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Intellectual Property Rights and Circular Economy: An Institutional Perspective

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Abstract: The transition from linear to a circular economy (CE) is essential to address environmental challenges such as resource depletion, waste generation, and biodiversity loss. This shift necessitates that CE related innovation is adequately supported and incentivized. Intellectual Property Rights (IPRs) can be considered an institutional mechanism that can serve this purpose, however its role is not straightforward. Drawing on institutional theory, this study analyzes how regulative, normative, and cognitive pillars connect with the 3Rs: repair, reuse, and recycling. Using qualitative content analysis of expert interviews, supported by literature and patent data, the findings reveal significant institutional misalignment. While recycling benefits from strong regulatory support, with IPRs incentivizing investment in circular technologies, they also restrict innovation in repair and reuse. The study concludes that aligning IPR regimes with sustainability goals is critical to accelerating CE transitions and enabling more balanced innovation and diffusion.

Keywords: Intellectual property rights; circular economy; patent; technology diffusion; institutional theory

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1 Introduction

The world faces major environmental challenges arising from waste generation, systematic pollution, biodiversity loss, and unsustainable resource use. The dominant linear economic model based on 'take–make–dispose' has led to increasing material consumption and ecological degradation. In response, the concept of the Circular Economy (CE) has gained significant attention in academic research and policy discussions. The CE aims to maintain the value of products, materials, and resources for as long as possible while minimizing waste and environmental impacts. It emphasizes strategies such as repair, reuse, remanufacturing, recycling, and regenerative resource flows (Geissdoerfer et al., 2017; Kirchherr et al., 2017; Manon, 2025). These strategies extend product life cycles and reduce dependence on virgin resource extraction. As a result, CE contributes society's sustainable development (Vuță et al., 2018), rising the potential to reach economically, ecologically, and socially beneficial solutions (Erdiaw et al., 2025; Llano et al., 2025). Likewise, scholars increasingly recognize that the transition toward a CE is essential for achieving sustainable development goals (SDGs) and long-term economic resilience.

However, the transition toward a CE is not only a technological shift but a broader socio-technical transformation. It involves changes in production systems, consumption patterns, business models, and regulatory frameworks (Santibanez et al., 2019; Maitre & Dalhammar, 2019; Asgari & Asgari, 2021; Iacovidou et al, 2021). The transformation requires innovation in product design, materials science, logistics systems, digital technologies and collaborative platforms (Burke et al., 2023; Ahmić & Ćosić, 2025; Han et al., 2023; Panza et al., 2022). It also requires new business models such as Product-as-a-Service (PaaS), where firms retain ownership of products and provide services instead of selling products outright (Han et al, 2020; Krummeck et al., 2022). At the same time, CE related innovation is characterized by high uncertainty, long payback periods, and systemic interdependence across actors and sectors (Manu et al., 2025; Triguero et al., 2022; Parsa et al., 2021). Therefore, institutional and regulatory conditions play an important role in shaping these innovation processes.

In this context, Intellectual Property Rights (IPRs) become highly relevant. IPRs, including patents, trademarks, copyright and design rights are traditionally considered relevant for innovation because they provide legal protection needed to combine intellectual assets from multiple sources without fear of losing those completely, and allow firms to appropriate returns from their research and development investments once innovation emerges (Hurmelinna-Laukkanen, 2009; 2011). For example, patents grant exclusive rights for a limited period, typically 20 years to inventors and firms, allowing them to prevent others from using their intellectual assets. Similarly, trademarks eliminate confusion and help to avoid blurring, tarnishing, and unfair freeriding related to an innovation's brand value (Senftleben, 2024). These exclusionary rights are designed to incentivize innovation by granting temporary exclusive rights to inventors (Teece, 2018). Thereby, IPRs systems aim to encourage investment in innovation by reducing the risk of unwanted imitation.

