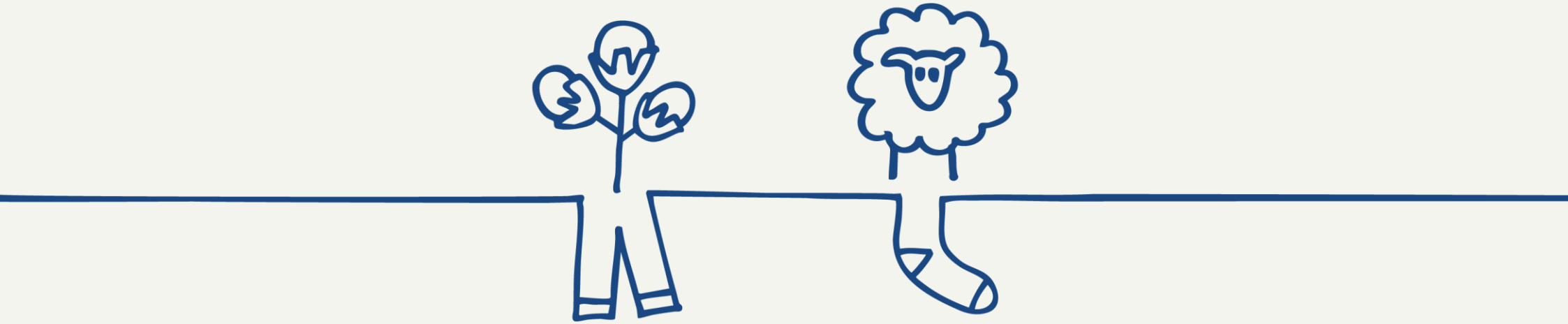
SPECULATING ON HOW WE COULD

COMPOST CLOTHING



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ABSTRACT

Natural textile fibers are compostable, offering a promising opportunity to create a regenerative textile cycle that reduces clothing waste. This research investigates how people might engage with disposing of compostable garments, emphasizing the practical, emotional, and ecological dimensions of this emerging practice. Composting is framed as a process of unmaking within more-than-human design approaches. Using speculative enactments and world mapping exercises with 15 participants, including 5 experts in regenerative textile cycles, qualitative visual data were collected on motivations, requirements, and imagined composting behaviors and journeys. The results reveal diverse disposal methods such as home composting, integration with gardening, burial rituals, and centralized composting facilities. These findings suggest the need for greater transparency and labeling on garments, as well as expanding evaluation criteria to include ecological contributions beyond composting. By deepening understanding of disposal behaviors, this research informs the design of more effective regenerative textile cycles.

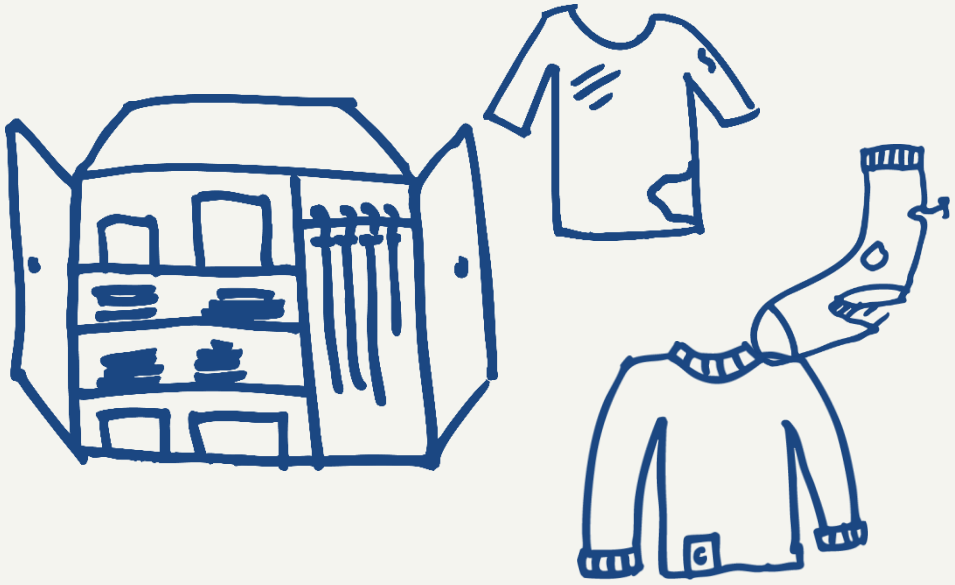
Figure 1 Demoday exposition showing clothing compost possibilities physically

“It’s finally spring again. The days are getting warmer, and the clothes are getting lighter. Ah, my closet could use a proper declutter. So, I spend an entire weekend sorting through all the garments: a pile to give away to friends and family, a pile of good items to sell, a pile to recycle for fabric, and a pile to... compost?

This final pile contains the garments that are labelled as compostable. They are truly at the end of their wearing journey: lonely socks, stained tops, and pajamas with too many holes.

Okay, so let’s compost them. But how?

Although no major cleanups follow, you still occasionally part with individual compostable items. However, there are still two moments when you discard individual pieces that are compostable and ready to return to the soil. So, where do you take them?”



INTRODUCTION

A regenerative clothing system

For many years in human history, natural textiles such as cotton [2, 19, 25], linen [10], hemp [1], and wool [5] could decompose safely and return to the earth [32]. However, innovations in clothing production over the past century, synthetic fibers, chemical processes, dyes, sewing yarns, and labels, have made most garments non-compostable [35]. These changes have optimized clothing for cheap, fast consumption.

In recent years, clothing consumption per person has risen significantly, alongside a substantial increase in synthetic fibers like polyester, which is now the majority of global fiber production [37]. Synthetic fibers contribute to microplastic pollution, shedding plastic particles during washing and wear that enter waterways and ecosystems [8, 28]. The current waste management system is also a cause for environmental problems, with around 73% of discarded clothing sent to landfills or incinerated, leading to resource loss and pollution [8].

This situation calls for a systemic shift towards sustainable materials and circular textile practices. While many projects and Dutch Policy Program for Circular Textiles 2025–2030 focus on recycling [28], there is also growing interest in new biomaterials and lifecycle-conscious design, particularly within the HCI and e-textile communities [15, 16, 22-24, 45, 49]. The concept of unmaking challenges human-centered views of a product’s lifecycle, emphasizing ongoing transformation beyond human use [3]. Rather than focusing on recycling or developing new biomaterials, this research applies the perspective of unmaking to the design

process, working with long-established natural materials that can return to the earth.

Exploring the Future of Compostable Clothing Disposal

The compostable nature of natural fibers offers valuable opportunities to rethink the system and achieve circularity by revisiting traditional practices within today's context. The regenerative clothing cycle from Fibershed describes a closed-loop system where natural fibers are produced, processed, worn, and returned to the soil [32]. Achieving such a system requires multi-sectoral development and collaboration among diverse disciplines. Inspired by this model, this study narrows its focus to an underexplored phase: the disposal of compostable garments. As shown in Figure 2, this design research focuses on the phase between wearing a garment and its composting. Consumer disposal habits are often driven by convenience, routine, and existing systems [18]. Without intentional design for this intermediate phase, even garments made from fully compostable materials risk ending up in landfills or incineration. It explores how people might discard garments in ways that enable composting.

This research raises questions such as:
Why would we compost? What would we compost? When would we compost? What are the requirements? How would we compost? What is the journey of a garment? What systems are needed, and which humans, organizations, and non-humans are involved?

This paper presents stories developed through collaborative speculation with participants, including five field experts. Using speculative enactments as a design research method, combined with a semi-structured world mapping exercise, the research gathers rich, qualitative data on how individuals envision bridging the gap between worn-out garments and their return to soil.

Figure 2 Visualized regenerative clothing cycle, adapted from the soil to soil framework by fibershed [32].

Speculative enactments was chosen as a method for this topic because it allows participants to actively engage with a future scenario that does not yet exist, making abstract ideas tangible. The visual speculative world mapping exercise further supported this process by helping participants externalize and organize their thoughts in a visual format. The stories they shared verbally and through the mapping are presented in visually in this report, contributing valuable insights toward advancing a regenerative textile system focused on the end-of-use phase of garments.

BACKGROUND AND CONTEXT

Position statement

This research is inherently interdisciplinary and global, so it's important to clarify my background, expertise, and limitations. I am an industrial designer specializing in regenerative design and textiles. My strengths include navigating complex information, communicating it accessibly, and connecting material knowledge with design challenges. However, I lack hands-on experience with farming, gardening, and composting.

This research does not claim composting clothing is the solution to fashion's challenges, but explores it as one promising path. My goal is to open up conversations, highlight possibilities, and inspire further experimentation. I also acknowledge that speculative ideas can bring new challenges, and I hope that future work in this area will continue to embrace a critical and reflective mindset.

