifhold, C., Iran, S., 2018. Collaborative fashion consumption – drivers, barriers and future pathways. J. Fash. Mark. Manag. https://doi.org/10.1108/JFMM-10-2017-0109.

Becker-Leifhold, C.V., 2018. The role of values in collaborative fashion consumption - a critical investigation through the lenses of the theory of planned behavior. J. Clean. Prod. 199, 781–791. https://doi.org/10.1016/j.jclepro.2018.06.296.

Bedford, E., 2020. In: Canadian Apparel Market – Statistics & Facts [WWW Document]. Statistica. https://www.statista.com/topics/5125/apparel-market-in-canada/#topicHeader_wrapper. accessed 11.24.20.

Bick, R., Halsey, E., Ekenga, C.C., 2018. The global environmental injustice of fast fashion. Environ. Heal. A Glob. Access Sci. Source 17, 1–4. https://doi.org/10.1186/s12940-018-0433-7.

Blazquez, M., Henninger, C.E., Alexander, B., Franquesa, C., 2020. Consumers' knowledge and intentions towards sustainability: a Spanish fashion perspective. Fash. Pract. 12, 34–54. https://doi.org/10.1080/17569370.2019.1669326.

Böcker, L., Meelen, T., 2017. Sharing for people, planet or profit? Analysing motivations for intended sharing economy participation. Environ. Innov. Soc. Transit. 23, 28–39. https://doi.org/10.1016/j.eist.2016.09.004.

Botsman, R., Rogers, R., 2010. What's Mine Is Yours: the Rise of Collaborative Consumption. Harper Collins, New York.

Brydges, T., Hanlon, M., 2020. Garment worker rights and the fashion industry's response to COVID-19. Dialogues Hum. Geogr. 10, 195–198. https://doi.org/10.1177/2043820620933851.

Brydges, T., Heinze, L., Retamal, M., Henninger, C.E., 2021. Platforms and the pandemic: a case study of fashion rental platforms during COVID-19. Geogr. J. 187, 57–63. https://doi.org/10.1111/geoj.12366.

Brydges, T., Hracs, B.J., 2019. What motivates millennials? How intersectionality shapes the working lives of female entrepreneurs in Canada's fashion industry. Gend. Place Cult. 26, 510–532. https://doi.org/10.1080/0966369X.2018.1552558.

