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Household Repair Cultures and Material Consumption Reduction

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Abstract

Household material consumption is shaped not only by what consumers purchase but also by what they maintain, repair, continue using, and ultimately decide not to replace. Repair therefore represents a potentially important mechanism for slowing product turnover and reducing demand for material-intensive replacement goods. However, repair behavior cannot be understood solely as an individual environmental preference. It depends on interconnected household competences, maintenance routines, emotional relationships with objects, product repairability, access to tools and repair services, spare-part availability, economic considerations, and prevailing expectations regarding replacement. This study develops a household repair-culture framework for evaluating how these conditions may influence material-consumption reduction. Because authenticated household surveys, repair diaries, and material-flow measurements were not supplied, the quantitative component is explicitly designed as a simulation-based methodological study.

A synthetic population of 180 households is evaluated across clothing, furniture and homewares, small electrical appliances, large household appliances, and consumer electronics. A Household Repair Culture Index is developed from repair competence, preventive-maintenance routines, repair accessibility, product attachment and care, and replacement restraint. Material effects are represented through an Annual Material-Replacement Demand Index that records the relative replacement burden associated with products leaving household use. Simulated results indicate progressively lower replacement demand as repair culture strengthens. High repair-culture households record a mean material-replacement demand index of 69.1 compared with 101.0 among low repair-culture households, representing a simulated relative difference of approximately 31.5%.

The findings do not imply that repair automatically produces equivalent reductions in physical resource use, because rebound consumption, inefficient older products, unsuccessful repairs, and product-specific environmental trade-offs must also be considered. The study nevertheless demonstrates that repair culture can be conceptualized as a socio-material household capability capable of delaying replacement and supporting product longevity. Effective policy should therefore address skills, affordability, product design, repair infrastructure, information access, and cultural expectations simultaneously rather than treating repair as an isolated consumer choice.

Keywords: repair culture, household consumption, material consumption, product longevity, circular economy, sustainable consumption, repair behavior, sufficiency.

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1. Introduction

Household consumption contributes to material demand not only through the number and type of products acquired but also through the speed with which existing products are replaced. A product that remains functionally useful for an extended period postpones the production, distribution, and acquisition of a replacement, whereas premature disposal accelerates material throughput even where discarded materials are subsequently recycled. Cooper's concept of slower consumption established an early connection between longer product lifetimes, sufficiency, and reduced pressure from the continuous turnover of household goods. He argued that product longevity deserves attention alongside conventional efficiency improvements because sustainable consumption cannot be separated from the duration for which products remain in use.

Repair is one of the principal practices through which households can extend those use periods. Yet repairing an object is substantially more complex than deciding whether environmental protection is desirable. Gregson, Metcalfe, and Crewe's ethnographic examination of household maintenance demonstrated that cleaning, maintenance, quick fixes, restoration, and repair form part of the changing social lives of ordinary consumer objects. Their research emphasized the importance of household competence and the meanings attributed to objects rather than treating repair as a purely technical intervention. Later work on repair behavior reached a comparable conclusion. Jaeger-Erben, Frick, and Hipp found that repair likelihood is connected with social and material settings, meanings, competences, prior repair experience, and product type, reinforcing an interpretation of repair as an everyday social practice rather than a single purchase decision.

The environmental relevance of these practices is closely connected with product longevity. Bakker, Wang, Huisman, and den Hollander demonstrated that extending product life can provide significant environmental advantages for selected durable products and emphasized that appropriate lifetime-extension strategies depend on product characteristics. Bocken and colleagues subsequently positioned lifetime extension within the broader circular-economy strategy of slowing resource loops. Repair, reuse, durable design, refurbishment, and related approaches can reduce the frequency with which products move from production to disposal, although their actual resource implications remain dependent on technological efficiency, product condition, and subsequent consumption behavior.

Repair behavior nevertheless encounters structural barriers that households cannot solve through motivation alone. Research on consumer electronics has identified problems involving inaccessible components, unavailable repair information, spare-part restrictions, specialized tools, high service costs, product designs that inhibit disassembly, and economic conditions in which replacement appears more attractive than repair. Svensson-Hoglund and colleagues therefore conceptualized repairability as an issue involving infrastructure and systems, business and industry, and consumer culture rather than only individual willingness. Terzioğlu likewise demonstrated that technical, emotional, and value-related considerations interact in shaping the decision to repair, while Jensen, Laursen, and Haase identified barriers to product longevity across business, product-development, and user perspectives.