In prior research, IPRs have been considered often to reach their aims, but also exhibit challenges (e.g. Dosi et al., 2006). Hence, it can be assumed that the relationship

between IPRs and CE – which builds inherently on wider degree on freedom to use existing materials and perhaps even intellectual assets – is even more complex and characterized by fundamental tensions. On the one hand, strong IPRs protection can encourage investment in circular technologies such as advanced recycling, biodegradable materials, and digital tracking systems (Szymanski, 2022; Mähönen & Pihlajarinne, 2024). On the other hand, CE transition heavily relies on collaboration, knowledge sharing, cross-sectoral diffusion of technologies, and reuse of existing innovative creations. In such context, exclusivity-promoting IPRs may limit access to technologies, restrict repair and reuse activities, and slow the diffusion of circular innovations across industries (Choudhary et al., 2025; Corrado, 2024; Eppinger et al., 2021). For example, firms may use IPRs to restrict third-party repairers from accessing spare parts, software codes, or repair manuals (Smith & Smith, 2024), creating barriers to circular practices.

This dual role of IPRs reflects a broader tension between individual value capture and joint value creation (Olander et al., 2014). While some scholars argue that IPRs support circular innovation by protecting investments and enabling commercialization (Daga & Choudhary, 2024; Sultana, 2024), others suggest that strong protection may hinder technology diffusion and limit circular activities such as repair, reuse, and remanufacturing (Calboli, 2024; Capponi et al., 2025). These tensions are increasingly visible in policy debates, such as the right-to-repair movement and regulatory initiatives like the EU Directive 2024/1799, which seek to balance IPR protection with sustainability objectives (Calabrese, 2025),

Despite growing academic and policy interest, empirical evidence on the role of IPRs in CE transitions remains limited and fragmented. Existing studies often focus on specific legal aspects (Steenmans & Lesniewska, 2023; Kyriakopoulos, 2021) rather than broader institutional dynamics. Therefore, this study addresses this gap by examining the role of IPRs in CE transitions from an institutional perspective, focusing on how IPRs interact with emerging CE norms. The research question guiding this study is: *What is the role of IPRs in the innovation-oriented transition toward a circular economy?* To answer this question, the study applies institutional theory and uses qualitative content analysis of expert interviews, supported by literature and patent trend observations capturing innovative endeavors in CE field. By focusing on the institutional environment surrounding IPRs, this study aims to provide new insights into how regulatory structures shape CE innovation and technology diffusion.

2 Theoretical Background

Circular economy (CE) has become a central concept in sustainability research, emphasizing the need to decouple economic growth from resource consumption. CE promotes strategies such as repair, reuse, remanufacturing, recycling, and product life extension, encouraging innovations that enable reduction of waste, resource efficiency, and material recovery (Barragán et al., 2021). For example, green innovation (i.e, innovation with no negative impact on the environment and goals to reduce material usage in new product/service development; Schiederig et al., 2012) is widely recognized as a key driver in CE development (Rao et al., 2022). Moreover, digitalization generally

boosts CE resource efficiencies (Antikainen et al., 2018; Manu et al., 2026), indicating that varying elements can be combined to generate CE advancing solutions. This also induces complexities in managing the related intellectual property.

IPRs are relevant for CE because circular solutions require new designs, materials, digital tools, and recycling technologies. By granting exclusive rights, IPRs allow firms to appropriate returns on investments and reduce imitation risks (Capponi et al., 2025; Portillo et al. 2024). At their best, patents protect inventions and encourage R&D investments, which is important in CE contexts characterized by high upfront costs and uncertainty (AlJaber et al., 2023). However, IPRs, especially patents and design rights, can restrict access to spare parts, repair manuals, and diagnostic tools, thereby limiting repair activities. Strong patents may deter collaboration, limit access to technologies, and create patent thickets. Copyright and trademarks may also present challenges (Izyumenko, 2024). For example, copyright protection of computer programs in the EU remains an underestimated obstacle to CE goals (Widła, 2023). High patent fees and strict enforcement disproportionately affect SMEs and developing countries (AlJaber et al., 2023) and may increase product prices (Xie et al., 2022; Wang et al., 2025). Hence, IPRs may restrict especially small firms' ability to innovate and defend their innovations, even if these actors are important in the CE landscape (Mähönen & Pihlajarinne, 2024). Both over- and under-protection challenge these firms' innovative contributions (Hurmelinna-Laukkanen, 2011) next to firms with strong knowledge stocks dominating CE innovation (Alessandri et al., 2026).

