Economic Sciences
https://economic-sciences.com
ES (2025) 21(2), 409-415| ISSN:1505-4683

# From Discard to Circularity: A Consumer-Centric Framework for E-Waste Management in the Circular Economy

**Mithil Kosarkar[1], Sunil Barthwal[2]**
[1]School of Business, UPES, Kandoli Campus, P.O. Kandoli Via Premnagar, Dehradun-248007, Uttarakhand, India, Email: mithil.kosarkar@ddn.upes.ac.in
[2]School of Business, UPES, Kandoli Campus, P.O. Kandoli Via Premnagar, Dehradun, Uttarakhand, India, Email: sunilb@ddn.upes.ac.in

***Abstract***

*Electronic waste (e-waste) is among the fastest-growing waste streams worldwide, yet circular economy (CE) outcomes remain limited by low consumer participation in formal repair, return, and recycling loops. This conceptual paper integrates scholarship on e-waste management, consumer behavior, and the CE to theorize how policy and business interventions shape the mechanisms that convert intention into sustained participation in formal channels. Building on the Theory of Planned Behavior (TPB) and extensions from behavioral economics, trust literature, and socio-technical transitions, we propose a multi-level framework linking micro-level consumer mechanisms (attitudes, social norms, perceived behavioral control, trust, and incentive salience) with meso-level firm strategies (design for disassembly, embedded trade-ins, data-wipe guarantees) and macro-level policy instruments (extended producer responsibility, right-to-repair, deposit-refund systems, enforcement). We develop twelve testable propositions, identify boundary conditions including product category and informal sector intensity, and specify feedback loops that stabilize behavior through habit formation and social proof. The paper contributes by (1) extending TPB with mechanism-level constructs of traceability, platform convenience, and credible guarantees; (2) clarifying complementarities within policy mixes; and (3) advancing a micro-meso-macro alignment for CE in e-waste. A research agenda outlines pathways for operationalization, empirical designs, and metrics to enable cumulative cross-context evidence and actionable implications for policymakers, firms, municipalities, and civil society.*

***Keywords:*** *circular economy, consumer behaviour, extended producer responsibility, right-to-repair, trust, traceability, trade-in, behavioural change, policy mix*

## 1. Introduction

Electronic waste (e-waste) is one of the fastest-growing waste streams worldwide, driven by rapid device turnover, shorter product lifecycles, and expanding electrification (Shittu *et al*., 2019). In 2022, the world generated an estimated 62 million metric tons of e-waste, of which only 22.3% was formally collected and recycled; current trajectories indicate annual generation could reach 82 million metric tons by 2030 (Baldé *et al*., 2024). Beyond material losses, low formal recovery rates leave substantial economic value (worth tens of billions of dollars) and hazardous substances unmanaged, intensifying environmental and public-health risks (Grant *et al*., 2013). Uncontrolled e-waste releases toxic components (e.g. mercury, lead) that can contaminate ecosystems and harm human health (Duraisamy *et al*., 2017; Tsydenova & Bengtsson, 2011), underscoring the urgency of improving end-of-life disposal practices.

The circular economy (CE) offers a systemic response by prioritizing value retention through slowing (repair, reuse), narrowing (efficiency), and closing (recycling) resource loops (Bocken *et al*., 2016). Yet the CE remains conceptually diffuse and operationally uneven across sectors and geographies. Syntheses of the CE literature show terminological plurality and variable emphasis on design, business models, and governance, complicating alignment among stakeholders and impeding coherent implementation (Kirchherr *et al*., 2017; Korhonen *et al*., 2018). CE has been described as an "essentially contested concept," with differing definitions and scopes that make unified action difficult (Korhonen *et al*., 2018). Clarifying how micro-level behaviors connect to meso-level firm strategies and macro-level policies is therefore central to moving from CE rhetoric to measurable outcomes in e-waste. Alignment across these levels can ensure that individual actions, business innovations, and policy frameworks reinforce each other toward circularity (Kuhlmann *et al*., 2023).

Consumer behavior sits at the heart of this challenge, as the effectiveness of CE in e-waste ultimately depends on individual decisions at end-of-life (Puzzo & Prati, 2024). Returning, repairing, reselling, or responsibly discarding devices are individual actions shaped by attitudes, perceived social expectations, and perceived behavioural control core constructs of the Theory of Planned Behavior (TPB) (May & Steuer, 2025). Empirical studies confirm that these psychological factors (e.g. attitudes, norms, perceived control) significantly predict e-waste recycling intentions (Puzzo & Prati, 2024; Koshta *et al*., 2022; Islam *et al*., 2021). Contemporary behavioral science further highlights the role of "hassle costs," present bias, and social influence in shaping sustainable choices, underscoring the need to design low-friction pathways and salient cues that convert intention into action (White *et al*., 2019). In the e-waste context, the psychological calculus additionally includes privacy and data-security concerns, risk perceptions (Lyu *et al*., 2023) about downstream handling, and uncertainty about the credibility of collection actors (Saphores *et al*., 2006; Borthakur & Govind, 2017). For example, many consumers hoard unused devices out of fear that personal data might be compromised or due to lack of trust in recyclers (Islam *et al*., 2021; Saphores *et al*., 2006). Integrating these behavioral mechanisms with CE design and policy levers is necessary to unlock durable participation in formal end-of-life channels, rather than leaving consumers to default to storing devices or using informal and potentially unsafe disposal methods.

Policy architecture sets the conditions for what firms provide and what consumers experience at end-of-life. Extended Producer Responsibility (EPR) regimes, for instance, reassign end-of-life responsibility to producers (Garlapati, 2016) and can be combined with deposit-refund systems, right-to-repair (R2R) provisions, and robust enforcement to improve collection, repairability, and recycling outcomes. However, the performance of any single instrument depends on complementary design and the broader ecosystem including logistics density, certification credibility, and interactions with the informal sector (Liu *et al*., 2023; Maheshwari *et al*., 2020; Tong *et al*., 2018; Davis & Garb, 2015; Shaikh *et al*., 2020). Recent policy guidance stresses both the benefits and trade-offs of EPR and related instruments, calling for careful calibration, harmonization, and monitoring to avoid free-riding and to enhance transparency (Mallick *et al*., 2024; Pruess, 2023). In practice, well-designed EPR policies have been shown to increase collection rates, but only when accompanied by convenient take-back infrastructure and public awareness; otherwise, targets (like the EU's 65% collection goal) remain unmet as observed in several countries (Shevchenko *et al*., 2019; Ramasubramanian *et al*., 2023; Mallick *et al*., 2024; OECD, 2024). This suggests that a policy mix combining financial incentives, legal mandates, and supportive services is more likely to succeed than any single policy implemented in isolation.