Against this background, the present study investigates Household Repair Cultures and Material Consumption Reduction through a simulation-based methodological framework. The term *repair culture* is used to describe a relatively stable household orientation in which maintaining, diagnosing, repairing, adapting, and continuing to use products are normalized practices supported by skills, accessible

resources, and meanings that favor continued use over premature replacement. The study develops a Household Repair Culture Index and connects it with a relative measure of material-replacement demand. No claim is made that the synthetic results describe a real population. Instead, the study establishes a transparent analytical architecture that can subsequently be validated through longitudinal household surveys, repair diaries, product-level material data, and verified replacement records.

2. Objectives of the Study

2.1 To Develop a Multidimensional Household Repair Culture Framework

The first objective is to develop an analytical framework that treats repair culture as more than an individual's stated willingness to fix broken products. A household can express environmentally favorable attitudes while still replacing products rapidly if repair costs are excessive, spare parts are inaccessible, household members lack confidence, or products are deliberately difficult to disassemble. Conversely, households with modest environmental motivations may nevertheless maintain products extensively because repair skills, frugality, attachment, or established family routines make repair normal.

The study therefore conceptualizes household repair culture through five interacting dimensions: practical repair competence, preventive-maintenance routines, access to repair resources, attachment and care toward household objects, and restraint toward premature replacement. This multidimensional approach allows the analysis to distinguish between households that merely prefer repair in principle and households in which repair is supported by actual routines and material conditions.

2.2 To Examine the Relationship Between Repair Culture and Replacement Demand

The second objective is to assess whether stronger repair cultures are associated with lower simulated demand for replacement goods. Repair can reduce material throughput only when it produces additional periods of useful product service. An unsuccessful repair that is immediately followed by replacement may consume additional parts and labor without materially extending product life.

The analysis therefore evaluates repair outcomes together with replacement frequency and estimated product-level material burden. The focus is not simply the number of repairs completed but whether repair postpones the acquisition of substitute goods. This approach places material-consumption reduction at the center of the framework rather than assuming that every repair activity produces identical environmental benefits.

2.3 To Identify the Conditions Under Which Repair Becomes a Stable Household Practice

The third objective is to evaluate how household-level conditions interact with product and infrastructure characteristics. Repair competence can be ineffective when products cannot be opened; repairable products can still be replaced when service costs approach the price of new alternatives; and strong emotional attachment cannot always overcome safety or technological obsolescence.

The study therefore interprets household repair culture as a capability emerging from the interaction of people, products, services, knowledge, and social meanings. This perspective supports interventions that extend beyond environmental-awareness campaigns toward repairable product design,

accessible spare parts, local repair ecosystems, skill development, diagnostic information, and stronger cultural legitimacy for keeping products in service.

3. Review of Literature

3.1 Product Longevity, Slower Consumption, and Material Throughput

Cooper's work on slower consumption provides an important conceptual starting point because it identifies product lifetime as a key variable connecting household behavior with resource demand. Longer use periods can reduce the frequency of replacement and thereby slow material throughput, although their environmental advantages vary according to product efficiency and technological change. This qualification is especially important for household appliances, where retaining a very inefficient product may sometimes create greater use-phase impacts than replacing it with a substantially more efficient alternative.

Bakker and colleagues investigated this trade-off for refrigerators and laptops and concluded that product life extension was preferable for the cases they modeled. Their analysis reinforces the proposition that durability and lifetime extension can be important design objectives, while also demonstrating that appropriate lifetimes should be evaluated using product-specific life-cycle evidence rather than generalized assumptions. Bakker, Mugge, Boks, and Oguchi later emphasized the broader need to understand and manage product lifetimes through durability, reuse, repair, refurbishment, remanufacturing, and circular business models.

Replacement decisions are also influenced by perceived obsolescence rather than physical breakdown alone. Wieser and Tröger's study of mobile-phone replacement, repair, and reuse found that perceived obsolescence played an important role in replacement behavior and that longer expected product longevity could increase the attractiveness of repair and reuse. Consequently, the relationship between repair and material consumption cannot be reduced to failure events. Products can leave household use because they are perceived as unfashionable, technologically outdated, inconvenient, or no longer aligned with users' expectations even when technically repairable.