The relationship between IPRs and circular innovation is therefore not straightforward (Eppinger et al., 2021). Restrictive IPRs create barriers to knowledge sharing and innovation diffusion, with strong IPRs restricting follow-on innovation and diffusion (Maataoui, 2021; Song et al., 2022). In fact, insufficient implementation of CE laws and unclear regulation of IPRs in the field has been found problematic (Chakraborty, 2023). Considering that CE has not reached up to all expectations, incorporation of CE concepts into IPRs law can be considered relevant to enhance CE goals from the institutional side (Mubarik et al., 2024; Pihlajarinne, 2020).

2.1. Institutional Theory in Circular Economy Transition

Institutional theory highlights that firms operate under multiple and sometimes conflicting pressures, explaining how organizational behavior is shaped by formal rules, norms, and shared beliefs (Suddaby & Zakaria., 2026.; Roszkowska-Menkes, 2023; Aksom & Tymchenko, 2020; Wang et al., 2014). Institution's structure can be formal or informal (Lauth, 2004), guide economic activity (Parto, 2005; North, 1993), and influence actions of organizations and individuals (Wallis, 2011).

Institutional pressures may encourage firms to adopt certain practices or technologies. Firms often adapt their behavior to gain legitimacy and access resources, and in CE contexts, they must balance innovation protection with knowledge sharing (Ipaki & Heydarie, 2025; Yin et al., 2025). This creates institutional complexity, where competing logic coexists. Such tensions across regulative, normative, and cognitive pillars may lead to institutional change, including regulatory reforms, new governance mechanisms, and hybrid IPR strategies (Buyukyazici et al., 2025). Firms may adopt flexible approaches

such as licensing, patent pooling, and open innovation to enable innovation appropriability and diffusion. In this way, institutional theory provides a useful framework to understand how IPRs interact with CE transitions and how institutional alignment can accelerate sustainable innovation.

In institutional theory, institutions are often categorized into three pillars: regulative, normative, and cognitive (Scott, 2005). These pillars interact in complex ways in CE transitions. First, regulative institutions refer to formal rules such as laws, regulations, and policies that constrain and guide organizational behavior (Scott, 2005). For instance, patent laws, copyright regulations, and design protection influence how technologies are developed, protected, and commercialized (Ballardini et al., 2021; Bergamini, 2025). CE policies and environmental regulations, in turn, promote sustainability-oriented innovation (Gnekpe, 2023). Second, normative institutions reflect societal values and expectations, such as sustainability, resource efficiency, repairability, and product longevity (Scott, 2005). Reflecting this view, the rise of CE is strongly linked to global agendas such as the SDGs. Under these conditions, norms such as the right-to-repair (Abrol, 2024) challenge traditional IPR logic by emphasizing access and longevity over exclusivity. Finally, cognitive institutions refer to shared understandings and taken-for-granted assumptions that shape how actors interpret their environment (Scott, 2005). Traditional views frame IPRs as essential for protecting innovation against imitation, while emerging CE perspectives emphasize openness, collaboration, and system-level innovation. These cognitive shifts influence how organizational actors interpret risks, ownership, and innovation strategies. In this study we expect that these pillars could also help understand the complexities between IPRs and CE.

2.2. Institutional support for the 3Rs: Repair, Reuse, and Recycling

Policy initiatives increasingly aim to align IPRs with sustainability (Xia & Zhu, 2024), with varying programs promoting innovation and flexible licensing (Kur & Calboli, 2023; European Union, 2023). Earlier research suggests that aspects such as eco-design, extended producer responsibility, and transparent eco-labeling support CE transitions (Choudhary et al., 2023), and that responsible use of IPRs can increase social and environmental benefits (Vimalnath et al., 2023). However, existing IPR frameworks are often designed for linear economies and do not fully align with CE needs (Kur & Calboli, 2023; Calboli, 2024). Right-to-repair policies, including EU Directive 2024/1799, represent progress, but insufficiently address IPR constraints (Vítová, 2024; Calabrese, 2025). IPRs hinders CE due to limited policy support (Manu et al., 2025).