Empirical evidence shows that specific consumer barriers persist even under supportive policies and firm initiatives (Islam *et al*., 2021; Gaur *et al*., 2024; Parajuly *et al*., 2019). Surveys indicate that a significant share of consumers retain unused devices due to concerns about personal data, while others cite lack of convenient options or uncertainty over what constitutes responsible disposal (Prabhu *et al*., 2023; Adeel *et al*., 2023; Shevchenko *et al*., 2019). For instance, a recent survey in Ireland found 21% of adults aren't recycling old electronics primarily because of data privacy worries (Paben, 2023), and additional consumers keep gadgets as spares or simply do not know where to take them. Such "reasons against" recycling (e.g. perceived hassle, distrust in handlers, low perceived value) often outweigh the "reasons for" in consumers' decision-making, implying that interventions must simultaneously address convenience, trust, and incentive salience rather than rely on information or goodwill alone (Dhir *et al*., 2021). Behavioral reasoning theory research has demonstrated that perceived risks and inconveniences can significantly dampen recycling intentions despite pro-environmental attitudes (Dhir *et al*., 2021). In other words, even if consumers *intend* to recycle, they may not follow through if the process feels cumbersome or untrustworthy. Overcoming these barriers requires reducing the effort required (increasing convenience), providing credible assurances (building trust in the system, including data-wipe guarantees), and making the benefits salient (e.g. visible rewards or environmental impact).

The CE's promise depends not only on policy but also on meso-level choices by firms including product design and service innovations that directly influence consumer behavior at end-of-life (Mugge, 2018; de Kwant *et al*., 2021). Key strategies involve design for disassembly and repair, ensuring the availability of spare parts and repair manuals, offering embedded trade-in or buyback options at the point of upgrade, providing data-wipe guarantees for returned devices, and implementing transparent tracking of devices through certified recycling channels (Baldé *et al*., 2024; Gazeau *et al*., 2024; Tozanlı *et al*., 2020; Ipaki & Hosseini, 2025; Vanegas *et al*., 2018). These firm-led choices shape consumers' perceived behavioral control (by reducing the effort, cost, and uncertainty of doing the right thing), attitudes (by signaling that devices have residual value and that the company is environmentally responsible), and social norms (by normalizing return/reuse via visible take-back programs and marketing). For example, when manufacturers and retailers make it easy to trade in old electronics (with immediate credit and assurance of safe data handling), consumers are more likely to return them instead of storing or trashing them (May & Steuer, 2025; Tozanlı *et al*., 2020; Shevchenko *et al*., 2019). Such interventions effectively increase consumers' confidence and willingness to participate in formal e-waste programs (Wang *et al*., 2016; Saphores *et al*., 2006; Islam *et al*., 2021). Yet the literature often treats these interventions in isolation, with limited theorization of how specific levers map onto specific behavioural mechanisms, or how bundles of policy and business instruments interact to produce complementarities or unintended consequences in settings with active informal sectors. This gap in an integrated approach leads to mixed results: generous incentives without credible traceability can backfire when trust is low (consumers may suspect greenwashing or improper handling); enforcement without convenience may push flows toward informal collectors (as seen in regions where crackdowns on informal recycling simply drive the practice underground (Chi *et al*., 2011)); and repair messaging without R2R support may frustrate consumers (if devices remain difficult or expensive to fix) and erode goodwill. The need for combined solutions is clear for instance, deposit-refund incentives work better when consumers also trust the collection system and find it easy to return items, highlighting why coordination between policy and industry measures is essential (Kirchherr *et al*., 2017).

This paper addresses these gaps by developing a consumer-centric conceptual framework that links micro-level behavioural mechanisms (attitudes, subjective norms, perceived behavioural control) with two additional proximal constructs trust (including data privacy assurance and credible downstream handling) and incentive salience (the perceived net value minus hassle costs) and then maps these to meso-level firm strategies and macro-level policy instruments relevant to e-waste management. Building on TPB and contemporary behavioural insights, we theorize how specific levers (e.g. deposit–refunds, R2R laws, embedded trade-in programs, data-wipe guarantees, traceability standards, and stronger enforcement) can shift these psychological mechanisms and thereby strengthen the intention-behaviour link for consumers. In parallel, we specify critical boundary conditions including product category heterogeneity (e.g., data-bearing smartphones versus large appliances), digital access and literacy, and the strength of local informal sectors that moderate intervention effectiveness. By articulating these pathways and contingencies, we move beyond generic calls for "more awareness" or "better infrastructure" to a mechanism-specific agenda for circular participation (White *et al*., 2019; Baldé *et al*., 2024). The framework thus integrates insights from behavioral science with CE principles, illustrating precisely which combinations of incentives, conveniences, and assurances can overcome inertia or mistrust in different contexts. Ultimately, this approach aims to inform both practitioners and researchers on designing interventions that not only encourage e-waste recycling in principle but also translate into measurable increases in formal collection and reuse rates on the ground.

## 2. Theoretical Foundations

### 2.1 Circular economy and e-waste

The circular economy (CE) is commonly framed as a systemic alternative to the "take-make-dispose" model, emphasizing value retention through strategies that slow (repair, reuse), close (recycling), and narrow (efficiency) resource flows (Bocken *et al*., 2016; Kirchherr *et al*., 2017). While the literature converges on these principles, reviews also note conceptual plurality and inconsistent operationalization across domains, which complicates policy alignment and firm implementation (Kirchherr *et al*., 2017; Ghisellini *et al*., 2016). In electronics, the CE agenda is tightly coupled to climate and resource objectives, because prolonging device lifetimes and recovering critical materials can reduce primary extraction and associated emissions (van Gaalen & Chris Slootweg, 2025; Sahle-Demessie *et al*., 2021). Yet e-waste poses distinctive challenges: heterogeneity of products, hazardous fractions, and the prevalence of undocumented flows that weaken traceability and dilute recovery outcomes (Baldé *et al*., 2024; Ilankoon *et al*., 2018; Liu *et al*., 2023). These domain-specific features elevate the importance of consumer-facing trust, convenience, and credible certification in enabling circular pathways.

### 2.2 Consumer behaviour theories relevant to e-waste

At the micro level, the Theory of Planned Behavior (TPB) posits that behaviour is governed by attitude (ATT), subjective norms (SN), and perceived behavioural control (PBC), with PBC also approximating actual control at enactment (Ajzen, 1991). In the e-waste context, Attitude (ATT) reflects evaluative beliefs about the outcomes of behavior, including perceptions of environmental harm reduction, a sense of personal responsibility, and contribution to societal well-being. Subjective Norms (SN) capture the perceived social pressures and expectations from salient referents such as peers, firms, and institutions to engage in responsible disposal. Perceived Behavioral Control (PBC) denotes beliefs about the ease or difficulty of performing the behavior, encompassing perceptions of time, access to facilities, information availability, and one's capability to complete e-waste returns or repairs (Kumar, 2017; Vijayan *et al*., 2023; Islam *et al*., 2021; May & Steuer, 2025). The Value-Belief-Norm (VBN) tradition emphasizes personal moral norms activated by environmental values (Schwartz, 1977; Stern, 2000). Contemporary behavioural science highlights hassle costs, present bias, and social influence as levers to convert intention into action (White *et al*., 2019). Habit formation explains how repeated successful returns/repairs can become automatic responses to end-of-use cues (Lally *et al*., 2010). Finally, trust and risk particularly fears about data privacy and proper downstream handling are pivotal; generic trust theory suggests that perceptions of ability, benevolence, and integrity shape willingness to rely on counterparties (Mayer *et al*., 1995; Lyu *et al*., 2023). Together, these lenses imply that e-waste participation hinges not only on pro-environmental attitudes but on credible, low-friction, and norm-supported pathways.