Research Context: The Netherlands

Understanding the local setting is key to interpreting this research, which is grounded in the Dutch textile landscape. This study involves mostly Dutch participants and experts working within local production systems. While the Netherlands has a history of textile manufacturing, much of the industry has moved abroad. With no industrial spinning facilities remaining, the garment-making process must continue elsewhere in Europe.

Linen and hemp grow in the Netherlands, but the climate is too cold to grow cotton. Though the Netherlands has many sheep, primarily kept for milk and meat, much of their wool is discarded as waste [30].

Although the research focuses on a local context, it acknowledges the global nature of textile systems and the broader implications of these systemic changes.

Terminology

Composting enriches soil, but not everything that degrades benefits the ecosystem. Some materials release harmful substances like toxins or microplastics, polluting rather than regenerating. Clear definitions and terminology are essential to ensure only safe, beneficial materials enter compost systems. However, they are often misleadingly labeled, creating uncertainty about compost safety. In the packaging industry, such confusion has led to soil contamination with plastics [4, 26]. Below are brief explanations of key terms used in this research:

Degradation refers broadly to the breakdown of materials into smaller components via chemical, physical, or biological processes. **Biodegradation** is a specific type of degradation in which microorganisms break down materials. However, biodegradable

materials are not necessarily safe for soil addition, as they may leave behind toxic residues or microplastics [32, 36].

Compostable materials break down under controlled, aerobic composting conditions into carbon dioxide, water, inorganic compounds, and biomass without leaving toxic residues. The resulting compost should actively enrich the soil [36]. Another distinction between biodegradability and compostability is the timeframe: biodegradable materials may take decades to decompose fully whereas composting is generally expected to occur within a much shorter period, typically three months to a year, though exact durations can vary [3].

A common misconception is that compostable clothing lacks durability. While washing and wear affect both synthetic and natural materials, compostable materials like wool and cotton do not degrade simply from being worn or stored. They remain functional and durable throughout their use phase [32].

Circularity aims to keep materials in use and reduce waste to minimize environmental harm. However, recycling alone does not guarantee a truly circular system. Recycled textile fibers often require blending with virgin materials for quality, and recycled synthetics continue to shed microplastics [32, 36]. Additionally, products are sometimes labeled "circular" after only a single recycling step without accounting for long-term impacts or safe reuse within the system.

Regenerative systems go beyond minimizing harm; they focus on restoring and enhancing ecosystems. In regenerative approaches, waste is not just reduced but transformed into a source of renewal. When conducted correctly with appropriate materials, composting is an example of a regenerative process by returning nutrients to the soil [32].

However, while the researcher works with this terminology, participants mapping their composting journeys were not necessarily aware of strict definitions. While 'composting' served as the guiding term, this research remained open to exploring broader ecological practices, imagining ways for the material to take on a new life within an ecosystem after wear.

A regenerative system

With these definitions in mind, we can look to emerging models like Fibershed that embody regenerative textile principles. Fibershed, a global organization aiming for a regenerative textile system, supports a network of organizations working to establish a healthy circular system by designing for textile compostability, allowing textiles to return to the ecosystem [11].

This framework involves many industries and disciplines: from farmers and fashion designers to yarn and fabric producers, brands, consumers, waste facilities, and government institutions. Setting up such a system requires extensive collaboration and a shift in mindset across all parties.

Siegele identifies the following systemic challenges [32].

Clear standards for composting: Avoiding soil pollution requires clear rules and standardized compostability tests [32, 47]. **Infrastructure for collection and separation:** Systems for collecting and separating compostable textiles must be developed, alongside better post-consumer management policies [14, 32]. Similar infrastructure is also needed for recycling [28, 46]. **Traceability and transparency:** Labels should include full material details, including

sewing yarns, dyes, and treatments, as current labels are insufficient for composting decisions [32]. **Protecting natural fiber sectors:** As synthetic fibers are economically advantageous, policies must also address the environmental impacts of microplastics and non-biodegradable textile waste [32]. **Research on additives and dyes:** More research is needed on compostable additives, dyes, and high-quality natural alternatives [19,29].

In addition to these challenges, a general shift in production and consumer values is also essential. Synthetic fibers are cheaper and faster to produce, while natural fibers grow at a slower rate. Therefore, we must adjust our fashion habits: producing less and at a slower pace. I ask designers to prioritize compostability over profit, while consumers should focus on buying less, wearing items longer, and repairing what they own. This research aims to complement ongoing developments in these areas.

RELATED WORK

Biodegradable e-Textile Innovations

Sustainable textile design has become an increasingly important topic within the HCI community, with recent research exploring innovative biomaterials, e-textile applications, and lifecycle perspectives that aim to reduce environmental impact. Guridi et al.'s literature review [A4] provides an overview of the growing interest in biomaterials within interactive textile and e-textile research, with bio-based materials such as mycelium, bacterial cellulose, and alginate. Specific examples demonstrate how sustainability is integrated into e-textile design: Guridi et al.'s LIGHT TISSUE develops cellulose-based optical textile sensors [16]; Wicaksono et al. upcycle waste cotton by carbonizing fabric to create conductive e-textiles [45]; Vasquez et al.'s Desktop Biofiber Spinning offers an open-source platform for bio-based fiber production [A5]; and Zhu et al.'s EcoThreads presents a prototype for biodegradable e-textiles using thread-based fabrication [49]. Beyond e-textiles, Vasquez and Vega's Myco-accessories [24] explore fungal mycelium as a biodegradable material for wearable design. Their focus lies more on material sourcing and lifecycle than on interactivity.

Compared to the e-textile field, the apparel industry has a longer history of material innovation, though sustainability was often overlooked. It is promising that many e-textile researchers are already integrating ideas about degradation and lifecycle into early design stages, whereas traditional apparel innovations of the past century have mostly neglected these concerns. This research builds on those emerging perspectives with a different focus: rather than introducing new material innovations or embedding interactivity, it examines existing materials with a long-established role in clothing. The aim is to explore how these natural fibers, in their unmodified forms, can re-enter ecological cycles through composting, embracing an unmaking mindset that centers decay as part of a regenerative design process.

Unmaking

The concept of unmaking considers these material transitions. Recent work has begun to frame degradation not as the end of a product's life but as part of an ongoing process of transformation. Bell et al.'s *Biodegradation as More-than-Human Unmaking* [3] critiques the human-centered framing of an object's "life cycle," which defines its value solely based on human utility. In this framing, "extending life" refers to care and repair, while "new life" involves repurposing, disassembling, or recycling. Biodegradation is often described as "end-of-life," yet the material continues as part of a new life involving microorganisms. They propose a more-than-

human perspective, challenging assumptions about what it means for a material to reach the “end-of-life.” Therefore, I deliberately avoid referring to composting as the “end-of-life” stage of a garment, instead, I use “end-of-wear”. My research seeks to bridge human-centered ideas of discarding behavior with an understanding of garments as part of ongoing material cycles.

This perspective aligns with broader research in the CHI community exploring unmaking as a design approach. Song and Paulos [34] introduce unmaking through acts of failure, destruction, and decay as material exploration. Bell et al. [3] and Song et al. [33] build on this by positioning biodegradation and disassembly as deliberate design choices, reframing breakdown not as failure, but as transformation. Vasquez et al.’s Designing Dissolving Wearables [23] crafts garments that are meant to dissolve after use, offering a vision of wearables as ephemeral, regenerative elements rather than permanent waste. Taken together, these perspectives suggest a shift in mindset: from designing for use and permanence toward designing for return, and ecological integration. In this view, unmaking becomes a creative and ecological act, one that reimagines the role of the designer as a collaborator with decomposition, and of the garment as a participant in a broader cycle of life, wear, and return.

Transparency and Traceability

Addressing transparency and traceability in sustainable textile design is critical in enabling regenerative clothing systems. Gupta and Dubey propose using deep learning to classify fabric types and embed UV-visible codes for durable textile traceability [14], supporting recycling and possibly composting. Moreover, Haberfellner et al.’s *Threads of Traceability* explores embedding digital textile IDs to enable comprehensive lifecycle tracking in sustainable fashion systems [17].

The Textile Exchange Regenerative Agriculture Outcome Framework is a tool designed to measure and track the impacts of regenerative agricultural practices within the textile supply chain. By providing clear indicators and metrics, it helps brands and producers set baselines and monitor progress toward sustainability goals [38]. This framework enhances traceability and transparency by keeping consistent reporting and collaboration, allowing stakeholders to verify environmental outcomes and communicate them clearly to consumers.

While my research focuses on imagining a future where compostable clothing is a norm, I deliberately left the design of transparency and traceability systems open for participants to envision. Although participants did not design traceability tools explicitly, the principles discussed here could inform future iterations of such systems in speculative design workshops.

Projects and Companies as Experts in This Research

The ideas explored in this research are reflected in real-world practices by designers and businesses shaping regenerative futures. This section introduces five companies and projects engaged in circular and regenerative textile systems. The people involved in these projects inform this study by being participants.