The CE is generally operationalized through the 3Rs: repair, reuse, and recycling. These elements of CE are differently supported by institutional structures such as IPRs. First, repair strategies are central to CE transitions (Svensson et al., 2021), yet IPRs have been found to limit access to spare parts, repair manuals, and design information (Montagnani, 2023). Court decisions and policy debates in the EU and US further highlight tensions between IPRs and repair rights (Widła, 2023; Rosborough et al., 2023; Svensson et al., 2021). Addressing these challenges, the right-to-repair movement emphasizes extending product lifespans and reducing waste. It empowers consumers and independent repairers (Abrol, 2024) and contributes to sustainability and reduced new

resource extraction (Ballardini et al., 2025). It has consequently been suggested that acts such as compulsory licensing may be needed to balance repair rights and patent holders' interests (Ballardini et al., 2025).

Second, reuse (Foster, 2020; Minunno et al., 2020) may be influenced by IPRs and other institutional factors. On the one hand, IPRs may become a restricting factor like in case of repair. On the other hand, reuse supported by CE principles and anti-waste norms is not necessarily as problematic when exhaustion of the IPRs (meaning that once a protected product has been released on the market by the rights holder or with their consent, the rights holder can no longer control the resale, use, or further distribution of that specific product) balances the situation. However, research shows that resource use decreases when circulated (Figge et al., 2022), which could indicate challenges not only in consumer behavior and acceptance, but also with other forms of institutional support or, rather, lack thereof.

Third, recycling is the most institutionally supported dimension (Pronti & Zoboli, 2024), and regarding IPRs, innovation in this area seems supported. Policies such as waste regulations and extended producer responsibility create strong incentives for recycling innovation (Choudhary et al., 2023). However, recycling patent trends in the EU show a decline (see Giucă et al., 2025). While this may indicate reduced patenting more generally, efficient recycling systems remain essential for achieving SDGs (Kaivo et al., 2022; Jakubelskas & Skvarciany, 2023). China leads in recycling patents, with universities as key actors (Priore et al., 2025). Countries with lower recycling rates face limitations in innovation and competitiveness (Ślusarczyk et al., 2025).

Overall, IPRs tend to constrain repair and reuse more strongly, while recycling benefits from clearer existing regulatory and institutional support. However, as research still is still undecisive regarding the connection between IPRs and CE, gathering empirical insights is warranted.

3 Empirical Examination

3.1. Research Design

The empirical examination relies on qualitative content analysis as research design, enabling a systematic and theory-driven interpretation of complex and context-dependent phenomena (Selvi, 2019). Qualitative content analysis is particularly suitable for examining institutional dynamics related to the interaction of CE and IPRs, as it allows identifying meanings, patterns, and themes embedded in data such as expert interviews, policy documents, and legal texts (Hsieh & Shannon, 2005). This method provides flexibility to combine both inductive and deductive approaches, which is important when applying institutional theory while remaining open to emerging insights from empirical data (Elo & Kyngäs, 2008; Mayring, 2014). Moreover, it supports the identification of latent content, enabling the study to capture underlying institutional logic, norms, and tensions that are not always explicitly stated (Krippendorff, 2018). Given the exploratory nature of our research question and the limited empirical evidence on IPRs in CE transitions, qualitative content analysis is appropriate for generating in-depth

understanding, ensuring transparency and rigor through systematic coding and categorization, and enhancing the reliability and validity of findings (Kuckartz, 2019; Elo et al., 2014; Finfgeld, 2014).

3.2. Data Collection

The primary empirical data for this study were collected through semi-structured expert interviews. A total number of four formal interviews were conducted in the first half of 2026 with experts in the fields of IPRs, CE, and innovation, using a combination of purposive and convenience sampling (Obilor, 2023). While these sampling methods have also been criticized, they served the purposes of this study where specific aspects were to be examined. In particular, the informants were required to have long-term experience and professional expertise in handling innovation and IPRs, and they were expected to have visibility in their tasks to CE specific innovation. The interviews with an expert in IPRs, two patent attorneys, and an academic expert in innovation and CE (Experts A, B, C and D in the analyses) lasted between 30 and 60 minutes and were conducted in person, over phone, and online video conferencing platforms. Interviews were conducted in English and Finnish. The interview guide included questions related to the role of IPRs in circular innovation and especially repair and reuse, technology diffusion in CE systems, and policy issues associated with IPRs. With the consent of the participants, all interviews were documented using audio recording and written transcript. Interview notes were also taken during the conversations to capture contextual observations. The transcriptions were prepared shortly after each interview to ensure accuracy. When necessary, interview recordings were revisited to verify specific statements or clarify interpretations.