3.2 Repair as Household Practice, Skill, and Care

Research on household maintenance has demonstrated that repair is embedded in everyday practices of caring for material objects. Gregson, Metcalfe, and Crewe showed that consumer objects undergo continual maintenance, adjustment, quick fixes, and restoration within the home and that these activities influence whether objects remain incorporated into everyday life or become candidates for disposal. Repair culture can therefore be understood as part of household material competence rather than simply a reaction occurring when a product fails.

Jaeger-Erben, Frick, and Hipp explicitly examined repair through social-practice concepts and found that meanings, competences, and material arrangements help explain why users repair some products and replace others. Their work suggests that previous repair experience can reinforce later repair behavior, indicating the possibility of cumulative household learning. Terzioğlu similarly identified a wide range of technical, emotional, and value-related factors influencing user repair decisions, demonstrating that repair depends on interactions between the user and the characteristics of the product.

Community repair introduces an additional cultural mechanism by creating spaces in which repair is visible and socially legitimate. Van der Velden's research characterizes community repair as a socio-material practice involving tinkering, sharing, product attachment, and care rather than merely a stage in circular material flows. Meißner identified dimensions of care directed toward objects, other people, community, and environment within repair-café practices. Moalem and Mosgaard's review similarly concluded that repair cafés can support product lifetime extension while serving educational, social, and cultural functions, although their broader sustainability contribution depends on the conditions under which participation translates into continued repair behavior.

3.3 Structural Barriers to Repair and the Limits of Individual Responsibility

Repair culture cannot become widespread when product and market systems consistently reward replacement. Svensson-Hoglund and colleagues documented multiple barriers within consumer-electronics repair, including design limitations, access to parts and information, legal restrictions, specialized-tool requirements, low replacement prices, and weak repair-sector profitability. Their repair-society perspective demonstrates that consumer culture forms only one part of a broader institutional environment.

Product design is particularly consequential because households cannot maintain items whose construction prevents reasonable intervention. Bracquené and colleagues compared repairability-assessment systems for washing machines and emphasized the importance of measurable design characteristics for supporting repair and longer product use. Jensen, Laursen, and Haase's review further demonstrates that product longevity can be constrained at multiple levels, including business strategy, product development, and user behavior.

The literature therefore suggests a research gap between three bodies of work: studies examining product repairability, research on individual repair motivations, and circular-economy scholarship concerned with resource-loop slowing. Comparatively fewer frameworks directly connect a household-level culture of repair with a measurable reduction in replacement-related material demand. The present study addresses this gap by conceptualizing repair culture as a multidimensional household capability and modeling its potential influence on replacement throughput.

4. Research Methodology

4.1 Research Design and Synthetic Household Portfolio

The study employs a quantitative simulation-based methodological design. No authenticated household surveys, purchase histories, product weights, repair-service records, waste audits, or material-flow accounts were supplied. Accordingly, the numerical results presented below should not be interpreted as measurements from actual households.

A synthetic population of 180 households is constructed and divided into three repair-culture categories: low, moderate, and high. Each household is assigned a portfolio of consumer products across five categories: clothing and textiles, furniture and homewares, small electrical appliances, large household appliances, and consumer electronics. Product observations include simulated failure events, maintenance frequency, repair attempts, repair outcomes, replacement events, and relative material burden.

The analytical design deliberately distinguishes repair attempt from successful lifetime extension. A repair contributes to the material-reduction outcome only when the product remains in use for an additional period and replacement is delayed.

Table 1: Variables Used to Measure Household Repair Culture and Material Demand

Analytical Dimension	Operational Indicator	Interpretation	Expected Relationship
Repair competence	Ability to diagnose, sew, adjust, disassemble, or undertake minor repair	Practical capacity to intervene when products deteriorate	Higher competence should increase repair attempts
Maintenance routine	Frequency of cleaning, servicing, adjustment, and preventive care	Indicates whether product care occurs before complete failure	Stronger maintenance should extend functional life
Repair accessibility	Availability of tools, information, spare parts, local services, or knowledgeable helpers	Represents the material infrastructure enabling repair	Greater access should improve repair feasibility
Attachment and care	Willingness to preserve familiar or valued possessions	Represents meanings supporting continued use	Higher attachment can increase repair motivation
Replacement restraint	Propensity to retain functional products despite new alternatives	Captures resistance to premature or fashion-driven replacement	Greater restraint should reduce turnover

4.2 Construction of the Household Repair Culture Index

The index ranges from 0 to 1. Values below 0.40 represent comparatively weak repair culture, values from 0.40 to below 0.70 represent moderate repair culture, and values of 0.70 or above represent comparatively strong repair culture.