### 2.3 Governance and policy instruments

Macro-level instruments structure the ecosystem within which firms design services and consumers act. Extended Producer Responsibility (EPR) reallocates end-of-life obligations to producers (Garlapati, 2016) and can harmonize financing, logistics, and performance reporting; effectiveness depends on design details, monitoring, and enforcement (OECD, 2024). Deposit-refund systems enhance the salience of returns by embedding value at purchase and redeeming it at end-of-use, while right-to-repair (R2R) provisions reduce repair barriers by mandating access to parts, manuals, and software updates (Kulshreshtha & Sarangi, 2001; Linderhof *et al*., 2019; Jin *et al*., 2023; OECD, 2024). In practice, policy mixes EPR, deposit-refund, R2R and enforcement often outperform single instruments because they jointly target incentives, information, and capability constraints (Ramasubramanian *et al*., 2023; Faibil *et al*., 2023; Linderhof *et al*., 2019). However, absent credible traceability and convenient access, such instruments may underperform, especially where informal collection is highly competitive (Davis & Garb, 2015; Davis, 2021).

### 2.4 Firm-level strategies and product/service design

At the meso level, firms translate policy signals and consumer needs into circular product and service strategies (Camacho-Otero *et al*., 2018; Kjaer *et al*., 2019). Product design that supports repairability and disassembly (e.g., modular components, standardized fasteners) lowers actual and perceived effort, thereby raising PBC; service innovations such as embedded trade-in at purchase/upgrade and data-wipe guarantees reduce hassle and risk, increasing conversion from intention to behaviour (Nisha *et al*., 2022; Dao, 2022; Sabbaghi *et al*., 2016; Dangal *et al*., 2022; Amend *et al*., 2022). The CE design literature distinguishes circular product design from traditional eco-design and offers typologies and strategy sets to align design choices and business models with slowing, closing, and narrowing loops (Bocken *et al*., 2016; den Hollander *et al*., 2017). These choices are not merely technical; they are behaviour-shaping signals that indicate residual value, competence, and integrity building blocks of trust and drivers of repeated participation.

### 2.5 Integration: a micro–meso–macro mechanism map

The foregoing strands imply a mechanism map linking interventions to behavioural pathways. At the micro level, ATT, SN, and PBC augmented by trust and the salience of incentive determine intention and enactment. At the meso level, firms can reduce hassle (home pick-up, one-click scheduling), increase perceived control (repairability cues), and bolster trust (certificates, track-and-trace, guaranteed data erasure). At the macro level, policy mixes set credible expectations, embed value (deposit-refund), and enforce standards (traceability, reporting), while R2R reduces capability constraints. Feedback loops are central since successful experiences generate habit formation, and visible participation drives social proof, reinforcing norms and sustaining circular outcomes. In e-waste, boundary conditions notably product category heterogeneity and the strength of informal collection moderate these effects, requiring calibration of trust, convenience, and enforcement to local contexts.

## 3. Proposed Conceptual Framework

### 3.1 Mechanism map: from levers to behaviour

Our framework links policy and business levers to the micro-level mechanisms that determine whether consumers participate in formal e-waste loops. Extending the Theory of Planned Behavior, we specify how individual levers act on attitude (ATT), subjective norms (SN), perceived behavioral control (PBC), and two proximal mechanisms, trust and incentive salience. Convenience architectures such as dense drop-off networks, home pick-up, and embedded trade-in at upgrade primarily enhance PBC and strengthen the intention-to-action conversion by reducing hassle costs (Bouvier & Wagner, 2011; Shevchenko *et al*., 2019; Li *et al*., 2022; Park *et al*., 2020). Economic instruments such as deposit-refund schemes raise incentive salience, with effects that are markedly larger when trust is high (Linderhof *et al*., 2019). Traceability and certified data-wipe guarantees build trust, thereby moderating and amplifying the influence of both incentives and convenience on behavior (Navarro *et al*., 2022). Right-to-repair provisions and repairability-by-design increase PBC and shift ATT toward repair and return rather than replacement (Parajuly *et al*., 2024). Finally, policy mixes that combine EPR, deposit-refund, R2R, and enforcement shape SN by clarifying what is expected and by reducing leakage to informal channels. Together, these pathways operationalize a sequence from levers to mechanisms (ATT/SN/PBC, trust, incentives) to intention and, ultimately, to formal participation via return and repair.

### 3.2 What each lever targets (micro–meso–macro alignment)

**Policy layer (macro):**

At the macro level, policy instruments operate through distinct behavioural pathways. Extended Producer Responsibility (EPR) assigns end-of-life accountability and mandates performance reporting, thereby clarifying institutional expectations (SN) and establishing a backbone for auditable traceability (Leclerc *et al*., 2024; Ramasubramanian *et al*., 2023). Deposit-refund schemes embed value at the point of purchase and make it salient at end-of-use, elevating incentive salience when consumers decide whether to return devices (Linderhof *et al*., 2019). Right-to-repair (R2R) provisions lower capability barriers by ensuring access to parts, manuals, and diagnostics, which increases PBC. Finally, enforcement and technical standards enhance the credibility of certificates and curb free-riding, strengthening trust and reinforcing SN that favor participation in formal channels.

**Firm layer (meso):**

At the meso level, firm strategies translate policy intent into low-friction consumer experiences that activate specific behavioural mechanisms. Product design for repair and disassembly through modularity, standardized fasteners, and accessible parts raises perceived behavioral control (PBC) and signals residual value, thereby shifting attitudes (ATT) toward repair/return (Amend *et al*., 2022; Dangal *et al*., 2022). Platformized returns, embedding trade-in at the upgrade moment with instant valuation and one-click scheduling, further curb transaction and search costs, reinforcing PBC and improving intention-action conversion. Complementing these, data-wipe guarantees and end-to-end track-and-trace directly address privacy and downstream handling risks, strengthening trust in formal channels and sustaining participation beyond one-off returns.