Stijntje Jaspers is program director and co-founder of Fibershed Nederland, the Dutch branch of the global Fibershed network. As outlined earlier, Fibershed Nederland connects producers, designers, and makers to build local, regenerative textile value chains [12]. Three other featured experts are also part of this network.

Reina Ovinge, founder of The Knitwit Stable, promotes Dutch wool and local craftsmanship by producing fully traceable knitwear using regenerative practices. At her farm in Baambrugge, she raises sheep, runs knitting machines for her own label, and shares knowledge through educational programs [39].

Joline Jolink, founder of the slow fashion label Joline Jolink, is a pioneer in sustainable design, known for transparent collections that emphasize timelessness and minimal environmental impact, with compostable garments in her collection [20].

Iris Veentjer, founder of i Focus, does projects centered on regenerative design. Rietgoed explores reed as a textile material [43], while Undergarden develops compostable undergarments from organic cotton without synthetic elastane, using mechanical techniques for stretch [42].

Minne Zeijdner, founder of Diekees, creates biodegradable plant pots from Dutch waste wool; an alternative to plastic that supports both plant health and soil regeneration [6]. Diekees served as an important inspiration for this research.

METHODS

Participants

This research involved 6 research sessions, 15 participants (N=15), including five field experts that are introduced above. I conducted individual sessions with the experts, three in person and two online, and one group session with the remaining ten participants (Appendix A). The group consisted of design and fashion students, with design students focusing on textiles or more-than-human design.

Sampling

For both participant groups, I used purposeful sampling to ensure a degree of alignment with the research topic. In the case of the group session, convenience sampling also played a role, as I reached out to peers within my student network.

The experts were selected for their extensive professional experience. Although the group participants weren't experts, the students brought design and textile knowledge, as well as more-than-human perspectives, enabling engaged speculative discussions within this topic.

This participant mix was chosen to bridge current knowledge and values with speculative futures, enriching the discussion through both professional expertise and emerging design perspectives. However, because all participants were already familiar with sustainable fashion practices, the sample inherently reflects a sustainability-aware viewpoint. While this alignment supported depth and engagement, it also introduced a degree of bias, limiting the range of perspectives to those already sympathetic to regenerative fashion ideas.

Speculative Enactments

To explore how people might compost their compostable clothing, this research employed speculative enactments (SE), an experience-centered method within speculative design research [9]. This approach was motivated by an insight from early first-person burial trials, that engaging with real materials and personal belongings can deepen reflection on potential futures.

Participants were given the freedom to compost garments in a way that made sense to them. In the group session, a clothing swap was

organized prior to the composting, allowing participants to bring in garments they no longer wanted, exchange items, and discard old clothing in a shared outdoor setting. For the expert participants, many were already planning to conduct composting tests related to their own work. Their enactments focused more on execution and observing material degradation than open-ended exploration.

To relate this method to the framework of speculative enactments, I reflect below on the key qualities distinguished by Elsden et al. and how they manifested in this study [9]:

sequential and Real Experience

et al. highlight that spec nts gain depth when nts face real stake d dating scenario. udy, the group se unity to e garments and erts ed enactments into periments, he activity meaning hile Elsden et al. ed interpersonal r reorients n around ecologi n garments, nd the compostin

Participants are 'in' and Co-Construct the fiction

The group session was framed as a clothing swap with composting as a part of this, hoping to encourage intrinsic interest rather than formal research participation. For experts, the work aligned with their professional interests, fostering active engagement and motivation.

Relying on Existing Routines

Embedding enactments in familiar routines grounds speculation in real behaviors. Clothing disposal, a common activity, served as the entry point, with the swap event serving as a familiar social activity that invited participants to bring garments they would discard. For expert participants, the process and setting varied according to their personal or professional routines.

Practicing Ethical Enactments

Ethics extended beyond participant wellbeing to include environmental care. Since most existing garments aren't fully compostable, I provided 100% compostable cotton options (figure 3). Non-compostable garments were removed after a few days to prevent harm, while compostable ones remained.

Figure 3 100% undyed cotton garments made by the researcher

Speculative World Mapping exercise

To capture participants' personal reflections and speculative futures, a visual storytelling exercise followed the composting process. Participants were invited to shape and reflect on their own stories through a visually oriented exercise: Speculative World Mapping (SWM). Inspired by Greyson's Information World Mapping [13], the method allowed for intuitive, creative storytelling as an alternative to purely verbal data.

Each participant received three semi-transparent pages (figure 4), each with prompts and minimal visuals to guide their reflection. These layers, focused on garment relationships, motivations and requirements for composting, and the imagined journey, were designed to build on one another, creating a cohesive narrative (figure 5). The transparency aimed to visually connect the stages of their stories, encouraging a layered form of reflection.

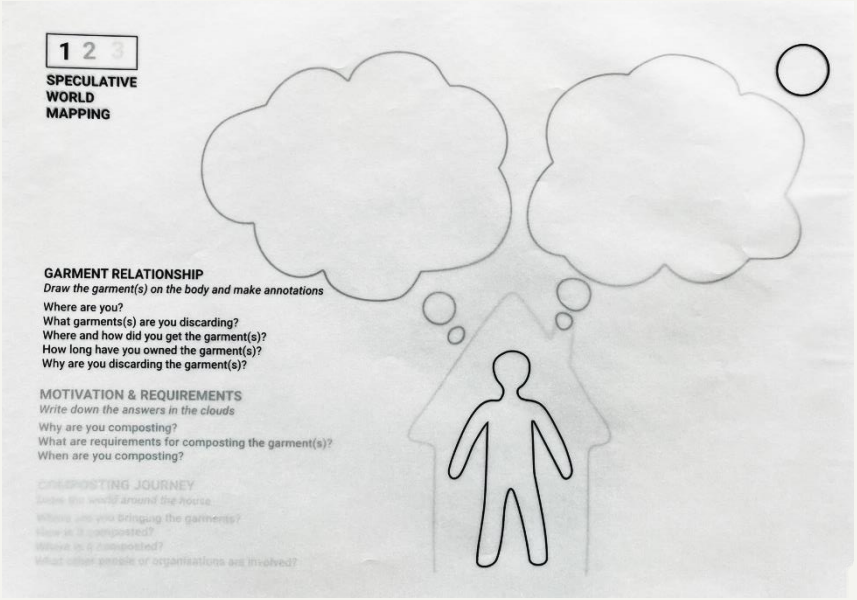


Figure 4 Transparent Speculative World mapping pages

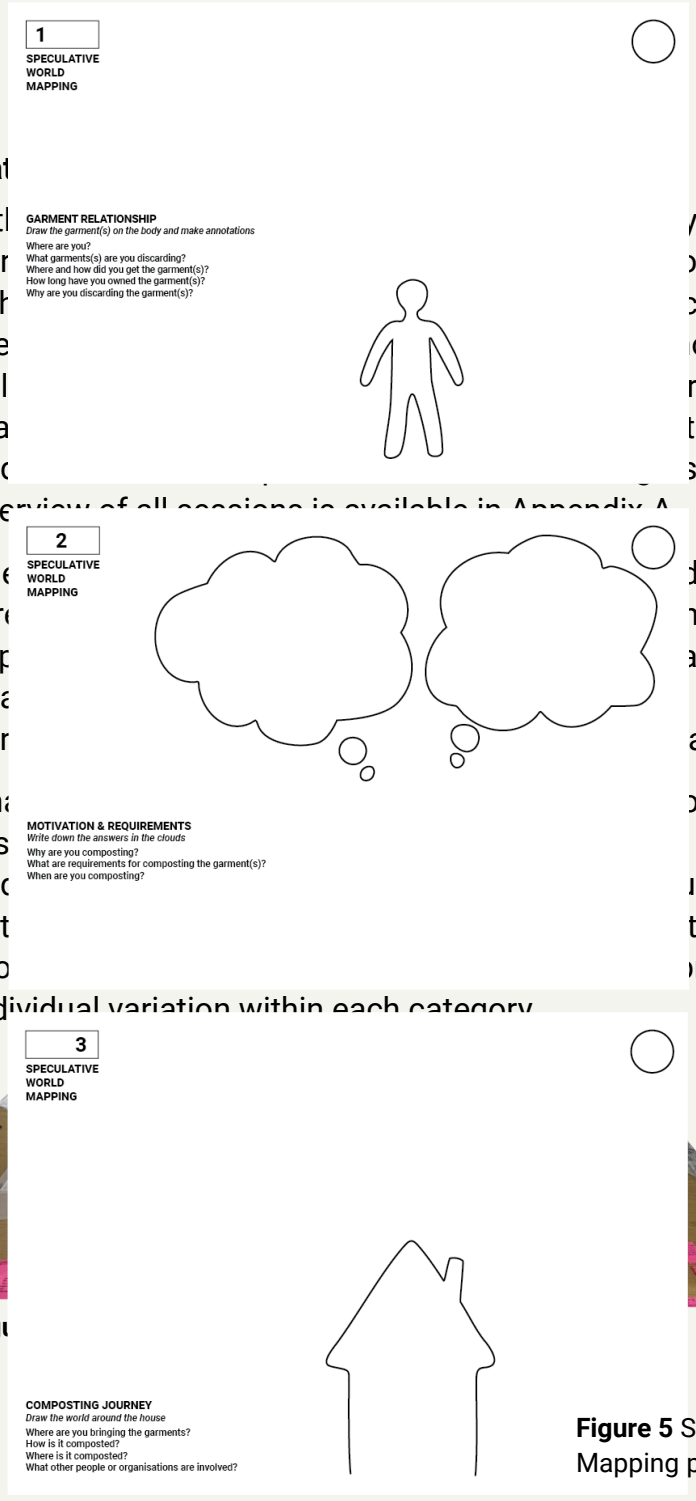


Figure 5 Speculative World Mapping pages layout

RESULTS AND FINDINGS

Speculative enactments

The speculative enactment data, including comments and photographs, are not presented as final data in this report, as these sessions primarily served as exploratory moments for participants to inform their speculative world maps. This visual page offers a glimpse into the exploratory nature and atmosphere of the sessions.