For a wider objective view, we further scrutinized policy documents and, especially, patent data from the European Patent Office (EPO) and World Intellectual Patent Organization (WIPO). These materials were analyzed and reviewed to identify patterns and trends in CE-related patenting activity. This triangulated approach provides a comprehensive understanding of how IPRs function in CE contexts and how they influence innovation and technology diffusion.

3.3. Data Analysis

Offering contextual understanding, patent analysis data shows mixed trends in CE-related patents. Search results in the European patent database shows over 867 000 recycling patent families worldwide. China is in the 1st position with over 66% patent publications followed by the US and Japan 21% and 17% respectively. Germany holds the highest position in Europe, featuring over 44 000 patent families. The analysis shows that Germany also is the leader in EU in CE-patenting (Remeikienė et al., 2025). The Nordic countries are in the forefront in circular technologies, and jointly occupy almost 29 000 patent families. Figure 1 shows the patent families among 4 Nordic countries (excluding Iceland who hold a total of 227 patent families) from 2015 – 2026 to match the informant's core working contexts. A notable issue is that CE shows a declining trend, likely reflecting the varied practical and institutional challenges in CE adoption.

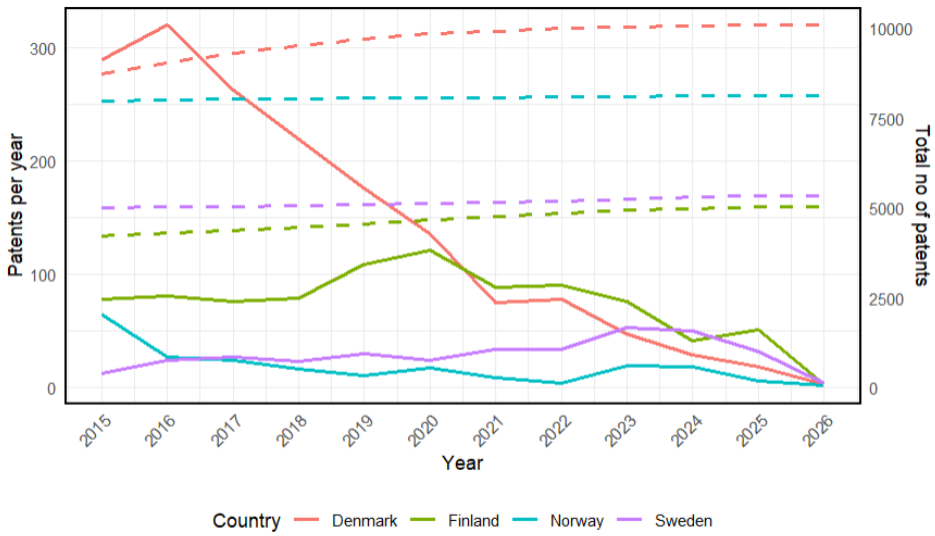

Figure 1: Recycle patent trends of Nordic countries (2015–2026), Data source: Espacenet

The interview data were analyzed using qualitative content analysis following a structured coding process (Selvi, 2019). The analysis involved three main stages: open coding, category development and interpretation. At the first stage, the transcripts were read multiple times to identify meaningful statements related to IPRs and CE transitions. Relevant segments of text were labeled with initial codes. In the second stage, similar codes were grouped into broader thematic categories such as *enabling institutional mechanisms*, *constraining institutional mechanisms*, *institutional misalignment* and *emerging institutional change*. These categories represented recurring patterns in the interview data. In the final stage, the thematic categories were interpreted using institutional theory to understand how IPRs regimes shape circular innovation and technology diffusion. The coding process resulted in several key analytical themes, including *innovation incentives*, *repair barriers*, and *technology diffusion constraints*. For reliability, coding was crosschecked, interview quotes were verified against transcripts, and only data emerging consistently across interviews were included in findings.

4 Findings

Our analysis revealed that the relationship between IPRs and CE innovation cannot be understood solely through traditional innovation logic. Instead, the findings show that IPRs interact with CE through complex institutional mechanisms. IPRs operate simultaneously as regulative, normative, and cognitive institutions, shaping repair, reuse, and recycling in distinct and sometimes conflicting ways. Our findings are organized according to Scott's (2005) institutional pillars, followed by an integrative discussion of institutional misalignment.