**Consumer layer (micro):**

At the micro level, ATT, reflected in beliefs about environmental benefits and societal contribution, SN, expressed through perceived expectations from peers and authorities, and PBC, manifested in judgments about ease and capability, combine with trust and incentive salience to shape intention. The translation of intention into behavior is governed primarily by PBC, which captures actual and perceived control at enactment, and by trust, which reflects confidence in privacy protection and responsible handling (Paben, 2023). This aligns with the TPB control pathway and foundational trust theory (Mayer *et al*., 1995). In essence, intention reflects evaluative, normative, and capability appraisals augmented by credibility and value signals, while enactment depends on whether consumers both can act easily and believe the system is reliable.

### 3.3 Ecosystem interactions and competition with informal channels

Consumers make end-of-use decisions within a plural ecosystem that includes producers and retailers, refurbishers, certified recyclers, municipalities, and digital platforms, alongside informal collectors offering doorstep convenience and instant liquidity (Faibil *et al*., 2023; Davis, 2021; Sengupta *et al*., 2023). In high-informality contexts, convenience upgrades or monetary incentives alone are insufficient. Without credible assurances of verifiable handling and secure data erasure (trust), and without visible and proportionate enforcement, material flows continue to leak into informal channels, undermining formal recovery and auditability. Effective intervention therefore requires a calibrated bundle in which trust, convenience, and enforcement are jointly designed so that each dimension reinforces the others rather than functioning as an isolated lever.

### 3.4 Feedback loops and dynamic stabilization

We posit three feedback channels through which episodic returns evolve into durable circular habits. First, experience fosters habit formation (Lally *et al*., 2010). When returns are smooth, quick, and transparently handled, with low hassle and prompt payout, behavior develops automaticity, increasing the likelihood of repetition at subsequent end-of-use moments. Second, transparency strengthens trust (Mayer *et al*., 1995; Navarro *et al*., 2022). Consumer-visible tracking and certified outcomes, such as data-wipe confirmation or chain-of-custody receipts, progressively enhance confidence in system integrity. Third, visibility generates social proof. Public dashboards, neighborhood drives, and peer testimonials reshape subjective norms by making formal participation salient and expected (Li *et al*., 2023). Collectively, these loops suggest that early interventions should prioritize frictionless first returns coupled with salient proof of outcome; once habits and norms are established, lower ongoing incentive levels can sustain behavior. In practice, the loops may unfold on different time scales, trust often builds more gradually than habit and their effects are multiplicative, with well-designed initial experiences amplifying transparency gains, which in turn magnify norm formation.

### 3.5 Boundary conditions and moderators

Several boundary conditions qualify the expected effects. Product category moderates lever effectiveness. Data-bearing, high-value devices such as smartphones and laptops are highly trust-sensitive, making traceability and certified data-wipe mechanisms particularly impactful, whereas bulky appliances are logistics-sensitive, amplifying the value of dense collection networks, scheduled pick-ups, and two-way transport (Shevchenko *et al*., 2019; Prabhu & Majhi *et al*., 2023). Informal sector intensity further conditions outcomes. Where doorstep cash buyers dominate, the marginal returns to incentives and convenience are limited unless reinforced by stronger traceability and credible enforcement that enhance perceived integrity and expected compliance (Chi *et al*., 2011; Sengupta *et*

Economic Sciences
https://economic-sciences.com
ES (2025) 21(2), 409-415| ISSN:1505-4683

*al*., 2023). A final boundary condition concerns the definition and scope of circularity. Without an explicit mechanism map linking design and policy levers to ATT, SN, PBC, trust, and incentive salience, initiatives risk misalignment, for example by emphasizing recycling tonnage when the behavioral bottleneck lies in repair uptake. Careful specification of these moderators is therefore essential for context-calibrated interventions.

**Table 1. Micro-level (consumer) latent constructs**

| Construct (code) | Definition | Indicators | Role in model | Moved by |
|---|---|---|---|---|
| **Attitude (ATT)** | Overall evaluation of returning/repairing e-waste as useful, responsible, valuable. | Recycling e-waste is beneficial; Returning devices helps society. | Exogenous → **INT** | Awareness, credible outcomes feedback |
| **Subjective Norms (SN)** | Perceived social expectations from peers/community/firms/ institutions to use formal channels. | People important to me think I should return e-waste; perceived local participation. | Exogenous → **INT** | Public reporting, community drives |
| **Perceived Behavioral Control (PBC)** | Perceived ease/ability (time, access, know-how) to repair/return. | Easy to locate drop-off/pickup; I know how to wipe/return. | Mediator (Convenience → **INT/BEH**); Exogenous → **INT/BEH** | Dense sites, home pickup, one-click |
| **Trust/Traceability** | Belief that actors are able/benevolent/integritous; credible data security and downstream handling. | Confidence in certified data-wipe; visibility of track-and-trace; perceived integrity. | Mediator/Moderator (e.g., Incentives → **BEH** via trust) | Certifications, audits, traceability apps |
| **Incentive Salience** | Perceived net value of returning (reward minus hassle). | Buy-back value clarity; deposit refund awareness; immediacy of payout. | Moderator of **INT→BEH**; Exogenous to **INT/BEH** | Deposit–refund, instant valuation |
| **Platform Convenience** | Embedded, low-friction return options at upgrade/purchase. | Trade-in at checkout; one-click scheduling. | Exogenous → **PBC/BEH** (conditional on INT) | Retailer/OEM integration |
| **Intention (INT)** | Readiness to engage in repair/return. | Likelihood to return within a set time; attention to offers. | Proximal antecedent of **BEH** | — |
| **Habit Formation** | Automaticity of returning after prior successful experience. | Self-report habit; repetition without deliberation. | Mediator (Feedback → Habit → **BEH**) | Post-return impact feedback |
| **Social Proof (visibility)** | Perceived prevalence/visibility of others' participation. | Exposure to neighbour/peer participation; local dashboards. | Exogenous → **SN** | Public reporting; community drives |

**Table 2. Meso-level (firm) strategy constructs (as perceived by consumers)**

| Construct | Definition | Indicators | Role | Policy/Design linkage |
|---|---|---|---|---|
| **Repairability/Disassembly cues** | Product designed for easy repair/part replacement. | Modularity; standardized fasteners; parts availability. | Exogenous → **PBC/ATT** | R2R compliance; circular design |
| **Embedded Trade-in/Buyback** | Return pathway integrated in sales/upgrade. | Instant valuation; credit at checkout. | Exogenous → **Incentive** | EPR-funded take-back; retailer programs |

Economic Sciences
https://economic-sciences.com
ES (2025) 21(2), 409-415| ISSN:1505-4683

| | | | | |
|---|---|---|---|---|
| | | | **salience/Conversion** | |
| **Data-wipe Guarantees** | Assured, verifiable erasure of personal data. | Certificate of erasure; secure handling comms. | Exogenous → **Trust** | Standards & third-party certification |
| **Track-and-Trace Transparency** | Consumer-visible device journey. | QR/ID tracking; outcome reports. | Exogenous → **Trust** | Reporting/traceability standards |