Two expert participants shared their SE session on social media.

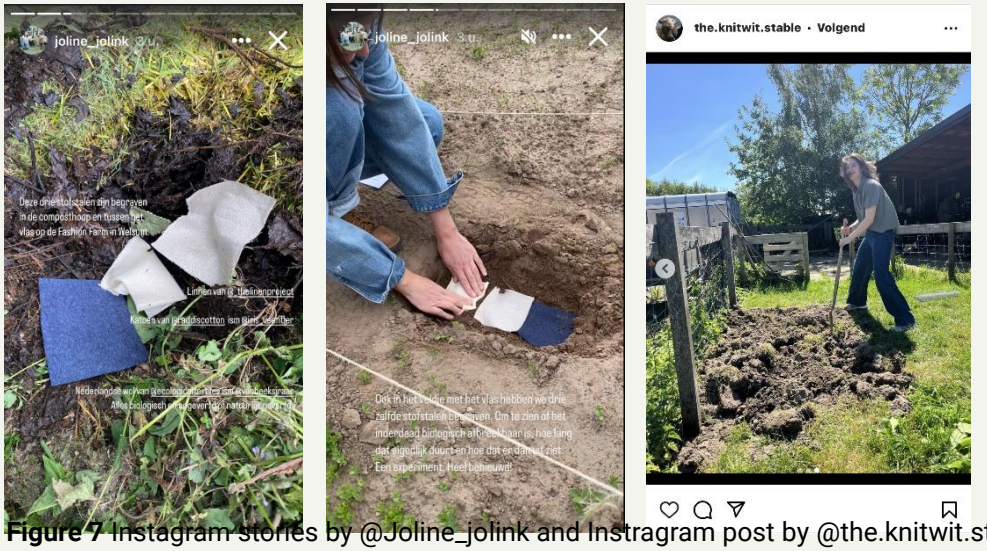


Figure 7 Instagram stories by @Joline_jolink and Instragram post by @the.knitwit.stable

Figure 8 Pictures of Speculative Enactments, made by the researcher or participants

Motivation and requirements

Most participants shared similar motivations and requirements for composting clothing. The main motivation was environmental: composting was seen as a way to prevent garments from ending up in landfills and to reduce harm to the environment. A key requirement mentioned across participants was clarity. It must be clearly known that a garment is compostable. Some participants added that composted clothing should benefit the soil or not disrupt the existing ecosystem.

Many participants believed that composting should only occur when a garment is no longer wearable or repairable, donating or mending should always come first, examples are shown in figure 9. These shared values point toward some important implications for the regenerative system.

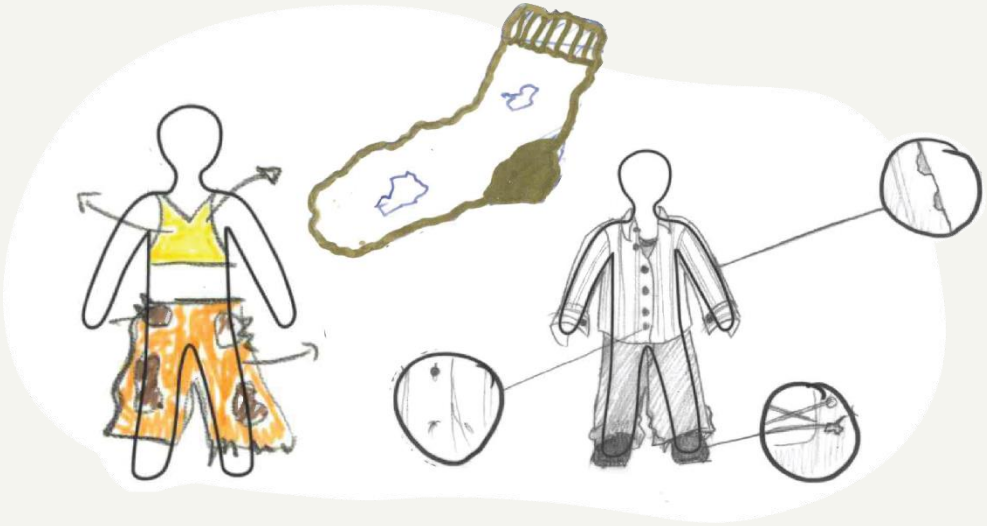


Figure 9 Sketches of broken clothing by P9, P11 and P13

Discarding Context

Another key distinction that emerged was the context in which people discard garments. Participants described two main patterns, with each approach mentioned by roughly half of them:

Single-item discarding: Garments are discarded individually when they become worn out or broken, prompting a more reflective and personal decision-making process. **Batch discarding:** Often during events like closet cleanups, multiple garments are sorted at once. This typically involves categorizing items into piles for donation, reuse, landfill, or compost.

Designing for these behaviors may require not only pre-sorting support but also post-sorting interventions, such as clear instructions or disposal options that align with each category.

Attempts to analyze how these patterns influenced discarding behaviors revealed varied connections. Two participants described a deeper emotional connection to their garments, by mentioning wanting a goodbye ritual (P5) or wanting to follow the garment (P12) as a single-item discarding process. In contrast, two others (P6 and P14) created more symbolic, ritual-like events to compost multiple garments at once, like a “mass burial.”

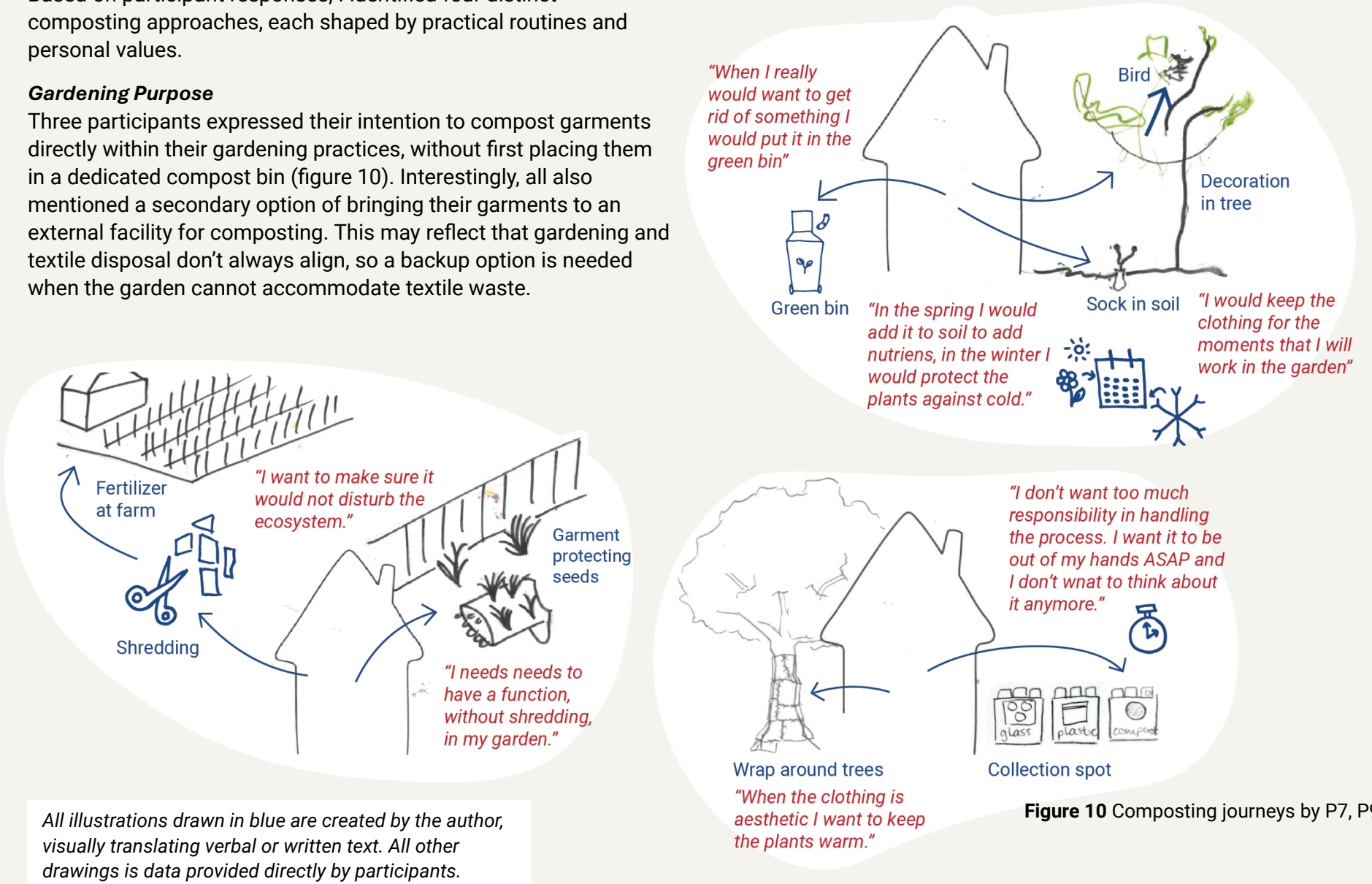
Those preferring quick, single-item disposal often integrated composting into existing routines, such as using the kitchen compost bin (P8), adding to green waste (P13), or combining it with other household waste (P9). Meanwhile, participants engaging in batch discarding described more deliberate drop-off behaviors, including traveling to composting collection points (P11 and P15).

