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REUSED OR USED UP? UPSCALING MATERIAL AND COMPONENT REUSE IN THE SWEDISH CONSTRUCTION SECTOR

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Material and component reuse is seen as vital for circularity in construction; but practical adoption remains relatively slow in Sweden. This paper examines how such reuse can catalyse a transition from linear to circular construction. Drawing on sociotechnical concepts in the sustainability transitions theory (multi-level perspective; technological innovation systems; and strategic niche management); it reviews national research on reuse in Sweden. The findings reveal institutional and cultural lock-ins; weak policy incentives; and inadequate market infrastructure; all contributing to stagnation. A cohesive framework is proposed to address these barriers through multi-actor coalitions (e.g., policy bodies; major construction firms; demolition contractors; and environmental NGOs); demonstration projects; digital platforms; regulatory reforms; and strategic public procurement. The study expands the understanding of construction sector's circular transformation and offers guidance on embedding reuse to improve resource efficiency while maintaining performance.

Keywords: material and component reuse; building production; upscaling; climate footprint; circular economy

INTRODUCTION AND BACKGROUND

In Sweden, construction activities generate approx. 22% of the country's total CO_2 emissions (ACAN, 2024) - therefore, decreasing those emissions can strongly contribute to Swedish climate neutrality goals by 2050. Such a decrease requires the reduction of the emissions embodied within building production (Burns *et al.,* 2024), as they represent approx. 20% of construction-related CO_2 emissions in Sweden (Karlsson, 2024). Product reuse in building production can contribute to Sweden's 2050 net neutrality goals (e.g., by reducing embodied emissions and enhanced resource efficiency) and create new forms of environmental, social and economic value within the built environment (Lundgren *et al.,* 2024; Riuttala *et al.,* 2024).

However, despite a growing research interest on material and component reuse, as well as its critical importance in achieving circularity in the built environment, practically implementing it in Swedish building production seems to be stagnating (Boverket, 2024). In this paper, we refer to stagnation as a condition in which reuse initiatives have emerged but fail to scale or integrate into standard building production processes. Rather than a complete absence of activity, stagnation describes a state of

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partial uptake where interest, policy ambitions, and isolated experiments exist, but structural barriers prevent broader adoption. In the Swedish context, this is evident in the disconnect between national circularity strategies and the limited reuse observed in practice - particularly in large-scale building production (Mjörnell, 2025; Boverket, 2024), as well as in how very few construction materials and components are recycled or reused in Sweden, with most being redirected to secondary construction uses instead of building production (Andersson and Buser, 2022). Therefore, in this paper, we attempt to diagnose why such a stagnation exists, and how it can be overcome towards upscaling material and component reuse in Swedish building production.

First, we conceive a theoretical framework of sustainability transitions by combining key sociotechnical concepts. Given the complexity of upscaling reuse in construction - a process shaped by actors, rules, practices, infrastructures, and markets - drawing on the sustainability transitions literature provides a foundation for understanding structural dynamics, innovation processes, and niche development, respectively. This approach allows us to analyse not only how reuse could emerge and spread, but also why it currently stagnates despite policy support. Then, by utilising the phenomena construction methodology, we use this framework to analyse recent empirical results of nationally funded research projects about circularity and sustainability in construction and ultimately propose implementation steps for upscaling material and component reuse in Swedish building production.

Theory - Sustainability Transitions

To understand why reuse in Sweden remains marginal despite rising interest and policy support, we turn to sustainability transitions theory; this will help unpack not only innovation emergence but also systemic inertia, institutional lock-ins, and governance challenges that shape the trajectory of change. Sustainability transitions theory aims at conceptualising how sociotechnical systems can be radically changed to address challenges incurred by unsustainable consumption and production patterns - as it is considered that incremental improvements and technological fixes ultimately fail to address those (Köhler *et al.,* 2019). Specific sociotechnical concepts are particularly prominent in this theory; however, power relations, everyday practices, and institutional structures also critically shape sustainable transitions (especially for understanding contextual barriers and enablers). Below, the key sociotechnical concepts in sustainability transitions are detailed, and will later be utilised to understand reuse in Swedish building production as a transitional phenomenon.