Equal weighting is used to preserve methodological transparency. A real empirical study could estimate alternative weights using factor analysis, structural-equation modeling, or longitudinal prediction of actual repair outcomes. Sensitivity analysis should also be conducted because the relationship between repair dimensions is likely to differ across products. Repair competence may strongly influence clothing repair, for example, whereas authorized-service access may be more important for complex appliances.

4.3 Material-Replacement Demand and Analytical Procedure

Material-consumption reduction is represented through an Annual Material-Replacement Demand Index (AMRDI). The index does not claim to calculate kilograms of economy-wide material extraction. Instead, it compares the relative material burden of replacement purchases within the synthetic household portfolio.

An AMRDI of 100 therefore represents approximately average replacement-related material demand within the modeled portfolio. Lower values indicate less replacement burden, while values above 100 indicate comparatively high product turnover.

This percentage represents a difference in the synthetic replacement-demand index rather than a verified reduction in actual raw-material extraction. Actual environmental performance would require product-specific life-cycle inventories, embodied material data, energy use, repair parts, rebound effects, and observed product lifetimes.

5. Analysis

5.1 Repair Practices Across Household Culture Levels

The simulation produces clear differences in how households respond when products deteriorate. Low repair-culture households frequently move directly from perceived failure to replacement, particularly for low- and medium-cost goods. Repair attempts are concentrated in simple clothing adjustments and minor furniture maintenance, while electronics and small appliances are more frequently replaced.

Moderate repair-culture households display greater willingness to obtain diagnostic information and compare repair costs with replacement. These households make greater use of repair services and informal assistance but remain sensitive to inconvenience, waiting time, and uncertainty concerning repair success.

High repair-culture households show a different sequence of responses. Maintenance begins before severe failure, households retain basic tools and repair knowledge, and replacement is more frequently treated as the final rather than first response to deterioration. High repair culture does not imply universal do-it-yourself repair. Professional repair, community assistance, warranty service, and component replacement all contribute where appropriate.

Table 2: Simulated Household Repair Culture and Material-Replacement Outcomes

Repair-Culture Group	Mean HRCI	Repair Attempt Rate	Successful Lifetime-Extension Rate	Mean AMRDI	Relative Position
Low repair culture	0.31	34%	23%	101.0	Highest replacement burden
Moderate repair culture	0.56	57%	44%	84.6	Intermediate replacement burden

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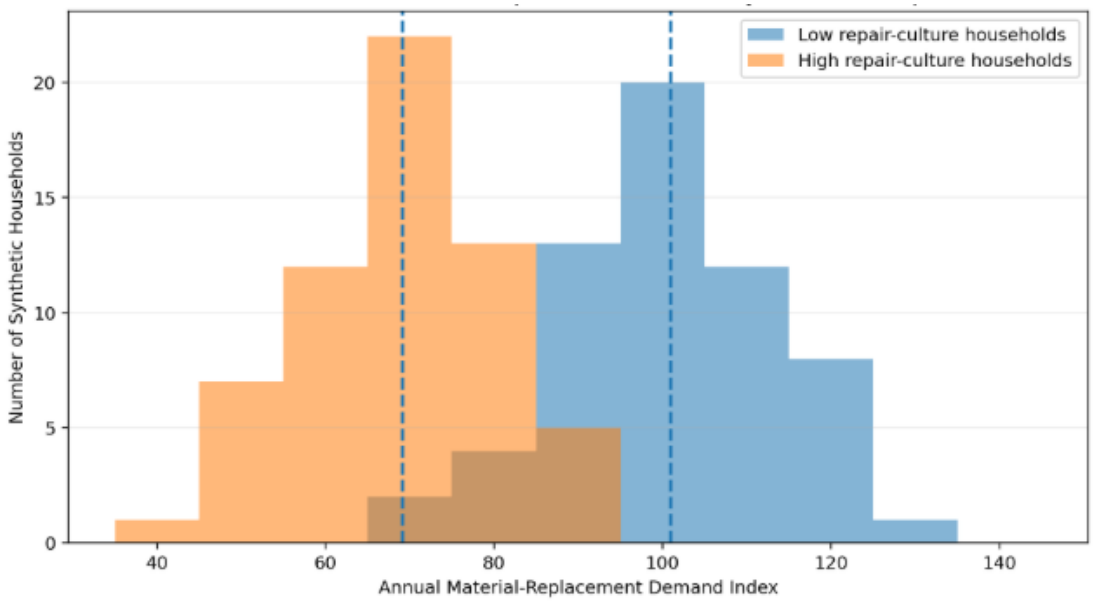
Repair-Culture Group	Mean HRCI	Repair Attempt Rate	Successful Lifetime-Extension Rate	Mean AMRDI	Relative Position
High repair culture	0.81	78%	65%	69.1	Lowest replacement burden