Divisions of composting journeys

Based on participant responses, I identified four distinct composting approaches, each shaped by practical routines and personal values.

Gardening Purpose

Three participants expressed their intention to compost garments directly within their gardening practices, without first placing them in a dedicated compost bin (figure 10). Interestingly, all also mentioned a secondary option of bringing their garments to an external facility for composting. This may reflect that gardening and textile disposal don't always align, so a backup option is needed when the garden cannot accommodate textile waste.



All illustrations drawn in blue are created by the author, visually translating verbal or written text. All other drawings is data provided directly by participants.

Figure 10 Composting journeys by P7, P9 and P1

Facility Composting

In addition to those who viewed facility composting as a secondary option, three participants relied solely on external composting through green bins or local pick-up points (figure 11).

Figure 11 Composting journeys by P13, P11 and P15

Burial Rituals

Three participants described more ceremonial approaches, involving either a collective "funeral-like" burial event or a private ritual to say goodbye to their garments (figure 12).

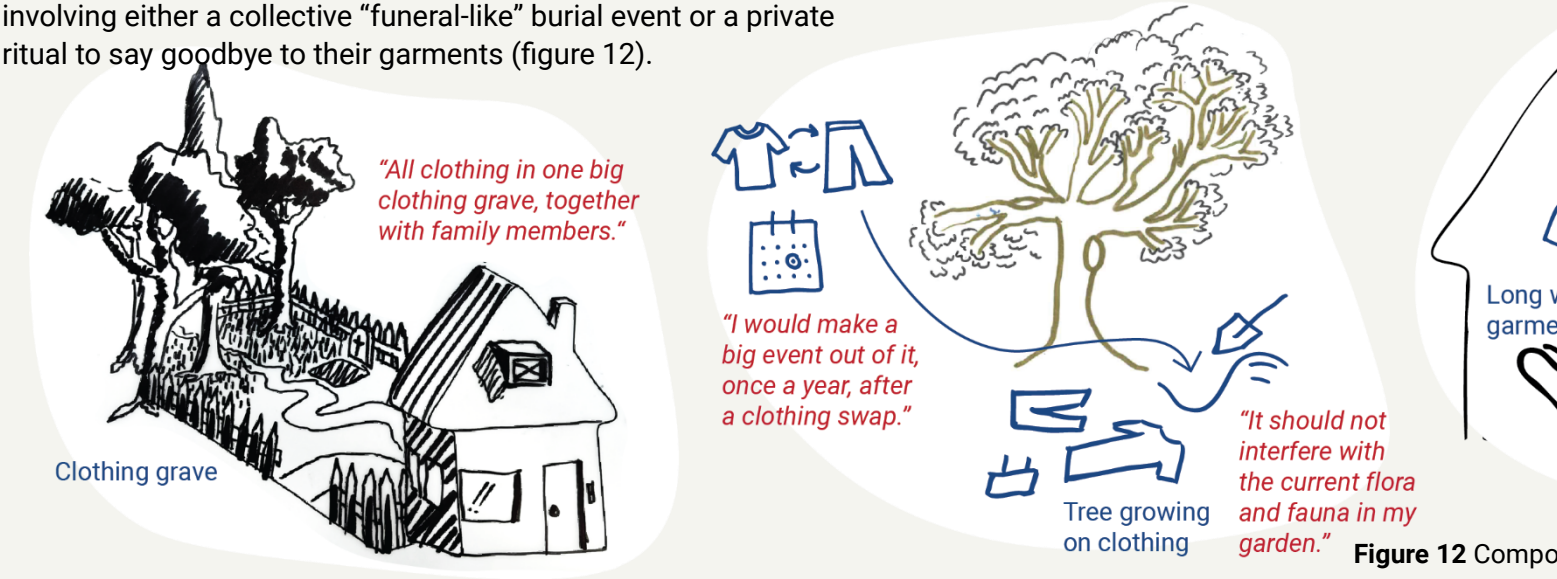
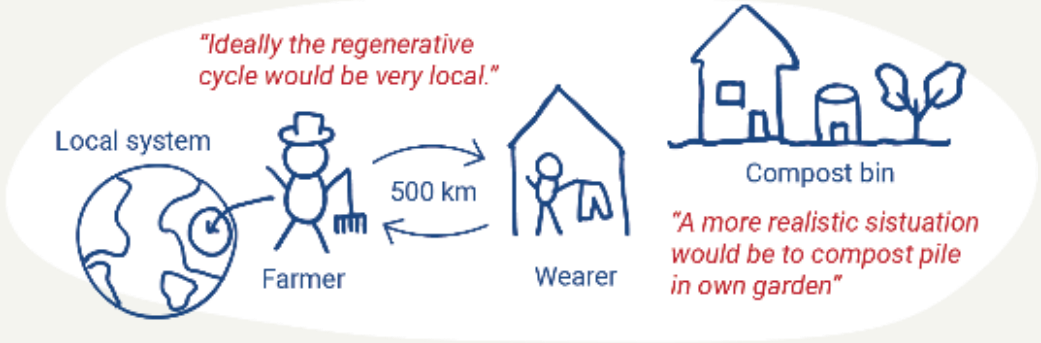
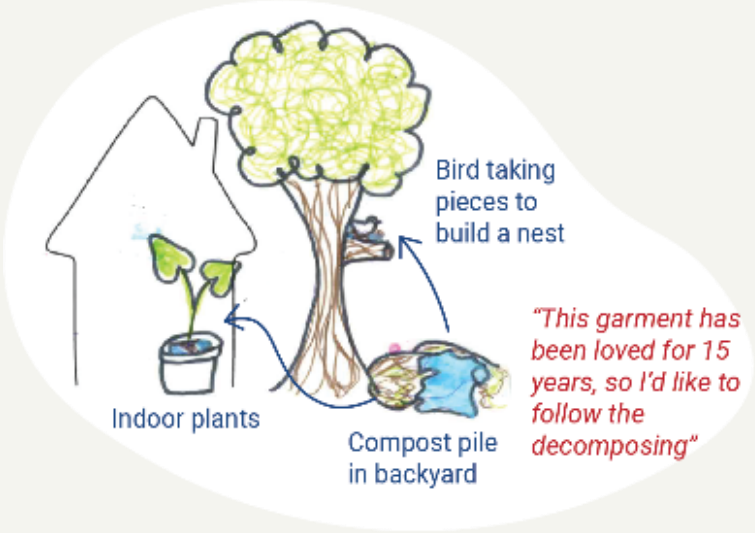


Figure 12 Composting journeys by P6, P14 and P5

Home Compost Bin

Six participants reported using personal compost bins or piles at home, using the compost for their own plants (figure 13).