Key Sociotechnical Concepts in Sustainability Transitions

The multi-level perspective (MLP) explains transitions as non-linear processes unfolding across three nested structuration levels: niches, socio-technical regimes, and the landscape (Köhler *et al.,* 2019). Niches are protected “incubation rooms” for radical innovations, where novelties can develop shielded from market selection (e.g., pilot projects for reuse); regimes represent the dominant technologies, infrastructures, business models and institutions stabilised by incumbent actors and routines, leading to path-dependence and incremental change; and the landscape denotes broader exogenous trends (e.g., climate targets, economic conditions, cultural values) pressuring the regime (Köhler *et al.,* 2019). Transitions occur when niche innovations mature and align with landscape pressures to sufficiently destabilise existing regimes, allowing for niches to upscale into new regimes (Geels, 2002). In MLP, stability and change interact; regimes are typically change-resistant, so niche breakthroughs require both internal momentum and external landscape pressure (Geels and Schot, 2007).

Apart from MLP, the technological innovation systems (TIS) framework focuses on the development of innovation systems around a specific technology or solution; it consists of actor networks (e.g., firms, users, policymakers), institutions (regulations, norms), and technological artifacts related to innovations (Bergek *et al.,* 2008). Rather than multi-level structures, TIS evaluates seven systemic functions - i.e., key processes that must be fulfilled to successfully develop and diffuse a novel technology: (1) knowledge development and diffusion; (2) entrepreneurial experimentation; (3) directionality of innovation efforts; (4) market formation; (5) sociopolitical acceptance and legitimation; (6) resource mobilisation; and (7) positive externalities (spillovers reinforcing the system) (Köhler *et al.,* 2019). By assessing functional strengths and weaknesses, systemic barriers hindering innovation can be pinpointed - e.g., a stagnation in reusing building materials might reveal a lack of relevant marketplaces or business models, or insufficient legitimation (scepticism about quality or code compliance). TIS is especially useful for understanding early-phase innovation dynamics and identifying policy or network interventions to strengthen the innovation system (Bergek *et al.,* 2008) and tends to emphasize the emergence and diffusion of novel innovations more than the active destabilisation of incumbent systems - which is MLP's focus (Köhler *et al.,* 2019).

Furthermore, strategic niche management (SNM) examines how to deliberately nurture niche innovations so they can grow and challenge the regime (Schot and Geels, 2008). It posits that radical innovations typically start in protective niches - e.g., subsidised demonstration projects, living labs, or specialised markets - where they are shielded from mainstream selection pressures (Köhler *et al.,* 2019). In these niches, dedicated actors (often startups or social entrepreneurs) invest in developing the innovation. SNM emphasizes three key processes for niche development: first- and second-order learning about both technical issues and broader societal impacts, network building by forming broad stakeholder alliances to support the innovation) and managing expectations and visions by articulating compelling narratives to attract attention and resources (Köhler *et al.,* 2019). Through iterative cycles of experimentation and feedback, a niche innovation can improve on technical performance, reduce uncertainties, and build up a supportive coalition (Köhler *et al.,* 2019). Successful niches may then scale up and enter mainstream markets. SNM thus provides a methodology for guiding experimental projects and strategically positioning innovations - which is highly relevant for building material and component reuse. In practice, SNM is often combined with MLP and TIS; niche experiments are seen as seeds for broader transition dynamics (Markard *et al.,* 2012).

Comparing the Sociotechnical Concepts

All three concepts (MLP, TIS, and SNM) adopt a systems perspective to capture the complexity of sociotechnical change (Köhler *et al.,* 2019), but they differ in focal scale and analytic lens. MLP is useful for understanding the timing of transitions in the macro-context, TIS for diagnosing innovation system weaknesses and crafting policy support for meso-level system building, and SNM for informing on-the-ground experimentation and micro-level innovation and stakeholder management. MLP, TIS, and SNM are often seen as complementary (Markard *et al.,* 2012), but they are widely applied in construction and circular economy research, few studies integrate them to construct a phenomenon-specific framework tailored to the context of reuse upscaling. Moreover, the theoretical implications of applying these frameworks to stagnated circularity efforts - rather than successful transitions - remain underexplored.

