

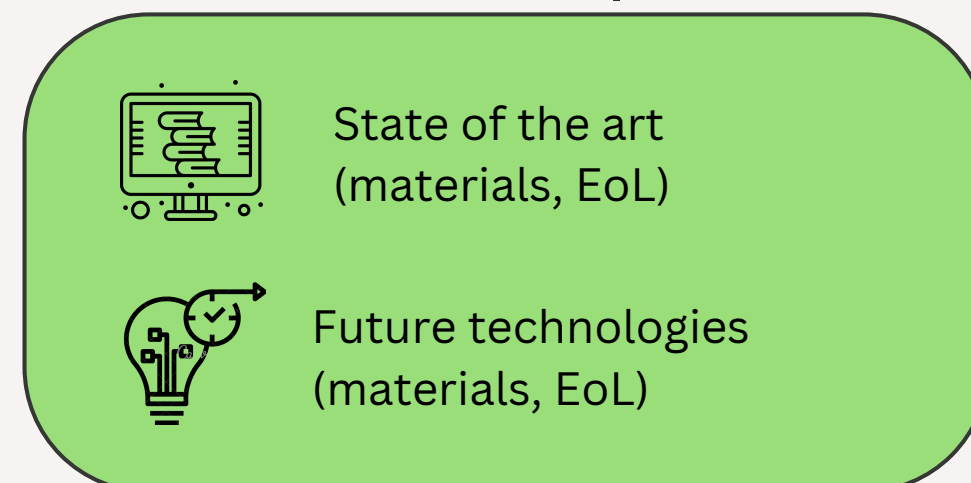
Socio-Technical Transition for a Circular Diaper System in 2030

Introduction

Globally 30 million tonnes of diapers are produced annually, and the market is forecasted to grow by around 6% each year to 2029, with adult diapers being the fastest growing market sector as a result of the increasingly elderly population. [1] The global warming impact of these disposable diapers can be estimated to around 3.6 million t CO₂eq/year in the EU and to around 87 thousand t CO₂eq/year for Denmark.

Furthermore, diapers are complex products, containing roughly 30 components, which are difficult to dissect after use, posing a challenge to their End-of-Life (EoL) management, especially recycling (Source: Abena visit). The EoL management of diapers is generally a complex undertaking that presents difficulties regarding pathogens and odour, and has thus strict hygiene requirements, that complicate recycling options even further. Consequently, there have been various initiatives around Europe to try to decrease the impact of diapers on the environment and reduce the waste associated to their use, with the primary focus on increasing the circularity of diapers. [2-5]

Product development



Recent studies indicate that the potential benefits of re-usable diapers are promising. From possibly almost halving the global warming potential compared to disposable diapers [6], to saving waste management costs for incineration and landfill [3] and even improving the quality of life and potentially improving incontinence-associated dermatitis with the help of smart diapers ([7-9]).

However, all these studies so far only focus either on the technical aspect or the social and/or economic aspects but do not combine all of them addressing their interdependence, endorsing the critique to the CE addressed by Corvellec et al. and failing at giving a holistic view of a circular diaper system.

This is where Diaper System 2030 project comes in. Discovering what it needs to successfully change from a linear diaper system to a circular considering all pillars of sustainability, namely society, economy and environment.