**Table 3. Macro-level (policy) levers**

| **Construct** | **Definition** | **Operationalization** | **Primary targets** |
|---|---|---|---|
| **Extended Producer Responsibility (EPR)** | Producer obligation for end-of-life financing/logistics/performance. | Policy exposure; target/certification stringency. | SN (norms), infrastructure (PBC), credibility (trust) |
| **Deposit–Refund** | Refundable charge redeemed at end-of-use. | Presence/amount/visibility of refund. | Incentive salience; **INT→BEH** elasticity |
| **Right-to-Repair (R2R)** | Access to parts/manuals/diagnostics/software. | R2R coverage index (by category). | PBC, ATT toward repair |
| **Enforcement & Traceability Standards** | Monitoring, anti-free-riding, reporting integrity. | Enforcement intensity; certification regime. | Trust; SN |

**Table 4. Moderators / boundary conditions**

| **Moderator** | **Rationale** |
|---|---|
| **Product Category (data-bearing vs bulky)** | Privacy salience vs logistics frictions differ by category. |
| **Informal-sector Intensity** | Competing high-convenience/liquidity channels. |
| **Digital Access & Literacy** | Ability to use scheduling/track apps and find info. |
| **Local Enforcement Capacity** | Probability of credible oversight. |

## 4. Propositions

This section translates the framework into empirically testable propositions by specifying the mechanisms through which policy and firm levers influence consumers' intentions and formal participation in e-waste loops. Propositions are organized by mechanism and articulate expected mediations, moderations, and outcomes, including conversion rates, return latency, and repeat behavior. They are grounded in the Theory of Planned Behavior (ATT, SN, PBC) and extended through insights on trust, behavioral frictions, and habit formation (Ajzen, 1991; Lally *et al.*, 2010; Mayer *et al.*, 1995; White *et al.*, 2019). We further connect policy instruments to concrete design choices such as repairable product architectures and platform-enabled returns as the channels through which mechanisms are activated (Bocken *et al.*, 2016; den Hollander *et al.*, 2017). These are situated within broader policy architectures, including extended producer responsibility (EPR), deposit-refund systems, right-to-repair (R2R), and enforcement and traceability regimes, which jointly target ATT, SN, PBC, trust, and incentive salience.

### 4.1 Convenience and capability (PBC pathway)

**P1 (Convenience → PBC → Behavior):** Interventions that lower hassle costs, including dense drop-off networks, home pick-ups, one-click scheduling, and embedded trade-ins, enhance PBC. Higher PBC, in turn, strengthens intention and increases conversion to formal participation, thereby mediating the effect of convenience on behavior. Expected observable outcomes include higher completion rates and reduced return latency.

**P2 (Platformization → Conversion):** Integrating return options directly into purchase or upgrade journeys, such as instant valuation at checkout, increases conversion among consumers with intention by reducing search and transaction costs. The effect is expected to remain significant even after controlling for incentive magnitude.

### 4.2 Incentive salience and its contingencies

**P3 (Incentives → Intention-Behavior Link):** Monetary or quasi-monetary incentives, such as buy-back schemes and deposit-refund systems, strengthen the translation of intention into behavior by increasing the elasticity of conversion. Effects are expected to be strongest when incentives are offered proximal to the action point and for products with clear residual value.

**P4 (Trust × Incentives → Behavior):** The effect of incentives on behavior is contingent on trust. When trust is low, due to concerns about privacy or irresponsible handling, the marginal impact of incentives is attenuated. When trust is high, supported by credible data-wipe guarantees and traceability mechanisms, incentives have a stronger effect. Thus, trust positively moderates the incentives-behavior relationship.

### 4.3 Trust, privacy, and traceability

**P5 (Traceability → Trust → Behavior):** Consumer-visible traceability mechanisms, such as digital certificates, tracking codes, and standardized data-wipe guarantees, increase trust. Trust, in turn, mediates the effects of both incentives and convenience on behavior. Expected outcomes include higher first-time conversion rates and greater repeat participation.

### 4.4 Repairability and right-to-repair

**P6 (R2R & Repairability Cues → PBC and ATT → Behavior):** Right-to-repair provisions, including access to parts, manuals, and diagnostics, together with design for repair and disassembly, PBC and improve ATT toward repair and return. These shifts reduce replacement intent and increase participation in formal repair and refurbishment pathways.

### 4.5 Social influence and visibility

**P7 (Social Proof → SN → Intention):** Public reporting mechanisms, such as neighborhood dashboards, community drives, and peer testimonials, strengthen SN. Stronger SN, in turn, increase intention to participate in formal channels. Effects are expected to be more pronounced when the sources of social proof are local and perceived as credible.

### 4.6 Policy-mix complementarities

**P8 (Policy Bundles → Super-Additive Effects on Participation):** Policy bundles that combine EPR (accountability), deposit-refund systems (value), right-to-repair provisions (capability), and enforcement and standards (credibility) generate super-additive effects on formal participation compared with single instruments. This is because bundles jointly target SN, incentives, PBC, and trust, thereby reinforcing multiple behavioral pathways simultaneously.

### 4.7 Feedback dynamics and durability

**P9 (Impact Feedback → Habit Formation):** Providing post-return feedback, such as certified data erasure, material recovery reports, or $CO_2$-equivalent savings, strengthens habit formation. Habit formation, in turn, mediates the effect of impact feedback on behavior by reducing future return latency and lowering the incentives required to sustain repeat participation in formal channels.

### 4.8 Boundary conditions and moderators

**P10 (Product Category → Moderation of Lever–Mechanism Effects):** Product category moderates the effectiveness of levers on behavioral mechanisms. For data-bearing, high-value devices such as smartphones and laptops, trust-enhancing interventions (e.g., traceability, certified data-wipe) have stronger effects. For bulky appliances, convenience-oriented interventions (e.g., scheduled pick-ups, dense drop-off networks) exert greater influence. Thus, product category moderates lever–mechanism relationships, shaping the pathways to behavior.

**P11 (Informal Sector Intensity → Moderation of Lever–Behavior Pathways):** Informal sector intensity negatively moderates the effects of formal-channel interventions on behavior. In contexts where informal collectors offer high convenience and instant liquidity, the impact of formal-channel incentives and convenience is dampened. These effects are restored or amplified only when complemented by trust-enhancing mechanisms (e.g., data-wipe guarantees) and credible enforcement.

**P12 (Trust → Moderation of ATT–Intention Pathway):** Trust positively moderates the relationship between ATT and intention. When trust exceeds a credibility threshold, pro-environmental attitudes translate more strongly into intention to participate in formal channels. In low-trust contexts, however, favorable attitudes do not reliably convert into action.