METHOD

In our research, we first implemented the qualitative abductive loop (Bell *et al.,* 2022) to work iteratively between the insights gained from a targeted literature review, the dimensions of our theoretical framework, and the second-hand learnings retrieved from a comprehensive meta-analysis. The empirical foundation of this paper is a meta-analysis conducted by Mjörnell (2025), which synthesizes findings from more than a dozen Swedish research projects funded between 2021 and 2025, all focused on reuse and circularity in construction. While this report is a secondary source, it functions as a second-order aggregation of empirical insights, drawing from diverse project contexts, stakeholder groups, and methodological approaches. As such, it provides a rich, composite overview of the current state of research and practice on reuse in Sweden, making it a suitable basis for our theory-led analysis.

The targeted literature review method was chosen based on the study's precise focus on a narrow topic positioned in a specific context (that of Sweden) (Bell *et al.,* 2022). For the references supporting the background in the Introduction, we focused on the past five years (2021-2025) to flag the temporal insight where the state-of-art corroborates that reuse in Swedish building production is currently stagnating. For the references on the different perspectives of sustainability transitions in Theory, we focused on the relevant developments of the last 20 years (2006-2025), as a reading of the pertinent literature revealed that this period showcased a more concentrated effort in synthesising and synergising those perspectives; however, some earlier seminal works (e.g., Rotmans *et al.,* 2001) were still included, as the conceptual foundations they helped us explain our theoretical framework. We targeted peer-reviewed academic sources mostly across Scopus and Web of Science, using keywords such as “material and component reuse”, “sustainability transitions theory”, “sociotechnical systems”, and “institutions”. We applied standard screening (Bell *et al.,* 2022), first by filtering by title/abstract relevance, followed by full-text review to identify sources and gain relevant insights. Grey literature (e.g., industry case studies, guidelines) was consulted sparingly to obtain additional insights, without dominating our source base.

Mjörnell's (2025) report, featuring a meta-analysis of the results of Swedish sustainability- and circularity-related research projects in 2021-2025, provided us with second-level intensive an extensive qualitative data (Pink *et al.,* 2013) that “closed off’ our abductive loop (Bell *et al.,* 2022) and helped understand where recent Swedish advancements fit in the sustainability transitions discourse we implemented, as well as corroborate the current stagnation of reuse in Swedish building production. This meta-analysis thus serves as our empirical material. We add to the meta-analysis, which is mainly descriptive, by applying the concepts of MLP, TIS, and SNM in a combined way to construct a cohesive framework that allows us to interpret stagnation and propose practical and theoretical steps for system reconfiguration.

Rather than aiming for empirical generalisation, our goal is to conceptually understand “reuse upscaling” as a transitional phenomenon. Drawing on Alvesson and Sandberg’s (2024) phenomena construction methodology, we use the aggregated empirical material to generate theoretical insights about system-level stagnation and pathways for reconfiguration. This approach allows us to move beyond fragmented case descriptions and instead synthesize structural dynamics across projects, using theory to reinterpret the current limitations and opportunities in the Swedish context.

FINDINGS

By implementing the phenomena construction methodology, we utilise our theoretical insights to analyse the compiled results in the meta-analysis by Mjörnell (2025). Based on this, we identify the sustainable transition characteristics for reuse in Swedish building production, as well as the current situation and need for change.

Sustainability transition characteristics for reuse in Swedish building production

Building production involves a complex sociotechnical system of technologies, markets, user practices, infrastructures, policies, and stakeholders (e.g., contractors, suppliers, and end-users). It faces tensions between long-standing practice norms and the increasing adoption of new tools (e.g., digital ones like BIM and digital twins) demanding new competencies. The buildings' lengthy operational life also makes it difficult to predict which emerging innovations will ultimately prevail.