4.1. Regulative Institutions and Their Influence on Repair, Reuse, and Recycling

Regulative institutions such as laws, policies, patent rules, and enforcement mechanisms emerged as the most visible and influential drivers of CE-related innovation. In all interviews, participants emphasized that firms rarely invest in circular solutions unless regulation creates a clear obligation, compliance pressures, or economic incentive. As Expert A noted, "*if something is not compulsory for the companies, they do not invent new things.*" This reflects a strong regulative dependency.

Regulative barriers are particularly evident in repair. Patent protection, design rights, and copyright were found to restrict access to spare parts, repair manuals, and diagnostic tools. Expert D described how firms can "*one patent… blocks a lot of businesses and creating new businesses and new ideas they do not want to use it*" by enforcing exclusive rights, limiting independent repair and refurbishment. The absence of clear right-to-repair legislation means that repair remains structurally constrained despite its centrality to CE.

The data further indicates that reuse is shaped by liability rules, product standards, and ownership structures. Interviewees highlighted that companies hesitate to adopt reuse-oriented innovations when future regulatory requirements remain uncertain. Firms often respond with "*nice, but not yet*" (Expert A); when presented with reuse-enabling technologies, firms prefer to wait for clearer regulatory signals before committing resources. This hesitation is reinforced by structural features of the patent system itself. As Expert B explained, "*there's that 18-month delay from the filing date,"* meaning that information about new innovations becomes publicly available only with delay, further increasing uncertainty for firms considering CE investments.

Recycling is the area where regulation most clearly enables innovation. Mandatory waste separation, landfill restrictions, and extended producer responsibility were noted to create strong incentives for technological development. As Expert A explained, "*you have to pay a huge amount of money in order to get rid of waste, then they have an incentive to do something*." Another Expert C confirmed "*you can also recycle everything; not just material and energy, all that.*" This aligns with patenting activity in recycling technologies, which interviewees described as both extensive and commercially relevant.

The regulative pillar posed challenges especially for SMEs. Expert A noted that "*you can easily use even 100,000 euros or 200,000 euros*" for a single patent family, which limited their participation in CE innovation. Similarly, Expert D stressed that SMEs "*have no credibility to work with big industry*," making it difficult to commercialize CE innovations. This reinforces structural inequalities in who can contribute to and benefit from CE transitions.

4.2. Normative Institutions: Emerging Sustainability Norms and Ethical Expectations

Normative institutions such as societal values, ethical expectations, and professional norms shape how actors perceive the legitimacy of CE practices. The interviewees highlighted growing societal pressure for sustainability but also noted tensions between ethical expectations and proprietary business models. For example, when discussing

essential technologies – comparing them to vaccines, Expert A noted the dilemma of whether "*is it okay that someone owns the patent*" when the technology is crucial for public welfare. These ethical concerns extend to CE, where sustainability norms increasingly challenge traditional proprietary logics.

Normative expectations around repair-related product longevity and consumer rights underpin the growing right-to-repair movement. Expert C considered problematic the motivation to "*block others to do business*". This is linked directly with right-to-repair critiques about monopolies over spare parts, diagnostics, and repair knowledge.

Norms around anti-waste culture and responsible consumption were considered to support reuse practices. Expert A noted it to give incentives to turn to CE "*if there comes some kind of regulation which says that you cannot do any more, put this waste away*." This companies acknowledge they should innovate toward circularity, but also highlights that without enforcement they do not necessarily act. Without regulatory reinforcement, normative pressure alone rarely leads to significant reuse-oriented innovation.

Recycling is a major, central pillar of circular economy and it also enjoys strong normative support. Expert A described "*recycling is one of the major things of circular economy*." This is a direct normative statement positioning recycling not just as an option, but as a core societal expectation, making recycling the most institutionally supported of the 3Rs.Overall, normative institutions support CE goals but are not yet strong enough to overcome the proprietary logic embedded in IPR systems.