The results suggest that the material effect is generated through a sequence rather than a single behavior. Stronger repair culture increases the probability that repair will be attempted; better competence and access increase the probability that the attempt will succeed; and replacement restraint increases the likelihood that the repaired product will continue to be used rather than being replaced for nonfunctional reasons.

5.2 Repair Culture and the Distribution of Replacement Demand

Graph 1: Simulated Distribution of Material-Replacement Demand by Household Repair Culture



The histogram shows a pronounced shift in the distribution of replacement demand. Low repair-culture households cluster around a mean AMRDI of 101.0, whereas high repair-culture households cluster around 69.1. Some overlap remains because repair culture is not the only determinant of replacement. Household size, product age, accidental failure, affordability, safety considerations, and unavoidable technological requirements can produce replacement even among households strongly oriented toward repair.

The relative difference between the group means is approximately 31.5%. The methodological interpretation is that stronger household repair culture can plausibly produce a meaningful reduction in replacement-related material demand when repair genuinely extends product use. It should not be

interpreted as evidence that every repaired product reduces total environmental impacts by the same percentage.

Key Finding: The simulation suggests that household repair culture affects material consumption primarily by delaying replacement cycles, rather than simply by increasing the number of repair activities.

5.3 Product Category Differences and Limits to Repair-Based Reduction

The strength of the repair-consumption relationship differs substantially across product categories. Clothing shows relatively high potential for household repair because basic sewing, patching, fastening replacement, and alteration can often be performed with low-cost tools. Furniture and homewares similarly permit maintenance, refinishing, tightening, reupholstery, or component replacement, particularly where products are physically accessible.

Consumer electronics create greater structural constraints. Wieser and Tröger found that replacement, repair, and reuse decisions for mobile phones are strongly influenced by perceived obsolescence and expected product longevity. For contemporary electronic products, software support, battery accessibility, proprietary components, diagnostic restrictions, and rapid technological change may weaken the relationship between household motivation and actual repair.

Large appliances occupy an intermediate position. Repair can avoid material-intensive replacement, but professional service costs and component accessibility often determine feasibility. Bracquené and colleagues' repairability analysis of washing machines demonstrates why design-level characteristics influence whether lifetime extension is practical. These variations reinforce the need to interpret repair culture alongside product-specific repairability rather than attributing replacement behavior entirely to household preference.

6. Discussion

6.1 Repair Culture as a Socio-Material Capability

The principal implication of the study is that repair culture should be understood as a household capability rather than a narrowly defined environmental attitude. Repair occurs when competence, product design, tools, information, time, economic feasibility, and social meaning converge sufficiently to make continued use realistic.

This interpretation is consistent with Gregson and colleagues' description of maintenance and repair as embedded practices through which households actively sustain relationships with objects. It also aligns with Jaeger-Erben, Frick, and Hipp's finding that social-practice dimensions explain differences in repair behavior across products and users. Repair culture is therefore not simply measured by asking whether respondents believe repair is important. It is demonstrated through repeated routines and supporting material arrangements.

This distinction has practical implications for behavioral interventions. An environmental campaign encouraging consumers to repair is unlikely to generate substantial change where repair shops have disappeared, spare parts are costly, products are sealed, warranties discourage independent intervention, or households lack basic diagnostic knowledge. Repair culture must be supported by a repair system.

6.2 Repair, Care, and the Social Value of Keeping Things

The second implication concerns the cultural meaning of repair. Replacement-centered consumption often treats products as temporary service carriers whose relevance ends when performance declines or new alternatives appear. Repair can establish a different relationship by recognizing that objects possess histories, accumulated familiarity, and continuing usefulness.