Transition pathways are often contested: dominant industry players guard their market positions (e.g., contractors focusing on new construction, suppliers on new products), while smaller firms specialising in deconstruction or reuse struggle to influence the broader shift. Since sustainability is a public good, businesses have few incentives to invest in reuse without regulatory support. Accordingly, public policies—e.g., taxes, subsidies, environmental regulations, and innovation strategies—play a key role in guiding transitions. In Sweden, policymakers could increase climate-footprint thresholds for both new and existing building materials or promote lower taxes on reuse and the relevant labour—making refurbishment more competitive than new construction. Having outlined the general characteristics and systemic tensions surrounding reuse in Swedish building production, we now turn to one of the key institutional dimensions shaping these dynamics: policy and power. This includes the role of legislation, regulatory gaps, and political signals influencing reuse adoption.

Policy and power in transition

The Swedish Planning and Building Act (PBL) currently lacks mechanisms to enforce reuse. Detailed building permit requirements allow minimal flexibility for reused materials, and there are no oversight policies for material inventories or verified waste quantities. Stronger legal and policy measures are needed to drive reuse adoption, including flexible permits and detailed plans supporting building conversion, alongside incentives such as VAT relief and tax deductions for reuse-oriented renovation. Municipalities should also be allowed to conduct reuse initiatives beyond their own jurisdictions. Rigorous oversight is crucial to document material inventories and consistently track reuse and waste quantities. While policy frameworks provide the formal scaffolding for reuse, governance mechanisms - such as data infrastructure and oversight systems - determine how reuse is coordinated and monitored in practice. The next section explores these operational dimensions.

Governing transitions

Information on reusable products is scarce and hard to access, obscuring availability, location, and ownership. The Swedish utility value principle for rent control further encourages new products by justifying higher rents. Strengthening the reuse market therefore requires increased digitalisation and efficiency, such as digital inventories, demolition permits, and shared databases detailing material availability and quality. A unified data environment can facilitate oversight, faster feedback, and new digital services, also aiding municipalities in monitoring reuse and demolition waste. Finally, clear traceability of reused products could benefit resource management. In addition to formal systems, societal values and cultural perceptions can be critical in enabling transitions, as described below in the influence of civic attitudes and norms.

Civic society, culture and social movements in transition
Linear construction and renovation practices remain the prevailing norm, with new materials and products often perceived as more valuable than existing ones - even though those are sometimes of higher quality. Notably, surveys show that 2/3 of tenants support increased reuse (Mjörnell, 2025). Therefore, greater awareness of reuse's value - emphasising the tangible quality and functionality of reclaimed materials - can help towards making reuse the standard approach. Nonetheless, cultural attitudes are not only embedded in civil society but also influence industry practices, therefore shaping reuse dynamics as shown in the following.

Businesses and industries in sustainability transitions
Few incentives currently encourage businesses to use reused materials and products; buying new items is simpler and less labour-intensive, with discounts on new products reinforcing this norm. As a result, reused products typically appear in renovations rather than new construction, and supply constraints hinder broader adoption. Heavy building components, like structural elements, are rarely reclaimed due to perceived risks and uncertainties around cost, warranties, and technical lifespans.

Though independent digital platforms facilitate sales of reused materials in Sweden, logistical hurdles (transport, storage) persist. Manufacturers often operate in mono-material flows, making sourcing reused components time-consuming. Therefore, the sector must link reuse to green loans and insurance, adopt iterative design processes that incorporate reuse options from the start, and establish procurement procedures allowing contractors to find appropriate reused products. Discount structures favouring new materials should be re-evaluated, and standardised assessment and quality-assurance methods (e.g., warranties and certifications) must be developed.

To integrate reuse into core offerings, building material suppliers could introduce warehouses and resale facilities - potentially supported by a "construction bank" for reused frames. Manufacturers should design recyclable products and assume responsibility for reclaiming them. Such strategies require deeper expertise in building production, including new roles like inventory specialists, dismantlers, and refurbishers who can certify quality and guarantees, as well as coordinating transportation and logistics for handling both new and reclaimed materials. While business practices shape the supply of reused materials, their uptake also depends on consumer demand and acceptance. In the following, the focus shifts from industry actors to end-users, examining how everyday preferences, perceptions, and price expectations influence reuse in building production.

