Extended Abstract
6th PLATE 2025 Conference
Aalborg, Denmark, 2-4 July 2025

The limitations of product longevity: Are longer product lifetimes really better for the environment?

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Keywords: product longevity; clothing; environmental impacts; literature review.

Introduction

Prolonging product lifetimes is an important strategy in the circular economy, as environmental benefits are expected from slower material cycles and reductions in production, transport, and waste (Cooper, 2020). However, our recent literature review on the environmental impact of product lifetime extension (PLE) revealed shortcomings in the underlying assumptions and a mismatch with the empirical research that could validate them (Maldini et al., unpublished). This paper builds on the literature review and ads a discussion on potential increases in environmental impact, using clothing as a case study. The expected environmental benefits of PLE rely on a logic of product substitution (see Fig 1), but instead, a logic of accumulation is most often found in clothing. Replacement behaviour is rare, and therefore longer product lifetimes do not result in the anticipated environmental savings. The implications of these findings are discussed, and recommendations for advancing knowledge on the impact of PLE across product types, users, and sectors are provided.

Method

In the previous study, a literature search focused on all products was conducted in the Scopus and Web of Science databases using two sets of search terms: longevity or durability-related, and sustainability-related. Further, a detailed process of backward citation tracking was applied, leading to a total of 192 publications, of which 37 were classified as empirical. In this follow-up study, we conduct a more detailed analysis of the existing empirical knowledge identified, specifically focusing on studies about clothing (12 publications), to discuss the implications of accumulation in assessing the environmental impact of PLE.

Findings

The identified publications anticipate environmental benefits of PLE across various product groups, except for those with high impact during use. Clothing is the most frequently studied category, followed by electronics, household appliances and vehicles. The most significant environmental benefits of PLE are attributed to savings in production, stemming from reduced demand due to delayed or avoided product replacement (see Fig. 1).

While literature on electronics, household appliances, and vehicles discusses PLE's environmental benefits with caution due to increasing energy efficiency (e.g. Iraldo et al. 2017; Kagawa et al. 2008), publications on clothing tend to discuss environmental savings with more certainty (e.g. Jung & Jin, 2014; Sun et al., 2021).

The 12 studies presenting empirical evidence on the environmental impact of clothing longevity include eight publications reporting results from LCAs (Beton et al., 2014; Farrant, 2008, Perdijk et al., 1995; Roos et al., 2015 as discussed by Roos et al., 2016; Slocinski and Fisher, 2016 as discussed by Laitala et al., 2018; Schmidt et al., 2016; Thomas et al., 2012; WRAP, 2012a,b) and Life Cycle Optimisation Modelling (Downes et al., 2011). Four publications report on consumer behaviour observed in the field (Armstrong & Park, 2020; Maldini et al., 2019; Stevenson & Gmitrowicz, 2012; WRAP, 2017). The LCAs rely on assumptions about product substitution previously discussed, except for Farrant (2008), who conducts field research on consumer behaviour to inform the LCA.