## 5. Theoretical Contributions

This paper advances theory at the intersection of consumer behavior and the circular economy for e-waste by specifying mechanism-level pathways, policy-design complementarities, and contextual contingencies. First, the TPB is extended by integrating trust and incentive salience alongside ATT, SN, and PBC. Trust is theorized as both an antecedent of intention and a moderator of the incentive-behavior link, while platform convenience is formalized as a designable dimension of PBC. Second, a micro-meso-macro alignment is developed, linking macro-level policy instruments (e.g., extended producer responsibility, deposit-refund, right-to-repair, enforcement, and traceability) to consumer mechanisms (SN, incentives, PBC, trust), and specifying how meso-level firm strategies (repairable design, platformized returns, data-wipe guarantees) translate macro intent into micro experience. Third, the paper theorizes policy-mix complementarities, predicting that bundles such as incentives coupled with credible traceability generate super-additive effects by jointly shifting ATT, SN, PBC, and trust. Fourth, dynamic feedbacks are incorporated, including habit formation, transparency-to-trust, and visibility-to-social proof loops, which highlight persistence mechanisms that reduce reliance on repeated incentives. Fifth, boundary conditions are specified, including product category differences (trust-sensitive versus logistics-sensitive items) and informal-sector intensity, which moderate lever-behavior effects. Finally, construct clarity is advanced by distinguishing traceability visibility and incentive salience from general awareness or undifferentiated incentives, enabling more precise empirical testing.

These contributions refine behavioral theory for e-waste, operationalize CE governance through mechanism-specific mappings, and explain contextual variance through moderators and feedbacks. The result is a set of novel, testable propositions and a research agenda for converting CE intent into trusted, convenient, and habitual consumer participation.

## 6. Limitations

This framework is mechanism-specific and testable, yet bounded by contextual, methodological, and ethical limits. Effects vary by product category. Trust-sensitive, data-bearing devices rely on traceability and certified data-wipe, whereas bulky appliances depend more on pick-up density and service standards. Informal-sector intensity further moderates outcomes; in markets dominated by doorstep cash offers, incentives alone may underperform unless coupled with credible enforcement or integration of informal actors, raising equity concerns. Institutional capacity also conditions outcomes, as weak enforcement or administrative gaps can attenuate instrument-mechanism links. Methodologically, incentives risk accelerating replacement cycles unless paired with repairability and right-to-repair measures, while trust breaches or reduced convenience may reverse habit formation. Constructs such as trust and incentive salience require discriminant validity beyond ATT, SN, and PBC, and reliance on self-reports introduces bias, necessitating behavioral data and robust identification strategies. Finally, ethical boundaries remain. Digital telemetry excludes some users, enforcement affects livelihoods, and effects may evolve with technology and policy regimes.

## 7. Conclusion

This study advances behavioral theory in the circular economy domain by developing a consumer-centric framework for e-waste that aligns policy instruments, firm strategies, and micro-level mechanisms of behavioral change. Extending the Theory of Planned Behavior, we propose that attitudes, subjective norms, and perceived behavioral control are complemented by two additional mechanisms critical to end-of-life electronics. Trust is conceptualized as perceptions of ability, benevolence, and integrity. Incentive salience is defined as value net of hassle. We specify the levers that activate these mechanisms. Deposit-refund systems enhance incentive salience. Right-to-repair (R2R) provisions and repairability cues increase PBC. Traceability and certified data-wipe guarantees build trust. Extended producer responsibility and enforcement reinforce normative expectations. We further theorize complementarities and argue that policy bundles generate super-additive effects relative to isolated instruments.

The framework contributes conceptually by articulating a mechanism map that links macro-level instruments and meso-level design choices to micro-level behavior, thereby clarifying why single-tool interventions often underperform. Empirically, it generates a set of testable propositions concerning mediation, for example convenience influencing PBC, moderation, for example incentives interacting with trust, and feedback dynamics. Practically, it informs implementation strategies for policymakers, firms, municipalities, and platforms, with attention to boundary conditions.

Future research should employ multi-method designs including policy experiments, conjoint analysis, longitudinal SEM/PLS-SEM, and system dynamics models, while addressing measurement validity, invariance, and ethical data governance. Overall, this study contributes to behavioral theory and CE governance by demonstrating how credible, convenient, and value-salient consumer journeys, embedded in robust policy architectures, can transform one-off returns into habitual participation and thereby translate CE intent into measurable and equitable outcomes.

**References:**

1. Adeel, S., Nayab, A., Qureshi, M. U., & Channa, K. A. (2023). University students' awareness of e-waste and its disposal practices in Pakistan: a construction of the conceptual framework. *Journal of Material Cycles and Waste Management*, *25*(4), 2457-2470.
2. Ajzen, I. (1991). The theory of planned behavior. *Organizational behavior and human decision processes*, *50*(2), 179-211.
3. Amend, C., Revellio, F., Tenner, I., & Schaltegger, S. (2022). The potential of modular product design on repair behavior and user experience–Evidence from the smartphone industry. *Journal of Cleaner Production*, *367*, 132770.
4. Baldé, C. P., Kuehr, R., Yamamoto, T., McDonald, R., D'Angelo, E., Althaf, S., … Wagner, M. (2024). *The Global E-waste Monitor 2024*. Geneva/Bonn: United Nations Institute for Training and Research (UNITAR) & International Telecommunication Union (ITU). Retrieved from https://ewastemonitor.info.
5. Bocken, N. M., De Pauw, I., Bakker, C., & Van Der Grinten, B. (2016). Product design and business model strategies for a circular economy. *Journal of industrial and production engineering*, *33*(5), 308-320.
6. Borthakur, A., & Govind, M. (2017). Emerging trends in consumers' e-waste disposal behaviour and awareness: A worldwide overview with special focus on India. *Resources, Conservation and Recycling, 117*, 102–113.
7. Bouvier, R., & Wagner, T. (2011). The influence of collection facility attributes on household collection rates of electronic waste: The case of televisions and computer monitors. *Resources, Conservation and Recycling*, *55*(11), 1051-1059.
8. Camacho-Otero, J., Boks, C., & Pettersen, I. N. (2018). Consumption in the circular economy: A literature review. *Sustainability*, *10*(8), 2758.
9. Chi, X., Streicher-Porte, M., Wang, M. Y., & Reuter, M. A. (2011). Informal electronic waste recycling: A sector review with special focus on China. *Waste Management, 31*(4), 731–742.
10. Dangal, S., Faludi, J., & Balkenende, R. (2022). *Design Aspects in Repairability Scoring Systems: Comparing Their Objectivity and Completeness. Sustainability, 14 (14), 8634*.
11. Dao, T. (2022). *Enhancing Product Repairability Through Sustainable Business Models. An Assessment of the'Consumer Repair Journey', Business Management and Future Legislation*. Nottingham Trent University (United Kingdom).
12. Davis, J. M. (2021). A model to rapidly assess informal electronic waste systems. *Waste Management & Research*, *39*(1), 101-107.
13. Davis, J. M., & Garb, Y. (2015). A model for partnering with the informal e-waste industry: Rationale, principles and a case study. *Resources, Conservation and Recycling*, *105*, 73-83.
14. de Kwant, C., Rahi, A. F., & Laurenti, R. (2021). The role of product design in circular business models: An analysis of challenges and opportunities for electric vehicles and white