Transitions in practice and everyday life (consumer perspective)
From a consumer standpoint, new products currently remain the default choice, and there is limited acceptance for paying the same price for reused products. This mindset reinforces a linear consumption model valuing novelty over sustainability. For reuse to become the new norm, consumers must actively seek out and prefer reused products, recognising that their quality and performance can rival - or even exceed - those of new materials. To support this shift in perception, the utility value principle should be revised, allowing rent increases for properties that incorporate reused elements, thus acknowledging their equal or greater worth. Consumer preferences and norms are not uniform across the country; they are shaped by spatial

context, infrastructure availability, and local policy conditions. We therefore explore next how location, scale, and place-specific initiatives affect transition dynamics.

Geography of transitions; space, scale and places

Currently, reusing building products in Sweden is primarily driven by occasional, often temporary, municipal initiatives, which pave the way for private-sector participation and the growth of reuse-related services. Most existing reuse hubs cater to individual consumers, selling single items rather than supporting large-scale commercial adoption. Although some property owners maintain their own storage facilities, there is currently limited infrastructure for broader efforts. Change would require local and regional authorities to establish or expand reuse hubs and streamline their logistics. Such hubs would allow public and private actors to adopt reuse, providing a central point for collecting, sorting, refurbishing and delivering materials on-time and cost-effectively. However, spatial variation in reuse practices reveals issues of access, equity, and environmental responsibility, which are addressed below.

Ethical aspects of transition: Distribution, justice, poverty

Renovation projects in Sweden do not require climate declarations, and there is no systematic carbon taxation on new building production. Additionally, there are no established methods for placing tangible value on reused materials, hindering comparisons with new alternatives. Moving forward, mandatory climate declarations for renovation projects, supported by a standardised methodology for including reused products, are essential. Carbon taxation on new items should be introduced to reflect their environmental impact and incentivise reuse. Beyond climate considerations, clear procedures for assessing reused materials - also considering quality, aesthetics, and historical significance - are necessary to encourage broader acceptance.

DISCUSSION

Building on the systemic challenges identified in the findings, the discussion now proposes a set of coordinated steps for enabling reuse to scale — grounded in the theoretical logic of transition pathways and institutional transformation. While some of the patterns outlined above — such as lock-ins and institutional misalignment — may appear familiar, this study contributes by analysing them as mutually reinforcing across niche, regime, and institutional levels. Rather than offering general policy advice, we conceptualise reuse stagnation as a system-wide coordination failure, where niche efforts lack sufficient alignment with existing rules, routines, and responsibilities. This adds to construction management literature by diagnosing how partial experimentation without structural support can stall transitions — a dynamic often overlooked in more success-oriented circularity studies. So, considering the dimensions described in the findings, we outline five steps for upscaling reuse in Swedish building production. Consistent with transition management, these steps should be placed in iterations of envisioning, experimenting, evaluating, and learning.

Step 1: Stakeholder coalition - Bringing together key stakeholders (e.g., the Swedish National Board of Housing, Building and Planning, major contractors, NGOs)

This coalition should develop a shared vision and targets for upscaling reuse (e.g., a roadmap to increase reused content in building production by 2030). A common vision can help align efforts across levels and create a mandate for change. Sweden's policy backdrop (fossil-free ambitions and circular economy strategy) can serve as guiding context, but this step translates high-level goals into a sector-specific mission. It also sets up governance for the transition: defining roles, forming working groups, and securing initial funding commitments for subsequent steps.

Step 2: Niche development - Launching a series of well-resourced pilot projects to demonstrate reuse in practice
These should vary by project type and geography across Sweden to explore different reuse aspects. For each pilot, SNM should be applied to identify and secure protections (e.g., regulatory sandbox arrangements or grants to cover extra costs), involve a broad participant network (e.g., contractors, suppliers of salvaged materials, approval authorities, end-users), and set clear learning objectives. By rigorous documentation and monitoring of technical performance of reused elements, cost and time impacts, and user satisfaction, an evidence base can be accumulated and best practices refined. These pilots should also serve as training grounds for professionals, help shift mindsets (seeing that reuse is feasible and can meet quality expectations), and the results disseminated through industry forums and media to build legitimation.