Camacho-Otero, J., Boks, C., Pettersen, I.N., 2019. User acceptance and adoption of circular offerings in the fashion sector: insights from user-generated online reviews. J. Clean. Prod. 231, 928–939. https://doi.org/10.1016/j.jclepro.2019.05.162.
CBC, 2017. In: Clothes from Canada Account for Huge Waste [WWW Document]. CBC. https://www.cbc.ca/player/play/1140389443838. accessed 10.24.20.
CBP, 2022. In: U.S. – Mexico – Canada Agreement (USMCA). CBP online. https://www.cbp.gov/trade/priority-issues/trade-agreements/free-trade-agreements/USMCA, 01/11/2022.
Chua, J.M., 2019. In: The Environment and Economy Are Paying the Price for Fast Fashion – but There's Hope [WWW Document]. VOX. https://www.vox.com/2019/9/12/20860620/fast-fashion-zara-hm-forever-21-boohoo-environment-cost. accessed 10.24.20.
Craig-Bourdin, M., 2019. In: Canadian Fashion Industry Acting to Reduce its Impact on the Planet: Expert [WWW Document]. Chart. Prof. Accountants Canada. https://www.cpacanada.ca/en/news/canada/2019-10-31-sustainable-canadian-fashion. accessed 10.17.20.
Crang, M., 2005. Qualitative methods: there is nothing outside the text? Prog. Hum. Geogr. 29 https://doi.org/10.1191/0309132505ph541pr.
Duggan, G., 2018. Our Fast Fashion Habit is Killing the Planet. CBC [WWW Document].
Ertz, M., Durif, F., Lecompte, A., Boivin, C., 2018. Does "sharing" mean "socially responsible". J. Consum. Market. 35, 392–402.
Environics, 2021. In: Modest Gains and Other Surprises in Canadian Retail Visits. Environics (online): https://environicsanalytics.com/en-ca/resources/blogs/ea-blog/2021/12/22/are-canadian-consumers-returning-to-shopping-centres-in-2021, 01/11/2022.
Gnanamkonda, V., Koundinya, C., Nandamuri, P.P., 2019. Executive garment rental service—a study on consumers' preferences. Theor. Econ. Lett. 9, 327–335. https://doi.org/10.4236/tel.2019.92024.
Government of Canada, 2022. In: Canada and the Commonwealth. CBD online. https://www.international.gc.ca/world-monde/international_relations-relations_internationales/multilateral-multilateraux/commonwealth.aspx?lang=eng, 01/11/2022.
Henninger, C.E., Amasawa, E., Brydges, T., Piontek, F.M., 2021. My wardrobe in the cloud: an international comparison of fashion rental. In: Ertz, M. (Ed.), Handbook of Research on the Platform Economy and the Evolution of E-Commerce. IGI Global, pp. 153–175. https://doi.org/10.4018/978-1-7998-7545-1.ch007.
Henninger, C.E., Bürklin, N., Niinimäki, K., 2019. The clothes swapping phenomenon – when consumers become suppliers. J. Fash. Mark. Manag. 23, 327–344. https://doi.org/10.1108/JFMM-04-2018-0057.
Hirschl, B., Konrad, W., Scholl, G., 2003. New concepts in product use for sustainable consumption. J. Clean. Prod. https://doi.org/10.1016/S0959-6526(02)00162-2.
Horton, H., 2019. In: Renting Clothes Will Replace Fast Fashion [WWW Document]. Telegraph. https://www.telegraph.co.uk/news/2019/08/27/renting-clothes-will-replace-fast-fashion-entrepreneur-says/. accessed 10.24.20.
Hu, Z.H., Li, Q., Chen, X.J., Wang, Y.F., 2014. Sustainable rent-based closed-loop supply chain for fashion products. Sustain. Times 6, 7063–7088. https://doi.org/10.3390/su6107063.
International Organisation for Standardization, 2006a. ISO 14040:2006 Environmental management — Life cycle assessment — Principles and framework.
International Organisation for Standardization, 2006b. ISO 14044:2006 Environmental management — Life cycle assessment — Requirements and guidelines.
Iran, S., Geiger, S.M., Schrader, U., 2019. Collaborative fashion consumption – a cross-cultural study between Tehran and Berlin. J. Clean. Prod. 212, 313–323. https://doi.org/10.1016/j.jclepro.2018.11.163.
Iran, S., Schrader, U., 2017. Collaborative fashion consumption and its environmental effects. J. Fash. Mark. Manag. 21, 468–482. https://doi.org/10.1108/JFMM-09-2016-0086.
Itten, R., Hischier, R., Andrae, A.S., Bieser, J.C., Cabernard, L., Falke, A., Ferreboeuf, H., Hilty, L.M., Keller, R.L., Lees-Perasso, E., Preist, C., 2020. Digital transformation—life cycle assessment of digital services, multifunctional devices and cloud computing. Int. J. Life Cycle Assess. 25 (10), 2093–2098.
James, A., 2006. Critical moments in the production of "rigorous" and "relevant" cultural economic geographies. Prog. Hum. Geogr. 30 https://doi.org/10.1191/0309132506ph610oa.
Japan Environmental Management Association for Industry, 2010. IDEA (Inventory Database for Environmental Analysis).
Johnson, E., Plepys, A., 2021. Product-service systems and sustainability: analysing the environmental impacts of rental clothing. Sustain. Times 13, 1–30. https://doi.org/10.3390/su13042118.
Klepp, I.G., Laitala, K., Wiedemann, S., 2020. Clothing lifespans: what should be measured and how. Sustain. Times 12, 1–21. https://doi.org/10.3390/su12156219.
Laitala, K., Klepp, I.G., 2021. Age and active life of clothing. In: PLATE Conference.
Lang, C., Armstrong, C.M.J., 2018. Fashion leadership and intention toward clothing product-service retail models. J. Fash. Mark. Manag. 22, 571–587. https://doi.org/10.1108/JFMM-12-2017-0142.
Lavin, J., 2020. Fast fashion: is it really a bargain? [WWW Document]. ratehub.ca. https://www.ratehub.ca/blog/fast-fashion-is-it-really-a-bargain/. accessed 4.27.22.