goods. *Sustainable Production and Consumption*, *27*, 1728-1742.
15. Den Hollander, M. C., Bakker, C. A., & Hultink, E. J. (2017). Product design in a circular economy: Development of a typology of key concepts and terms. *Journal of Industrial Ecology*, *21*(3), 517-525.
16. Duraisamy, S., Narayanappa, R. R., & Sobagiah, R. T. (2017). Self reported practice of e-waste disposal and awareness about its health hazards among people at various levels in selected urban slums of Bangalore: A cross sectional study. *Int. J. Commun. Med. Public Health*, *4*(6), 2146-2150.
17. Dhir, A., Koshta, N., Goyal, R. K., Sakashita, M., & Almotairi, M. (2021). Behavioral reasoning theory (BRT) perspectives on e-waste recycling and management. *Journal of Cleaner Production, 280*, 124269.
18. Faibil, D., Asante, R., Agyemang, M., Addaney, M., & Baah, C. (2023). Extended producer responsibility in developing economies: Assessment of promoting factors through retail electronic firms for sustainable e-waste management. *Waste Management & Research*, *41*(1), 117-142.
19. Garlapati, V. K. (2016). E-waste in India and developed countries: Management, recycling, business and biotechnological initiatives. *Renewable and Sustainable Energy Reviews*, *54*, 874-881.
20. Gaur, T. S., Yadav, V., Mittal, S., & Sharma, M. K. (2024). A systematic review on sustainable E-waste management: challenges, circular economy practices, and a conceptual framework. *Management of Environmental Quality: An International Journal*, *35*(4), 858-884.
21. Gazeau, B., Zaman, A., Minunno, R., & Shaikh, F. (2024). Developing traceability systems for effective circular economy of plastic: a systematic review and meta-analysis. *Sustainability*, *16*(22), 9973.
22. Ghisellini, P., Cialani, C., & Ulgiati, S. (2016). A review on circular economy: the expected transition to a balanced interplay of environmental and economic systems. *Journal of Cleaner production*, *114*, 11-32.
23. Grant, K., Goldizen, F. C., Sly, P. D., Brune, M. N., Neira, M., van den Berg, M., & Norman, R. E. (2013). Health consequences of exposure to e-waste: a systematic review. *The Lancet Global Health, 1*(6), e350–e361.
24. Ilankoon, I. M. S. K., Ghorbani, Y., Chong, M. N., Herath, G., Moyo, T., & Petersen, J. (2018). E-waste in the international context–A review of trade flows, regulations, hazards, waste management strategies and technologies for value recovery. *Waste management*, *82*, 258-275.
25. Ipaki, B., & Hosseini, Z. (2025). Repair-oriented design and manufacturing strategies for circular electronic products, from mass customization/standardization to scalable repair economy. *Results in Engineering*, *25*, 104169.
26. Islam, M. T., Huda, N., Baumber, A., Shumon, R., Zaman, A., Ali, F., ... & Sahajwalla, V. (2021). A global review of consumer behavior towards e-waste and implications for the circular economy. *Journal of cleaner production*, *316*, 128297.
27. Jin, C., Yang, L., & Zhu, C. (2023). Right to repair: Pricing, welfare, and environmental implications. *Management Science*, *69*(2), 1017-1036.
28. Kirchherr, J., Reike, D., & Hekkert, M. (2017). Conceptualizing the circular economy: An analysis of 114 definitions. *Resources, Conservation and Recycling, 127*, 221–232.
29. Kjaer, L. L., Pigosso, D. C., Niero, M., Bech, N. M., & McAloone, T. C. (2019). Product/service-systems for a circular economy: the route to decoupling economic growth from resource consumption?. *Journal of Industrial Ecology*, *23*(1), 22-35.
30. Korhonen, J., Honkasalo, A., & Seppälä, J. (2018). Circular economy: The concept and its limitations. *Ecological Economics, 143*, 37–46.
31. Koshta, N., Patra, S., & Singh, S. P. (2022). Sharing economic responsibility: Assessing end user's willingness to support E-waste reverse logistics for circular economy. Journal of Cleaner Production, 332, 130057.
32. Kuhlmann, M., Meuer, J., & Bening, C. R. (2023). Interorganizational sensemaking of the transition toward a circular value chain. *Organization & Environment*, *36*(3), 411-441.
33. Kulshreshtha, P., & Sarangi, S. (2001). "No return, no refund": an analysis of deposit-refund