4.3. Cognitive Institutions: Assumptions, Mental Models, and Innovation Logics

Cognitive institutions include shared beliefs, taken-for-granted assumptions, and mental models that shape how actors interpret both IPRs and CE. The interviews revealed several cognitive lock-ins that slow CE transitions. First, a dominant cognitive assumption is that innovation must be protected to be valuable. This belief leads firms to prioritize patents even when open approaches might better support CE. As Expert 4 explained, companies often patent because "*intellectual property and utility models might be blocked others,*" reflecting a cognitive logic of control rather than collaboration.

Second, interviewees described CE technologies as uncertain and dependent on future regulations. Expert A noted that "*you don't know, what does it happen after one year, two years, five years, or 10 years*." This reflects a cognitive framing of CE as risky and dependent on future regulation. Such assumptions discourage long-term investment in repair and reuse innovations.

Third, cognitive norms seem to be embedded in product design, especially in electronics and machinery. It reinforces the idea that products should not be opened or repaired by users, nor should this be encouraged. Expert A noted "*Secrecy is very good because others cannot read what you have done*." This logic leads to closed designs, hidden mechanisms, and restricted access norms that directly discourage user repair or reuse practices.

Fourth, although recycling is cognitively more accepted, interviewees noted that many firms still view waste primarily as a disposal problem rather than a resource stream. Expert A noted "*many of those inventions… they say, okay, we do not have to do this*

yet." This reflects the cognitive gap: recycling is approved in principle, but firms still delay engaging in it.

5 Discussion and Conclusion

The findings of this study show that the relationship between IPRs and CE innovation is shaped less by technological constraints and more by institutional dynamics across the regulative, normative, and cognitive pillars. This aligns with prior research showing that CE transitions depend heavily on regulatory clarity and enforcement (Choudhary et al., 2023; Kur & Calboli, 2023). The findings confirm that IPRs tend to create structural barriers for repair and reuse, echoing concerns raised in earlier literature about restricted access to spare parts, repair manuals, and diagnostic tools (Montagnani, 2023; Widła, 2023) and reflecting the prevailing thought that products are final outputs. While, normative institutions do not hinder sustainability, they do not yet override profit-driven proprietary logics either. Cognitive institutions remain anchored in linear economy assumptions, reinforcing risk aversion and proprietary control. In line with Eppinger et al. (2021) and Calboli (2024), we find that repair and reuse are disproportionately constrained, while recycling is comparatively supported due to clearer regulatory incentives and legitimacy (Pronti & Zoboli, 2024); firms face regulative incentives to innovate in recycling, normative pressure to support repair, and cognitive assumptions that discourage openness. Hence, the empirical insights reinforce that IPRs do not merely operate as legal instruments but function as institutional mechanisms embedded in broader socio-technical systems.

Responding to recent calls to examine sustainability transitions as institutionally embedded processes (Iacovidou et al., 2021; Roszkowska-Menkes, 2023) and applying institutional theory, this study contributes to existing research by empirically unpacking how regulative, normative, and cognitive pillars interact in shaping CE innovation. While prior work has acknowledged tensions between protection and diffusion (Olander et al., 2014; Hurmelinna-Laukkanen, 2011), our findings show that these tensions are not isolated; they are mutually reinforcing across institutional dimensions, creating systemic friction. For example, restrictive patent enforcement (regulative) is legitimized by firm-level beliefs about ownership (cognitive) and only weakly counterbalanced by sustainability norms (normative). Hence, misalignment across pillars, rather than any single pillar, explains slow CE progress. Within this setting, this study also extends existing knowledge (Mähönen & Pihlajarinne, 2024; Choudhary et al. 2025) by identifying IPRs as conditional enablers of circular innovation: they support innovation when aligned with CE-oriented norms and cognitive frames, but act as barriers within closed, proprietary systems.

These contributions bear policy implications, highlighting, first, the importance of hybrid governance mechanisms, such as patent pools, open licensing, and right-to-repair frameworks in balancing protection and accessibility. Relatedly, our study confirms that SMEs face disproportionate burdens for patent costs and bargaining power, hence highlighting concerns about unequal innovation capacities in CE ecosystems, which is an issue to be addressed at policy level. Finally, as the results show that cognitive lock-ins

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remain powerful barriers to circularity, regulatory changes need to be done keeping this in mind; CE transition necessitates clarity and predictability.

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