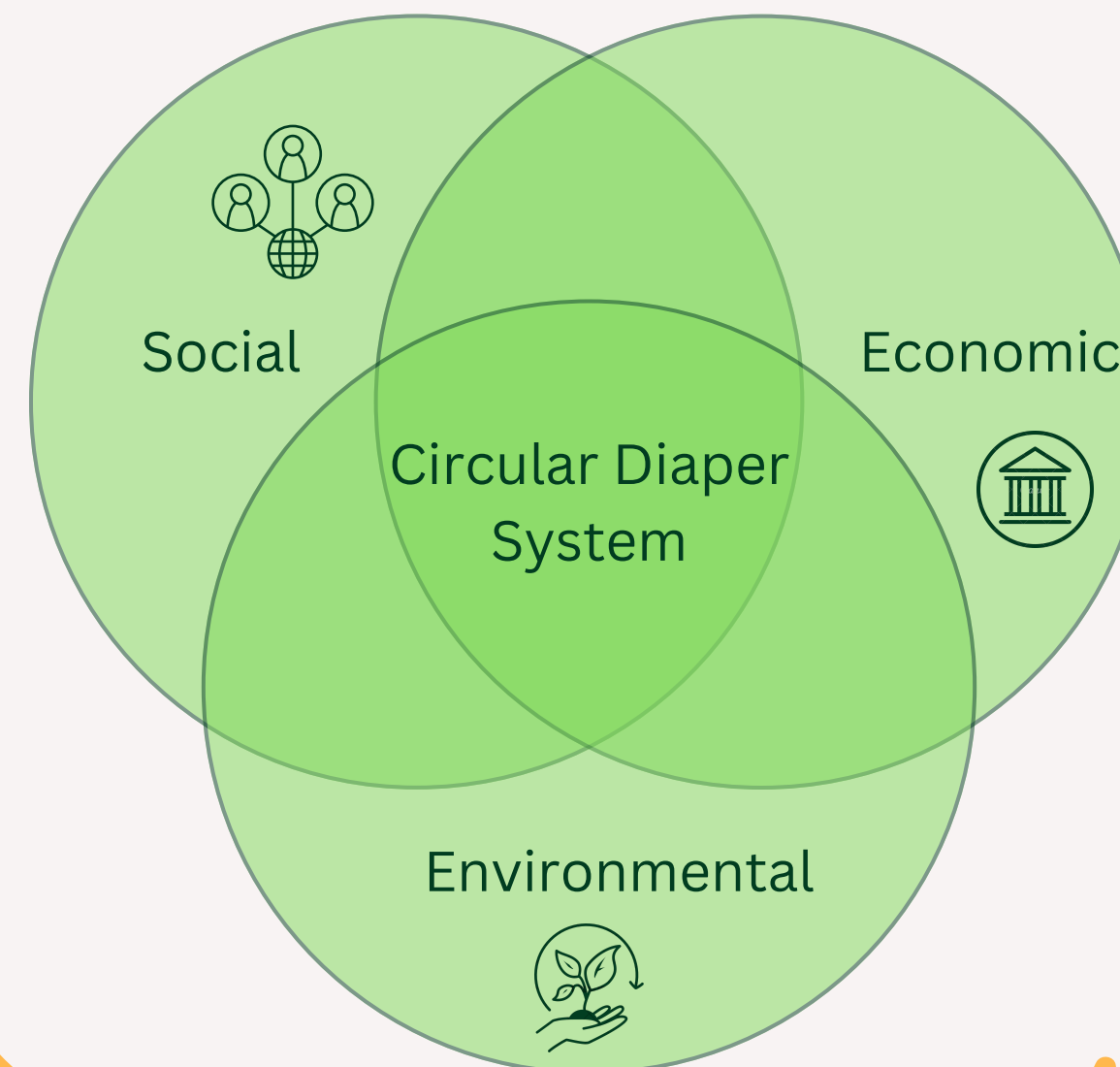
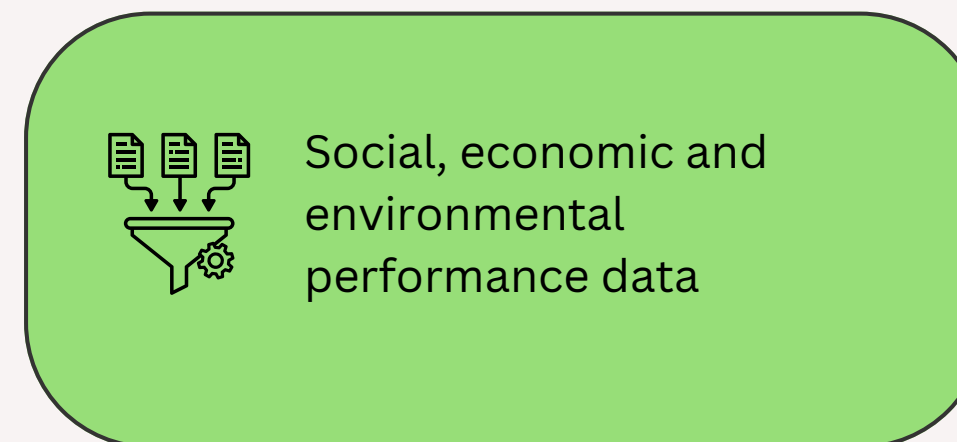
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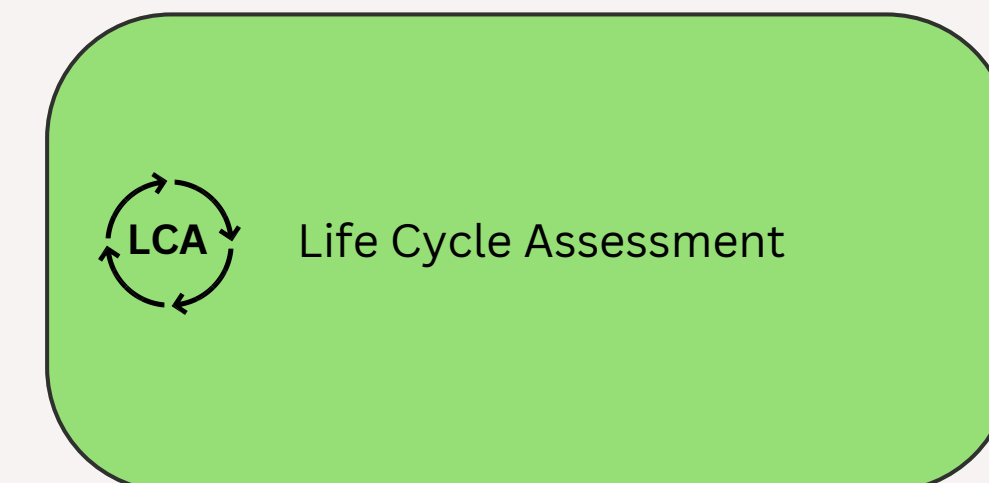
Test of future diaper system and products