systems. *Journal of Economic Behavior & Organization*, *46*(4), 379-394.
34. Kumar, A. (2017). Extended TPB model to understand consumer “selling” behaviour: Implications for reverse supply chain design of mobile phones. *Asia Pacific Journal of Marketing and Logistics*, *29*(4), 721-742.
35. Lally, P., Van Jaarsveld, C. H., Potts, H. W., & Wardle, J. (2010). How are habits formed: Modelling habit formation in the real world. *European journal of social psychology*, *40*(6), 998-1009.
36. Leclerc, S. H., & Badami, M. G. (2024). Extended producer responsibility: An empirical investigation into municipalities' contributions to and perspectives on e-waste management. *Environmental Policy and Governance*, *34*(2), 111-124.
37. Li, Y., Bhutto, M. Y., Sun, C., & Mehdi, S. M. (2023). Do information publicity and moral norms trigger waste-sorting intention among households? A sequential mediation analysis. *Frontiers in Psychology*, *14*, 1193411.
38. Li, Y., Wang, K., Xu, F., & Fan, C. (2022). Management of trade-in modes by recycling platforms based on consumer heterogeneity. *Transportation Research Part E: Logistics and Transportation Review*, *162*, 102721.
39. Linderhof, V., Oosterhuis, F. H., Van Beukering, P. J., & Bartelings, H. (2019). Effectiveness of deposit-refund systems for household waste in the Netherlands: Applying a partial equilibrium model. *Journal of environmental management*, *232*, 842-850.
40. Liu, K., Tan, Q., Yu, J., & Wang, M. (2023). A global perspective on e-waste recycling. *Circular Economy*, *2*(1), 100028.
41. Lyu, T., Chen, H., & Guo, Y. (2023). Investigating innovation diffusion, social influence, and personal inner forces to understand people's participation in online e-waste recycling. *Journal of Retailing and Consumer Services*, *73*, 103366.
42. Maheswari, H., Yudoko, G., Adhiutama, A., & Agustina, H. (2020). Sustainable reverse logistics scorecards for the performance measurement of informal e-waste businesses. Heliyon, 6(9).
43. Mallick, P. K., Salling, K. B., Pigosso, D. C., & McAloone, T. C. (2024). Designing and operationalising extended producer responsibility under the EU Green Deal. *Environmental Challenges*, *16*, 100977.
44. May, S. O., & Steuer, B. (2025). Electrical and electronic equipment repair in a circular economy: Investigating consumer behaviour in Hong Kong. *Resources, Conservation and Recycling*, *215*, 108036.
45. Mayer, R. C., Davis, J. H., & Schoorman, F. D. (1995). An integrative model of organizational trust. *Academy of management review*, *20*(3), 709-734.
46. Mugge, R. (2018). Product design and consumer behaviour in a circular economy. *Sustainability*, *10*(10), 3704.
47. Navarro, L., Esteban, J. C., Miralles, M. F., & Griso, D. F. (2022). Digital transformation of the circular economy: Digital product passports for transparency, verifiability, accountability. *Manuscript submitted for publication*.
48. Nisha, B., Shajil, S., Dutta, R., & Jain, T. (2022). Consumer awareness and perceptions about e-waste management in semi-urban area of northern Tamil Nadu: A mixed-method approach. *Journal of Family and Community Medicine*, *29*(2), 132-137.
49. OECD. (2024). *Extended Producer Responsibility: Basic facts and key principles* (OECD Environment Policy Papers, No. 41). Paris: OECD Publishing. https://doi.org/10.1787/67587b0b-en.
50. Paben, J. (2023, June 1). Survey provides insight into consumers’ data concerns. *Resource Recycling: E-Scrap News.* https://resource-recycling.com/e-scrap/2023/06/01/survey-provides-insight-into-consumers-data-concerns/
51. Parajuly, K., Green, J., Richter, J., Johnson, M., Rückschloss, J., Peeters, J., ... & Fitzpatrick, C. (2024). Product repair in a circular economy: Exploring public repair behavior from a systems perspective. *Journal of Industrial Ecology*, *28*(1), 74-86.
52. Parajuly, K., Kuehr, R., Awasthi, A. K., Fitzpatrick, C., Lepawsky, J., Smith, E., Widmer, R., & Zeng, X. (2019). *Future e-waste scenarios*. United Nations University (UNU), StEP Initiative, UNU ViE-SCYCLE, & UNEP IETC.

53. Park, J., Kim, S. D., & Choi, S. O. (2020). Demonstrating the effects of behavioral control beliefs on the actual WEEE discharge routes: A case study in South Korea. *Resources, Conservation and Recycling*, *163*, 105088.
54. Prabhu N, S., & Majhi, R. (2023). Disposal of obsolete mobile phones: A review on replacement, disposal methods, in-use lifespan, reuse and recycling. *Waste Management & Research*, *41*(1), 18-36.
55. Pruess, J. T. (2023). Unraveling the complexity of extended producer responsibility policy mix design, implementation, and transfer dynamics in the European Union. *Journal of Industrial Ecology*, *27*(6), 1500-1520.
56. Puzzo, G., & Prati, G. (2024). Psychological correlates of e-waste recycling intentions and behaviors: A meta-analysis. *Resources, Conservation & Recycling, 204*, 107462.
57. Ramasubramanian, B., Tan, J., Chellappan, V., & Ramakrishna, S. (2023). Recent advances in extended producer responsibility initiatives for plastic waste management in Germany and UK. *Materials Circular Economy*, *5*(1), 6.
58. Sabbaghi, M., Esmaeilian, B., Cade, W., Wiens, K., & Behdad, S. (2016). Business outcomes of product repairability: A survey-based study of consumer repair experiences. *Resources, Conservation and Recycling*, *109*, 114-122.
59. Saphores, J.-D. M., Nixon, H., Ogunseitan, O. A., & Shapiro, A. A. (2006). Household willingness to recycle electronic waste: An application to California. *Environment and Behavior, 38*(2), 183–208.
60. Sahle-Demessie, E., Mezgebe, B., Dietrich, J., Shan, Y., Harmon, S., & Lee, C. C. (2021). Material recovery from electronic waste using pyrolysis: Emissions measurements and risk assessment. *Journal of environmental chemical engineering*, *9*(1), 104943.
61. Sengupta, D., Ilankoon, I. M. S. K., Kang, K. D., & Chong, M. N. (2023). Circular economy and household e-waste management in India. Part II: A case study on informal e-waste collectors (Kabadiwalas) in India. *Minerals Engineering*, *200*, 108154.
62. Shaikh, S., Thomas, K., & Zuhair, S. (2020). An exploratory study of e-waste creation and disposal: Upstream considerations. *Resources, Conservation and Recycling*, *155*, 104662.
63. Shevchenko, T., Laitala, K., & Danko, Y. (2019). Understanding consumer E-waste recycling behavior: introducing a new economic incentive to increase the collection rates. *Sustainability*, *11*(9), 2656.
64. Shittu, O. S., Williams, I. D., & Shaw, P. J. (2019). Global e-waste management: Can WEEE make a difference? *Waste Management, 120*, 549–563.
65. Schwartz, S. H. (1977). Normative influences on altruism. *Advances in Experimental Social Psychology, 10*, 221–279.
66. Tong, X., Wang, T., Chen, Y., & Wang, Y. (2018). Towards an inclusive circular economy: Quantifying the spatial flows of e-waste through the informal sector in China. *Resources, Conservation and Recycling*, *135*, 163-171.
67. Tozanlı, Ö., Kongar, E., & Gupta, S. M. (2020). Evaluation of waste electronic product trade-in strategies in predictive twin disassembly systems in the era of blockchain. *Sustainability*, *12*(13), 5416.
68. Tsydenova, O., & Bengtsson, M. (2011). Chemical hazards associated with treatment of waste electrical and electronic equipment. *Waste management*, *31*(1), 45-58.
69. van Gaalen, J. M., & Chris Slootweg, J. (2025). From critical raw materials to circular raw materials. *ChemSusChem*, *18*(2), e202401170.
70. Vanegas, P., Peeters, J. R., Cattrysse, D., Tecchio, P., Ardente, F., Mathieux, F., ... & Duflou, J. R. (2018). Ease of disassembly of products to support circular economy strategies. *Resources, Conservation and Recycling*, *135*, 323-334.
71. Vijayan, R. V., Krishnan, M. M., Parayitam, S., Duraisami, S. P. A., & Saravanaselvan, N. R. (2023). Exploring e-waste recycling behaviour intention among the households: Evidence from India. *Cleaner Materials*, *7*, 100174.
72. White, K., Habib, R., & Hardisty, D. J. (2019). How to SHIFT consumer behaviors to be more sustainable: A literature review and guiding framework. *Journal of marketing*, *83*(3), 22-49.