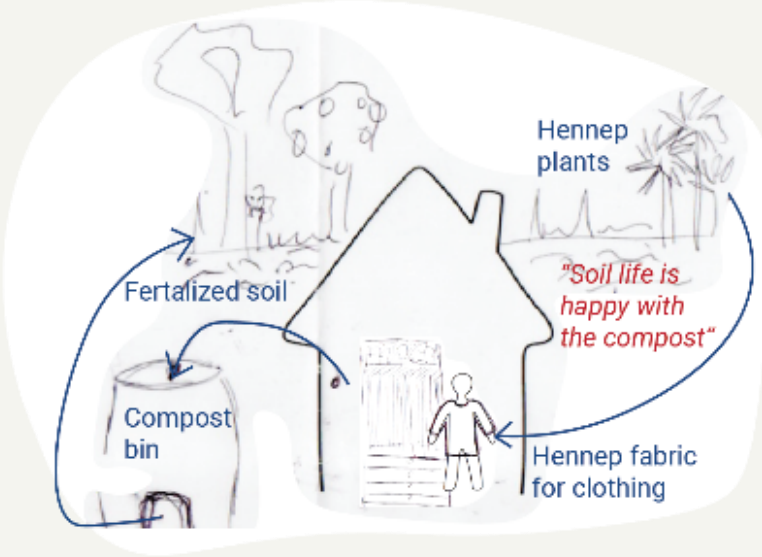


Figure 13 Composting journeys by P4, P3, P10, P8, P12 and P2

DISCUSSION

Labelling of garments

Since most participants expressed a desire to know whether a garment is compostable, one clear goal within the regenerative cycle should be the inclusion of proper labeling and guidance on the garment itself.

One participant noted, “I would like the label to include options for how I could compost them.” Another added, “I would like to know the added benefits for composting my garment.” Both later incorporated their garments into gardening practices. This suggests that personal engagement may increase when users are informed about both the environmental benefits and practical steps involved in composting.

A discussion with Reina from The Knitwit Stable raised an interesting question: would people want others to know they are wearing compostable clothing? Currently, their sweaters include only a label on the inside. However, they’ve observed two contrasting preferences; some people dislike visible branding and would remove external labels if present, while others appreciate a visible label as a conversation starter, allowing them to share the story behind the purchase. As a researcher, I chose to make their label visible on the outside (figure 14), embracing this latter perspective, to invite dialogue and make the regenerative potential of clothing more visible.

Figure 14 The Knitwit Label placed on the outside of a sweater

Compostability of situated material processes

Biodegradation and composting processes likely vary depending on whether garments are composted in a pile or bin, buried directly in soil, or intentionally placed to enhance plant growth. In this research, the term “composting” was deliberately left broad and interpreted as returning garments to the soil for degradation over time. However, other natural interactions, such as birds using textile pieces for nests, plants, roots or seeds being protected by the textile or outside decoration, were part of the stories shared by participants. Moreover, the difference between discarding garments individually or in batches may also influence the composting process. These factors probably influence possible differences between standardized composting tests and the composting results from the situated practices in the results of this research.

There is much knowledge to gain in testing compostability for different materials and in various soil environments, especially with modern chemical additives [32,47]. It’s possible that some of these processes no longer qualify strictly as “composting” if the new function or context slows degradation significantly. Although the central aim of this research is to support regenerative cycles

through composting, it is worth considering whether these materials could serve alternative ecological functions without causing harm, similar to wood, which does not compost quickly but creates its own ecosystem.

The situated nature of these diverse disposal options, combined with the limitations of standardized testing, creates a complex landscape. When testing for a broader scope than compostability, other questions become equally relevant. *Rather than: Is this material degrading? How long does it take? Does it leave behind harmful chemicals or microplastics?* We could ask: *Does it contribute positively to the soil? What organisms are influenced by the introduction of this material? In what ways is the material actually beneficial to the ecosystem, versus simply causing less harm than incineration?* These questions often fall outside the traditional scope of compostability testing, but are relevant when looking at the broad results of this research.

Different after-wear lifecycles might require different testing criteria. The variation in participant outcomes can be seen as many forms of backyard practices [44]. In this research, backyards and balconies emerge as interesting research environments, spaces where more-than-humans influences the research process, but still in small scale manner with proximity. Many of the SE and SWM outcomes in this research revealed this "backyard situatedness," emphasizing the local, lived nature of material degradation.

Designer and researcher Iris Veentjer emphasized the ideal of local cycles, outlining benefits such as shared norms, values, and regulations within the entire system, greater transparency, reduced CO_2 from transport, smaller production scales, and more balanced ecosystems. In practice, this would mean that people in the Netherlands would rely primarily on locally available fibers such as wool, linen, and hemp, rather than cotton. Although she acknowledged that the use of natural materials is currently a higher priority than strictly local systems, her perspective presents an interesting ideological approach to regenerative cycles. This aligns with more-than-human research, such as Situated Biomaterials [40], which explores the use of locally sourced materials in design processes. The authors note, "This led to constraints in material choice but loosened our definitions of what we required from the material." In this context, the requirement might extend beyond compostability, focusing instead on how a material can find a meaningful place within its local ecosystem.

If textile disposal and gardening practices were more closely intertwined, our relationship with clothing might also evolve. Two participants hinted at this possibility: P1 collected compostable garments throughout the year and composted them seasonally, in alignment with gardening cycles. Meanwhile, P11 speculated, "Maybe my garden could trigger a closet clean-up." This hints at a new possibility: aligning garment disposal with seasonal gardening rhythms to deepen the material connection. While it could potentially accelerate the disposal process, it also strengthens the connection to the material origin of our clothing, deepening our awareness of its life cycle.

Desired behavior from an ecological perspective

People's behaviors are largely influenced by the systems they interact with and the knowledge those systems provide. This research took a different approach by directly asking participants about potential disposal options, without imposing a preferred system or prescribing behavior from professionals. This raises an important question: what should the system ultimately prioritize? Should it preserve all disposal options and encourage personal

choice, or should it steer users toward the option that best benefits the environment?

Without extensive prior knowledge, participants imagined involving birds in their disposal journeys during speculative enactments and world mapping exercises. However, it's important to note that birds can become entangled in textile threads when using fabric to build their nests [21]. Such environment-driven insights should inform and motivate wearers' decisions. Another example is Minne from Diekees, who, through her work, had prior knowledge about the benefits of wool in supporting plant roots across different seasonal conditions. She connected this insight to potential applications for clothing as well.

Centralized composting systems could optimize the types and quantities of composted garments, supporting agricultural systems that grow natural fibers. On the other hand, home composting and gardening practices were valued for strengthening people's connection to the garment's origin and life cycle, potentially enhancing the perceived value of the clothing.

As described earlier in the section on 'Compostability of Situated Material Processes,' tests such as compostability assessments and the ecological impact of different materials and additives in different situations, inform the systems we establish and the knowledge communicated to consumers. If centralized disposal is preferred, it would require the development of a new waste infrastructure. In contrast, home composting or gardening solutions demand accessible information, or creative design interventions to encourage these practices. One example of such an intervention is embedding flower seeds into garments, offering a symbolic and functional nudge toward soil-based disposal methods.

Compostable underwear

Understanding which garments are most likely to be composted helps translate ecological preferences into practical design decisions. Since most participants preferred selling or giving away garments over composting, it's important to consider which types of clothing are most likely to be discarded. Transparency about compostability could fade with multiple wearers, as the garment was originally purchased from a brand. This highlights the need for systems that maintain and communicate compostability across users. A practical starting point for compostable clothing would be garments that are discarded quickly, such as underwear and socks, items frequently mentioned in both the speculative enactments and world mappings. Therefore, I find Iris's compostable underpants [42] a particularly smart starting point, offering a practical entry into compostable clothing that could later evolve into garments designed with longer-term use.

Human rituals

Burial rituals provide a unique perspective on this topic, reflecting traditional human interactions with nature and decomposition. Compostable textiles are now being used in human composting processes, typically when a body is composted alongside the fabric [27]. Participants presented this act of disposal, essentially separating from a garment, as similar to a funeral, with a ceremonial farewell. Similar to how home composting can enhance the connection to a garment, such rituals might deepen this emotional bond even further by offering a meaningful goodbye.

The question arises whether we could or should design for these types of rituals. While this research primarily focuses on behaviors that promote environmental regeneration rather than on rituals themselves, the fact that some participants suggested such

practices indicates that designing rituals to support regeneration could be a promising direction for future work. For example, participant P5, who described a ritual as a way of saying goodbye, also noted: “It’s the designer’s task to communicate composting differently, because composting sounds so clinical.” This suggests that a ritual-focused approach may require a new vocabulary, one less focused on biological processes. However, I would argue that any such approach should maintain a strong connection with nature, since the overarching goal of this research remains to integrate natural processes into the regenerative cycle.

Participants and method

This reflection on participant engagement and the methodological design supports the interpretive reliability of the findings presented, offering context for how the data was shaped by both the tools used and the participants involved.

The participants in this study were generally highly engaged with the topic of compostable clothing, which enriched the quality of insights but may have introduced a bias in favor of home composting. Their existing interest in composting likely influenced their preference for personal over centralized disposal methods, making the findings less representative of average consumer behavior.

While speculative enactments (SE) were intended to serve as an exploration for the Speculative World Mapping (SWM) exercise, offering a grounded, experiential prompt for decision-making, this connection was not explicitly tested. In some cases, parallels between the enactments and the mapping stories hinted at a possible influence, but in others, the narratives diverged significantly. SE ultimately served more as a reflective experience, while SWM provided structured, analyzable data that was more conclusive than exploratory.