Lee, S.H.N., Chow, P.S., 2020. Investigating consumer attitudes and intentions toward online fashion renting retailing. J. Retailing Consum. Serv. 52 https://doi.org/10.1016/j.jretconser.2019.101892.
Levanen, J., Uusitalo, V., Harri, A., Kareinen, E., Linnanen, L., 2021. Innovative recycling or extended use? Comparing the global warming potential of different ownership and end-of-life scenarios for textiles. Environ. Res. Lett. 16 https://doi.org/10.1088/1748-9326/abfac3.
Lieber, C., 2020. The fashion rental market tested and explained: who has the best service? Bus. Fash [WWW Document]. accessed 10.01.22 https://www.businessoffashion.com/articles/technology/fashion-rental-market-rent-the-runway-nuuly-le-tote-vince-unfold/.
Markides, C., 2006. Disruptive innovation: in need of better theory. J. Prod. Innovat. Manag. https://doi.org/10.1111/j.1540-5885.2005.00177.x.
Matthews, D., Hodges, N.N., 2016. Clothing swaps: an exploration of consumer clothing exchange behaviors. Fam. Consum. Sci. Res. J. 45, 91–103. https://doi.org/10.1111/fcsr.12182.
Ministry of Economy Trade and Industry, 2003. LCA Report on Textile Products (Clothing) (in Japanese).
Moeller, S., Wittkowski, K., 2010. The burdens of ownership: reasons for preferring renting. Manag. Serv. Qual. 20, 176–191. https://doi.org/10.1108/09604521011027598.
Mukendi, A., Henninger, C.E., 2020. Exploring the spectrum of fashion rental. J. Fash. Mark. Manag. 24, 455–469. https://doi.org/10.1108/JFMM-08-2019-0178.
Park, H., Joyner Armstrong, C.M., 2019. Will "no-ownership" work for apparel?: implications for apparel retailers. J. Retailing Consum. Serv. 47, 66–73. https://doi.org/10.1016/j.jretconser.2018.10.012.
Patterson, C., 2019. Fashion rentals, vintage and off-price could threaten traditional Canadian retailers. Retail Insid. [WWW Document]accessed 10.24.20 https://www.retail-insider.com/retail-insider/9/fashion-rentals-vintage-and-off-price-could-threaten-traditional-canadian-retailers-expert.
Philip, H.E., Ozanne, L.K., Ballantine, P.W., 2019. Exploring online peer-to-peer swapping: a social practice theory of online swapping. J. Market. Theor. Pract. 27 https://doi.org/10.1080/10696679.2019.1644955.
Philip, H.E., Ozanne, L.K., Ballantine, P.W., 2015. Examining temporary disposition and acquisition in peer-to-peer renting. J. Market. Manag. 31, 1310–1332. https://doi.org/10.1080/0267257X.2015.1013490.
Piontek, F.M., Amasawa, E., Kimita, K., 2020. Environmental implication of casual wear rental services: case of Japan and Germany. In: Procedia CIRP, pp. 724–729. https://doi.org/10.1016/j.procir.2020.01.076.
Piontek, F.M., Müller, M., 2018. Literature reviews: life cycle assessment in the context of product-service systems and the textile industry. Proc. CIRP 69, 758–763. https://doi.org/10.1016/j.procir.2017.11.131.
Piontek, F.M., Rapaport, M., Müller, M., 2019. One year of clothing consumption of a German female consumer. In: Procedia CIRP, pp. 417–421. https://doi.org/10.1016/j.procir.2019.01.055.
Pouri, M.J., 2021. Eight impacts of the digital sharing economy on resource consumption. Resour. Conserv. Recycl. 168, 105434 https://doi.org/10.1016/j.resconrec.2021.105434.
Retamal, M., 2017. Product-service systems in Southeast Asia: business practices and factors influencing environmental sustainability. J. Clean. Prod. 143 https://doi.org/10.1016/j.jclepro.2016.12.032.
Roos, S., Sandin, G., Zamani, B., Peters, G., 2015. In: Environmental Assessment of Swedish Fashion Consumption. Five Garments - Sustainable Futures https://doi.org/10.13140/RG.2.1.3084.9120.
Roos, S., Zamani, B., Sandin, G., Peters, G.M., Svanström, M., 2016. A life cycle assessment (LCA)-based approach to guiding an industry sector towards sustainability: the case of the Swedish apparel sector. J. Clean. Prod. 133, 691–700. https://doi.org/10.1016/j.jclepro.2016.05.146.
Sun, B., 2018. In: Textile Waste: the Facts [WWW Document]. RCO. https://rco.on.ca/the-average-person-throws-away-37-kilograms-of-textiles-annually/. accessed 10.24.20.
Tissura, 2022. In: Fabric by the Yard [WWW Document]. https://tissura.com/articles/fabric-by-the-yard. accessed 4.1.22.
Tukker, A., 2004. Eight types of product-service system: eight ways to sustainability? Experiences from suspronet. Bus. Strat. Environ. 13 https://doi.org/10.1002/bse.414.
Wahlen, S., Laamanen, M., 2017. Collaborative consumption and sharing economies. In: Keller, M., Halkier, B., Wilska, T.A., Truninger, M. (Eds.), Routledge Handbook on Consumption. Routledge, Oxford, pp. 94–105. https://doi.org/10.4324/9781315675015.
Wiedemann, S.G., Biggs, L., Nebel, B., Bauch, K., Laitala, K., Klepp, I.G., Swan, P.G., Watson, K., 2020. Environmental impacts associated with the production, use, and end-of-life of a woollen garment. Int. J. Life Cycle Assess. 25, 1486–1499. https://doi.org/10.1007/s11367-020-01766-0.
Zamani, B., Sandin, G., Peters, G.M., 2017. Life cycle assessment of clothing libraries: can collaborative consumption reduce the environmental impact of fast fashion? J. Clean. Prod. 162, 1368–1375. https://doi.org/10.1016/j.jclepro.2017.06.128.