Objectives

- Review of technical approaches to design and production of fully reusable and hybrid diaper products to support the product development and gain knowledge for the assessment of the full circular system
- Assessment of the full circular system, including circular logistics
- Scenario development of future adoptions considering results of the case study (environmental, economic and social) and socio-technical transition design aspects (investigated by PhD of Design School Kolding)
- Translating of case study data; social and economic data e.g. amount of diapers used, experienced life quality, time spent per patient, IAD so it can be used in the sustainability assessment
- Investigating aspects of rebound
- Assessment of full circular system including future adoption scenarios as well as possible rebound effects

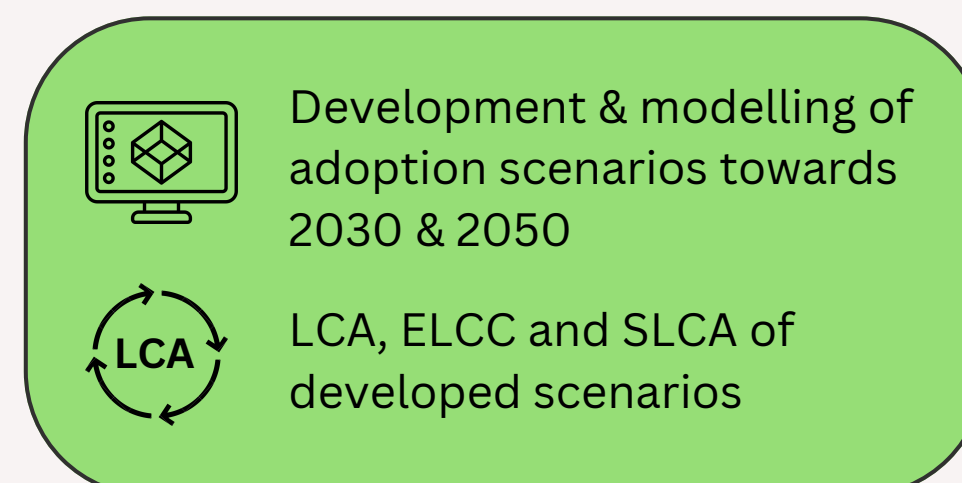
Environmental assessment



HYPOTHESIS:

A circular diaper system benefits the environment, is economically feasible and socially benign!

Scenario based sustainability assessment



References:

- [1] M. Arnold, M. Wahlström, R. Gilli, D. Nelen, and S. Colgan, "Headache fractions in mixed municipal waste," 2023.
- [2] Zukunft Pflanzen e.V. "Diaper Cycle." <https://dycycle.org/de> (accessed 06/03, 2024).
- [3] Zero Waste Europe, "It's time to clear out plastic & chemicals from nappies, not the poo," ed, 2021.
- [4] gdiapers. "NEW gCycle." <https://www.gdiapers.com/gcycle> (accessed).
- [5] Copenhagen Circular. "Diaper waste collection trial." <https://circularcph.cphsolutionslab.dk/cc/diapers/diaper-waste-collection-trial> (accessed).
- [6] S. Willskytt and A.-M. Tillman, "Resource efficiency of consumables – Life cycle assessment of incontinence products," Resources, Conservation and Recycling, vol. 144, pp. 13-23, 2019/05/01/2019, doi: <https://doi.org/10.1016/j.resconrec.2018.12.026>.
- [7] S. N. Rajabali, K. F. Hunter, P. Asaana, M. L. McCreary, S. Nazari, and A. S. Wagg, "Effectiveness of a Smart Urinary Continence Care Assessment System for Nursing Home Residents: A Quasi-Experimental, Sequential Quantitative-Qualitative Methods Trial," Journal of Wound Ostomy & Continence Nursing, vol. 50, no. 1, 2023. [Online]. Available: https://journals.lww.com/jwoconline/fulltext/2023/01000/effectiveness_of_a_smart_urinary_continence_care.9.aspx.
- [8] M. Omotunde et al., "A post-market cluster randomized controlled trial of the effect of the TENA SmartCare Change Indicator™ on urinary continence care efficiency and skin health in older nursing home residents," Trials, vol. 24, no. 1, p. 80, 2023/02/03 2023, doi: 10.1186/s13063-022-07031-z.
- [9] A. Huion, V. Decalf, C. Kumps, N. De Witte, and K. Everaert, "Smart diapers for nursing home residents with dementia: a pilot study," Acta Clinica Belgica, vol. 74, no. 4, pp. 258-262, 2019/07/04 2019, doi: 10.1080/17843286.2018.1511279.