Overall, the SWM exercise proved to be an effective method for collecting rich qualitative data in a relatively short timeframe. With 15 participants, the quantity of data was substantial but manageable, thanks to the pre-structured and visual nature of the maps, which minimized the need for extensive data preparation. Still, the absence of follow-up questions, especially with student participants, may have limited the depth of some insights. In contrast, expert interviews allowed for clarification and deeper understanding.

The combination of a visual framework and clearly defined questions encouraged expressive, creative responses, particularly among design students accustomed to working visually. This likely contributed to the high visual quality of many of the maps. However, future research should explore how well this visual mapping approach translates to a broader, more diverse participant base beyond design-oriented individuals.

The transparent structure of the mapping pages was intended to foster a sense of continuity, encouraging participants to perceive the three pages as one cohesive story rather than separate parts. However, in practice, participants didn't appear to actively build upon the visual layers beneath each page, likely due to the complexity and visual chaos this layering introduced. In this research, the transparency served primarily as a data-gathering tool rather than a tested methodological feature, but it raised valuable questions for future exploration. Specifically, the potential of layered transparency to add narrative depth and meaning could be further investigated as a method in its own right. This idea resonates with research on collaborative annotation [41], where layering is used to involve multiple voices in one visual field, although in this case, the layering was individual rather than collective. Exploring how layered visual storytelling affects meaning-making could be a promising direction for future methodological development.

Figure 15 Speculative world mapping executed by a participant

CONCLUSION

In a regenerative system, the goal is not merely to reduce harm but to actively contribute to ecosystems. This study explores how compostable clothing could integrate into such systems.

Through this research, 15 participants speculated on their engagement in disposing of compostable garments. First, they explored possibilities through speculative enactments, followed by visually mapping probable behaviors using the Speculative World Mapping exercise. This method proved effective in generating qualitative, structured visual narratives that reflect the situated complexities of these interactions.

The analysis of all collected narratives revealed four major themes in composting journeys: home composting, the involvement of clothing in gardening practices, funeral-like burial rituals, and centralized facility processing. These differing approaches to composting sometimes diverged from its conventional definition, instead expanding the spectrum of how natural textiles could become part of a broader, more-than-human ecosystem. This raises important questions about whether material composting alone is the only correct method for integrating clothing into regenerative systems. Transparency throughout the entire lifecycle and clear labeling appear crucial for enabling responsible disposal decisions, while existing human rituals and habits may also offer valuable insights for this field.

And so, the future of compostable clothing in regenerative ecosystems may depend not just on material innovation, but on reshaping cultural practices and systemic infrastructure to support sustainable transitions.

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Generative AI, specifically ChatGPT, was used as a tool to support grammar improvement and enhance the writing flow of this report. No text was solely generated by ChatGPT, and no participant data was used in prompts. A selection of example prompts used appears at the end of the reference list.

REFERENCES

[1] A T M Faiz Ahmed, Md Zahidul Islam, Md Sultan Mahmud, Md Emdad Sarker, and Md Reajul Islam. 2022. Hemp as a potential raw material toward a sustainable world: A review. Heliyon 8, 1: e08753. https://doi.org/10.1016/j.heliyon.2022.e08753

[2] Wendy Alwala, Antonia Perju, Mary Schwarz, Jean Bonhotal, Steven Pires, Mary Ankeny, Jesse Daystar, and Margaret Frey. 2024. The compostability of denim fabrics dyed with various indigos. BioResources 19, 2: 2685–2700. https://doi.org/10.15376/biores.19.2.2685-2700

[3] Fiona Bell, Nadia Campo Woytuk, Marie Louise Juul Søndergaard, and Mirela Alistar. 2024. Biodegradation as More-than-Human Unmaking. ACM Trans. Comput.-Hum. Interact. 31, 6, Article 79 (December 2024), 41 pages. https://doi.org/10.1145/3685526

[4] Closed Loop Partners. 2024. Unpacking Labeling and Design: U.S. consumer perception of compostable packaging - Closed loop partners. Retrieved from https://www.closedlooppartners.com/research/us-consumer-perception-of-compostable-packaging

[5] S. Collie, P. Brorens, M. Hassan, and I. Fowler. 2024. Biodegradation behavior of wool and other textile fibers in aerobic composting conditions. International Journal of Environmental Science and Technology. https://doi.org/10.1007/s13762-024-05802-6

[6] Diekees. Diekees: Circular design from natural resources. Retrieved from https://diekees.nl/

[7] Epstein Eliot. 2017. The science of composting. https://doi.org/10.1201/9780203736005

[8] Ellen MacArthur Foundation. 2017. A New Textiles Economy: Redesigning Fashion's Future. Retrieved from https://ellenmacarthurfoundation.org/a-new-textiles-economy

[9] Chris Elsden, David Chatting, Abigail C. Durrant, Andrew Garbett, Bettina Nissen, John Vines, and David S. Kirk. 2017. On Speculative Enactments. In Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems (CHI '17). Association for Computing Machinery, New York, NY, USA, 5386–5399. https://doi.org/10.1145/3025453.3025503

[10] Mohammad-Javad Esmaeilzadeh and Abbas Rashidi. 2018. Evaluation of the disintegration of linen fabric under composting conditions. Environmental Science and Pollution Research 25, 29: 29070–29077. https://doi.org/10.1007/s11356-018-2917-y

[11] Fibershed. 2025. Annual Report 2024. Retrieved from https://fibershed.org/annual-report/

[12] Fibershed Nederland. Fibershed Nederland: A regional fiber system for a regenerative textile economy. Retrieved from https://fibershed.nl/ [E1]

[13] Devon Greyson. 2013. Information world mapping: A participatory, visual, elicitation activity for information practice interviews. Proceedings of the American Society for Information Science and Technology 50, 1: 1–4. https://doi.org/10.1002/meet.14505001104

[14] Danika Gupta and Atul Dubey. 2024. Towards Improved Sustainability in The Textile Lifecycle with Deep Learning. In Proceedings of the 7th ACM SIGCAS/SIGCHI Conference on Computing and Sustainable Societies (COMPASS '24). Association for Computing Machinery, New York, NY, USA, 220–229. https://doi.org/10.1145/3674829.3675077

[15] Sofía Guridi, Matteo Iannacchero, and Emmi Pouta. 2024. Towards More Sustainable Interactive Textiles: A Literature Review on The Use of Biomaterials for eTextiles. In Proceedings of the 2024 CHI Conference on Human Factors in Computing Systems (CHI '24). Association for Computing Machinery, New York, NY, USA, Article 518, 1–19. https://doi.org/10.1145/3613904.3642581

[16] Sofía Guridi, Emmi Pouta, Ari Hokkanen, and Aayush Jaiswal. 2023. LIGHT TISSUE: Development of cellulose-based optical textile sensors. In Proceedings of the Seventeenth International Conference on Tangible, Embedded, and Embodied Interaction (TEI '23). Association for Computing Machinery, New York, NY, USA, Article 27, 1–14. https://doi.org/10.1145/3569009.3572798

[17] Mira Alida Haberfellner, Samuel Zühlke, Leopold Boess, Kathrin Probst, and Michael Haller. 2024. Threads of Traceability: Textile IDs in the Fabric of Sustainable Fashion. In Proceedings of the 2024 ACM Designing Interactive Systems Conference (DIS '24). Association for Computing Machinery, New York, NY, USA, 3063–3078. https://doi.org/10.1145/3643834.3661531 [CC]

[18] Fatema Tuj Jahura and Amrut Sadachar. 2024. Determinants of Consumers' Sustainable Disposal Behavior of Clothing Items. International Textile and Apparel Association Annual Conference Proceedings 80, 1. https://doi.org/10.31274/itaa.17113

[19] Stijntje Jaspers. 2024. Design voor Composteerbaarheid - Stichting Fibershed Nederland. Stichting Fibershed Nederland. Retrieved from https://fibershed.nl/design-voor-composteerbaarheid