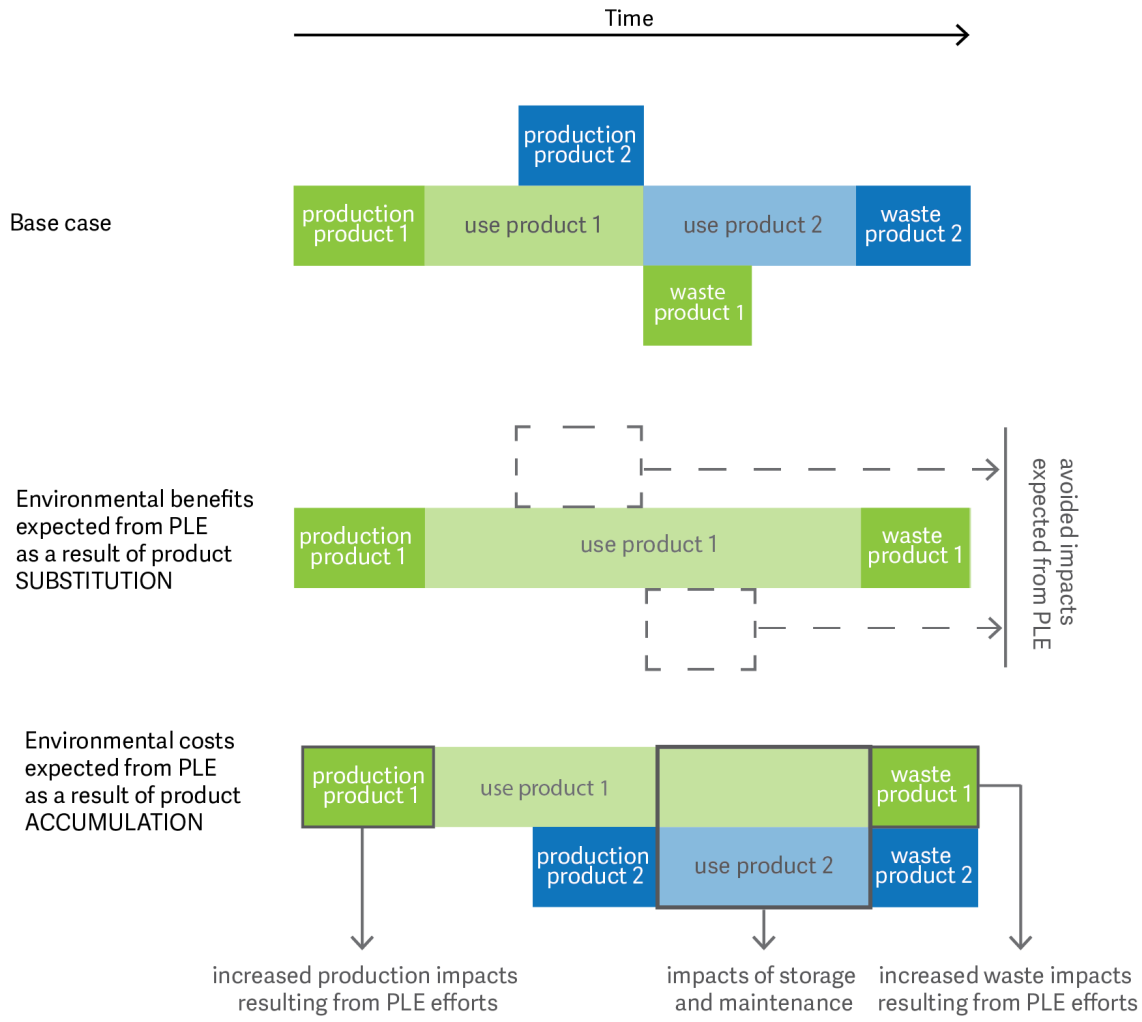

Figure 1. Environmental impacts of products over time and the expected effects of PLE in a scenario of product substitution vs. accumulation.

The other studies that include insights from consumer behaviour question the reductions in demand and production assumed by LCAs. They observe that longer clothing lifetimes reduce demand only if consumers refrain from new purchases, which is not the most common behaviour. These studies highlight the significance of clothing accumulation rather than demand reduction resulting from PLE.

Since quantitative assessments of the environmental impact on clothing lifetime extension rely on behaviours not confirmed in field research, it is questionable whether clothing longevity presents environmental benefits. Moreover, the context of product accumulation (rather than substitution) introduces additional environmental costs associated with PLE.

Discussion: Increased impact

Accumulating clothing and other consumer goods requires storage space (see Wieser et al. 2023). The impact of this additional infrastructure is not considered in any of the quantitative assessments reviewed. A study by Klint and Peters (2021) showed that the building space for washing machines is as impactful as the appliances themselves, indicating the importance of accumulation. Wardrobes grow over time (Haugrønning & Haugsrud, 2024), requiring space and attention. The fact that two thirds of clothes are not worn out when discarded might be related to this accumulation (Syversen et al., 2023).

Another negative effect may come from the growing focus on PLE in environmental policy (Heidenstrøm et al., 2021). Making clothes more "durable" is an important aim of the EU Textile Strategy (EC, 2022), and circular strategies in general (Klepp et al., 2023).

Current requirements for measuring durability favour synthetic materials because polyester, the most widely used fibre in textiles, is stronger and lighter than natural fibres (Fletcher et al., 2023). Evidence shows that consumers prefer natural fibres (Sigaard & Laitala, 2023) and use them for longer time and reuse them more often than synthetic materials, despite their lower physical durability (Laitala & Klepp, 2020). Moreover, fossil-based materials generate additional impacts associated with micro and macro plastic release (Kounina, 2024). Therefore, as Fig 1. shows, aiming at PLE may increase their environmental impact, especially if the savings expected from product substitution do not materialise.

Conclusion and recommendations

The environmental impact of PLE depends heavily on consumer and industry behaviour and their influence on product replacement or accumulation. Knowledge of how these behaviours vary across product groups, industries and users is lacking.

We suggest that research in the PLE field should avoid making claims about environmental impact without evidence. Much of the PLE literature does this, but repetition alone does not make something true. We recommend research on consumer and industry behaviour to understand not only when PLE reduces impact, but also how to make it effective. Examining the dynamics between the inflow, the outflow and the stock of products such as clothing is an important place to start.

The political implication of these findings is that PLE is not a solid foundation for environmental policy, as it is not known when reduction will occur. If the goal of the policy is to reduce environmental impact, it should instead be targeted towards quantities directly. So far, this approach has been effectively hindered (Maldini and Klepp, 2025 in press).

Acknowledgments

This work was supported by the Research Council of Norway, project nr. 315496 "CHANGE: Environmental system shift in clothing consumption".

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