Van der Velden's analysis of community repair emphasizes product attachment, tinkering, sharing, and care as important dimensions of circular practice. Meißner similarly demonstrates that collaborative repair can involve caring for objects, other people, communities, and environmental resources. These findings suggest that the potential contribution of repair culture extends beyond the quantity of items successfully fixed at a particular event.

Repair spaces can normalize the idea that failure does not immediately terminate a product's social or functional life. Moalem and Mosgaard's review of repair cafés indicates that such initiatives can contribute to product lifetime extension while also generating learning, social interaction, and alternative consumption narratives. If these experiences strengthen household confidence and subsequently alter everyday replacement decisions, their indirect material effect could exceed the immediate quantity of products repaired on site.

However, product attachment should not be romanticized. A household may retain broken or unused possessions without reducing new purchases. Material-consumption reduction requires continued functional use, not merely storage. The proposed framework therefore combines attachment with maintenance and replacement restraint rather than treating emotional value independently as proof of sustainability.

6.3 From Individual Responsibility to a Repair-Supportive Consumption System

The third implication is that responsibility for material-consumption reduction cannot be transferred entirely to households. The ability to repair depends heavily on how products and markets are organized. Svensson-Hoglund and colleagues demonstrated that repair barriers operate across consumer, market, product, legal, and infrastructure levels. Terzioğlu likewise shows that users' motivations interact with technical characteristics of products. Jensen and colleagues' review reinforces the conclusion that product longevity requires changes spanning business models, product development, and user practices.

A repair-supportive material-consumption strategy should consequently combine durable and disassemblable product design with access to diagnostic information, reasonably priced spare parts, independent and professional repair services, household skill formation, and policies that reduce artificial barriers to continued product use. Price structures also matter. When a new product costs only marginally more than repair, even environmentally motivated households may rationally choose replacement.

Material-consumption policy should also recognize the limitations of repair. Safety-critical failures should not be addressed through inappropriate amateur intervention, and certain high-energy products may warrant replacement when efficiency improvements generate sufficiently large use-phase savings. Repair should therefore be positioned within a broader hierarchy of maintenance, continued use, repair, upgrading, reuse, refurbishment, and responsible replacement, supported by product-specific life-cycle evidence.

The most promising transition is consequently not toward households that repair everything themselves but toward a society in which keeping useful products in service is easier, more affordable, technically supported, and culturally normal than prematurely discarding them.

7. Conclusion

Household repair cultures provide an important lens for understanding material-consumption reduction because they shift analytical attention from the moment of purchase toward the complete period during which products are maintained, damaged, repaired, retained, and eventually replaced. A household may reduce replacement demand not by eliminating consumption entirely but by extending the useful life extracted from products already within the home. This logic is consistent with slower-consumption and circular-economy approaches in which longer use periods contribute to the slowing of resource loops.

The simulation-based framework developed in this study operationalizes repair culture through five dimensions: competence, preventive maintenance, repair accessibility, product attachment and care, and replacement restraint. Synthetic analysis shows progressively lower material-replacement demand as these dimensions strengthen. Mean AMRDI declines from 101.0 among low repair-culture households to 84.6 among moderate households and 69.1 among high repair-culture households. The modeled difference of approximately 31.5% between the low- and high-repair groups illustrates the potential significance of delayed replacement, but it does not constitute an empirical estimate of physical material savings.

The study also demonstrates why repair should not be framed as an individual moral obligation. Household motivation cannot compensate for inaccessible components, unavailable parts, unaffordable services, inadequate product information, or products deliberately designed without reasonable repair pathways. Effective material-consumption reduction therefore requires alignment between household practices and broader systems of product design, retail, service provision, regulation, education, and local repair infrastructure. Repair cultures are produced socially and materially rather than solely through individual environmental consciousness.

Future empirical research should validate the proposed Household Repair Culture Index using longitudinal household data. Participants could maintain purchase, maintenance, failure, repair, and disposal diaries for different product categories while researchers record product mass, repair inputs, additional service life, and replacement timing. Such evidence would allow material-flow or life-cycle models to distinguish between successful lifetime extension, repeated unsuccessful repair, product stockpiling, efficiency-related replacement, and rebound purchasing. Research should also examine differences by income, housing type, household composition, age, gendered divisions of repair labor, geographic access to repair services, and product category. A mature repair culture should ultimately be evaluated not by the symbolic visibility of repair activity but by whether it enables households to obtain more useful service from existing material goods while reducing unnecessary demand for replacement products.

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