[20] Joline Jolink. Joline Jolink: Slow fashion brand. Retrieved from https://www.jolinejolink.com/
[21] Amelia Langas. 2025. What nesting materials are safe for birds? Audubon. Retrieved from https://www.audubon.org/magazine/what-nesting-materials-are-safe-birds
[22] Eldy S. Lazaro Vasquez, Mirela Alistar, Laura Devendorf, and Michael L. Rivera. 2024. Desktop Biofibers Spinning: An Open-Source Machine for Exploring Biobased Fibers and Their Application Towards Sustainable Smart Textile Design. In Proceedings of the 2024 CHI Conference on Human Factors in Computing Systems (CHI '24). Association for Computing Machinery, New York, NY, USA, Article 856, 1–18. https://doi.org/10.1145/3613904.3642387
[23] Eldy S. Lazaro Vasquez, Lily M Gabriel, Mikhaila Friske, Shanel Wu, Sasha De Koninck, Laura Devendorf, and Mirela Alistar. 2023. Designing Dissolving Wearables. In Adjunct Proceedings of the 2023 ACM International Joint Conference on Pervasive and Ubiquitous Computing & the 2023 ACM International Symposium on Wearable Computing (UbiComp/ISWC '23 Adjunct). Association for Computing Machinery, New York, NY, USA, 286–290. https://doi.org/10.1145/3594739.3610781
[24] Eldy S. Lazaro Vasquez and Katia Vega. 2019. Myco-accessories: sustainable wearables with biodegradable materials. In Proceedings of the 2019 ACM International Symposium on Wearable Computers (ISWC '19). Association for Computing Machinery, New York, NY, USA, 306–311. https://doi.org/10.1145/3341163.3346938
[25] Lili Li, Margaret Frey, and Kristie J Browning. 2010. Biodegradability Study on cotton and polyester fabrics. Journal of Engineered Fibers and Fabrics 5, 4. https://doi.org/10.1177/155892501000500406
[26] Kate Lyons. 2024. Poor labelling allows 'massive amounts' of plastic into Australia's garden waste, companies warn. The Guardian. Retrieved from https://www.theguardian.com/environment/2024/dec/01/australia-plastic-contamination-food-garden-waste-compostable-coffee-cups
[27] Jeff Meilander and J Gregory Caporaso. 2024. Microbiome science of human excrement composting. The ISME Journal 18, 1. https://doi.org/10.1093/ismejo/wrae228
[28] Ministry of Infrastructure and Watermanagement. 2024. Policy Programme for Circular Textiles 2025–2030. Retrieved from https://www.government.nl/binaries/government/documenten/reports/2024/12/31/policy-programme-for-circular-textile-2025-2030/Policy%2BProgramme%2Bfor%2BCircular%2BTextile%2B2025-2030.pdf [N]
[29] Reazuddin Repon, Barshan Dev, Md Ashikur Rahman, Sigita Jurkonienė, Aminoddin Haji, Md. Abdul Alim, and Eglė Kumpikaitė. 2024. Textile dyeing using natural mordants and dyes: a review. Environmental Chemistry Letters 22, 3: 1473–1520. https://doi.org/10.1007/s10311-024-01716-4
[30] Marc Ruyg. 2024. Merendeel Nederlandse schapenwol verdwijnt op de brandstapel en dat moet anders. NH Nieuws. Retrieved from https://www.nhnieuws.nl/nieuws/332605/merendeel-nederlandse-schapenwol-verdwijnt-op-de-brandstapel-en-dat-moet-anders
[31] Gustav Sandin and Greg M. Peters. 2018. Environmental impact of textile reuse and recycling – A review. Journal of Cleaner Production 184: 353–365. https://doi.org/10.1016/j.jclepro.2018.02.266
[32] Lindsey Siegele. 2024. Closing the loop: Can compostable textiles help lead us into the future? Fibershed. Retrieved from https://fibershed.org/2024/07/03/closing-the-loop-can-compostable-textiles-help-lead-us-into-the-future/
[33] Katherine W Song, Fiona Bell, Himani Deshpande, Ilan Mandel, Tiffany Wun, Mirela Alistar, Leah Buechley, Wendy Ju, Jeeeun Kim, Eric Paulos, Samar Sabie, and Ron Wakkary. 2024. Sustainable Unmaking: Designing for Biodegradation, Decay, and Disassembly. In Extended Abstracts of the CHI Conference on Human Factors in Computing Systems (CHI EA '24). Association for Computing Machinery, New York, NY, USA, Article 489, 1–7. https://doi.org/10.1145/3613905.3636300
[34] Katherine W Song and Eric Paulos. 2021. Unmaking: Enabling and Celebrating the Creative Material of Failure, Destruction, Decay, and Deformation. In Proceedings of the 2021 CHI Conference on Human Factors in Computing Systems (CHI '21). Association for Computing Machinery, New York, NY, USA, Article 429, 1–12. https://doi.org/10.1145/3411764.3445529
[35] Vildan Sülar and Gökberk Devrim. 2019. Biodegradation behaviour of different textile fibres: visual, morphological, structural properties and soil analyses. Fibres and Textiles in Eastern Europe 27, 1(133): 100–111. https://doi.org/10.5604/01.3001.0012.7751
[36] Textile Exchange. 2024. Glossary - Textile Exchange. Retrieved from https://textileexchange.org/glossary

[37] Textile Exchange. 2022. Preferred Fiber and Materials Market Report 2022. Retrieved from https://textileexchange.org/app/uploads/2022/10/Textile-Exchange_PFMR_2022.pdf
[38] Textile Exchange. 2025. Textile Exchange updates Regenerative Agriculture Outcome Framework - Textile Exchange. Retrieved from https://textileexchange.org/news/textile-exchange-updates-regenerative-agriculture-outcome-framework
[39] The Knitwit Stable. The Knitwit Stable: Dutch wool from sheep to shop. Retrieved from https://theknitwitstable.nl/en/pages/over-ons
[40] Lauren Thu and Ron Wakkary. 2025. Designing-With and Situating Biomaterials. In Proceedings of the Extended Abstracts of the CHI Conference on Human Factors in Computing Systems (CHI EA '25). Association for Computing Machinery, New York, NY, USA, Article 187, 1–6. https://doi.org/10.1145/3706599.3720039
[41] Elvia Vasconcelos, Kristina Andersen, and Ron Wakkary. 2024. Who is holding the pen? Annotating collaborative processes. In Proceedings of the 13th Nordic Conference on Human-Computer Interaction (NordiCHI '24). Association for Computing Machinery, New York, NY, USA, Article 65, 1–12. https://doi.org/10.1145/3679318.3685401
[42] Iris Veentjer. Undergarden: Design research into biodiversity and textiles. Studio i Focus. Retrieved from https://www.studioifocus.nl/portfolio-item/_undergarden_/
[43] Iris Veentjer. Rietgoed: Regenerative design for the Dutch landscape. Studio i Focus. Retrieved from https://www.rietgoed.nl/
[44] Ron Wakkary, Doenja Oogjes, Oscar Tomico, Nazmus Sakib, and Ege Kökel. 2025. Backyard Practices: A Liminal Approach to Designing in More-than-Human Worlds. In Proceedings of the 2025 CHI Conference on Human Factors in Computing Systems (CHI '25). Association for Computing Machinery, New York, NY, USA, Article 768, 1–18. https://doi.org/10.1145/3706598.3713291
[45] Irmandy Wicaksono, Aditi Maheshwari, Don Derek Haddad, Joseph Paradiso, and Andreea Danielescu. 2024. Design and Fabrication of Multifunctional E-Textiles by Upcycling Waste Cotton Fabrics through Carbonization. Proc. ACM Interact. Mob. Wearable Ubiquitous Technol. 8, 2, Article 45 (June 2024), 31 pages. https://doi.org/10.1145/3659588
[46] Irena Wojnowska-Baryła, Katarzyna Bernat, and Magdalena Zaborowska. 2022. Strategies of recovery and organic recycling used in textile waste management. International Journal of Environmental Research and Public Health 19, 10: 5859. https://doi.org/10.3390/ijerph19105859
[47] Diana A. Wyman and Sonja Salmon. 2024. Critical factors in Lab-Scale compostability testing. Journal of Polymers and the Environment. https://doi.org/10.1007/s10924-024-03311-8
[48] MinYoung Yoo, Sophia Ppali, William Odom, Yumeng Zhuang, Kritika Kritika, Wyatt Olson, Catherine Wieczorek, Heidi Biggs, Arne Berger, Audrey Desjardins, Ron Wakkary, and Kathryn E. Ringland. 2025. Translating HCI Research to Broader Audiences: Motivation, Inspiration, and Critical Factors on Alternative Research Outcomes. In Proceedings of the 2025 CHI Conference on Human Factors in Computing Systems (CHI '25). Association for Computing Machinery, New York, NY, USA, Article 455, 1–24. https://doi.org/10.1145/3706598.3713884
[49] Jingwen Zhu, Lily Winagle, and Hsin-Liu (Cindy) Kao. 2024. EcoThreads: Prototyping Biodegradable E-textiles Through Thread-based Fabrication. In Proceedings of the 2024 CHI Conference on Human Factors in Computing Systems (CHI '24). Association for Computing Machinery, New York, NY, USA, Article 857, 1–17. https://doi.org/10.1145/3613904.3642718

The following prompts have been used throughout this report to improve the text.

1. Could you give feedback on the following text, especially focusing on:

- Things that are grammatically incorrect

- Sentences that could really use improvement, with suggestions

- If the main flow is clear is if there needs to be sentences that could link separate parts

- If part really unnecessary or mentioned multiple times

2. This text is the draft of the xx section of my report. Could you highlight and structure the key points that I am making here.

3. Could you improve this text to improve the grammar and conciseness of the text, while keeping all the content.