Step 3: Developing, in parallel with pilots, the supporting infrastructure and knowledge networks for a reuse market
This could involve creating a digital marketplace platform for secondary products (with government support or as a public-private partnership), so that supply (from demolitions) can meet demand (building production) efficiently. Private sector participation should be incentivised - by, e.g., encouraging startups to offer deconstruction services, refurbishing, auditing and certifying salvaged components for resale. To tackle information and skill gaps, a national knowledge centre on circular construction (collecting data, publishing guidelines, and offering training modules) should be established, and regular workshops or "community of practice" meetings where project teams share lessons from reuse projects should be held. This step is about ensuring the TIS functions are fulfilled: connecting actors, spreading know-how, and lowering transaction costs to use reused components. Success can thus be measured by growth in the number of companies dealing with reuse, their turnover and increased listings or transactions on the marketplace over time.

Step 4: Policy and regulatory reform using insights from pilots and system analysis
The coalition (from Step 1) should work closely with policymakers to update standards and regulations in favour of reuse - e.g., by developing technical standards for reused structural elements, clarifying building code provisions to explicitly allow reused materials if certain criteria are met, and creating streamlined permitting processes for projects with high reused content. Moreover, potential economic measures can be introduced, including tax credits or grants for projects that incorporate reuse (both products and labour), reduced fees or faster permits as incentives, and higher landfill fees or stricter quotas for demolition waste diversion. Public procurement rules at the municipal and national levels should include evaluation criteria for circularity - making reuse a competitive advantage in bidding. These institutional changes can embed reuse and move it from niche to a normal option. It is important that reforms are designed collaboratively (with input from industry to ensure practicality) and are communicated clearly to avoid uncertainty. Over time, regulatory support increases the legitimacy of reuse and gives developers confidence that investing in it will pay off. This step addresses the institutional and political barriers systematically, turning enabling conditions into formal requirements.

Step 5: Scaling-up, monitoring, and adapting
As multiple pilots succeed and market infrastructure grows, the focus shifts to upscaling and continuous improvement. Larger-scale adoption should be encouraged, by, e.g., requiring that all publicly funded building projects in Sweden incorporate at least 30% (by value or volume) of reused or recycled components by a certain date,

gradually raising this threshold as the industry's capacity expands. Private developers can be engaged through green building certification systems (updating tools like Miljöbyggnad (environmental certification system for buildings in Sweden) or BREEAM-SE to reward reuse). Establishing metrics and monitoring for the transition will help track the building material and components reused annually, emissions or waste reductions achieved, etc. An independent review board (with academic experts and industry) can periodically assess progress against the vision and targets set in Step 1. Based on monitoring, adaptation measures should be taken - if some barriers persist (e.g., certain materials are still rarely reused, or unexpected safety issues arise), expert groups should adjust policies. This echoes the iterative, reflexive governance advocated in transition management (Rotmans *et al.,* 2001), for keeping the strategy on track. Finally, success stories should be communicated clearly - e.g., if a major new building is completed using mostly reclaimed materials, it should be publicised as a showcase of Swedish innovation. This helps maintain public and stakeholder support, which is crucial for long-term transition processes (Markard *et al.,* 2012).

These five steps form an actionable strategy for addressing stagnation and enabling a system-wide shift toward reuse. Next, we conclude by reflecting on how these findings contribute to both transitions theory and the construction management field.

CONCLUSIONS

Our findings suggest that stagnation is a distinct phase in sustainability transitions, where niche activity and political rhetoric exist, but fail to destabilise the regime or attract sufficient structural support. Recognising and diagnosing stagnation can help avoid "pilot fatigue" and redirect efforts toward systemic realignment. In this paper, we have formulated a theoretical framework and outlined five steps for upscaling reuse in Swedish building production: (1) forming a multi-actor stakeholder coalition to overcome fragmented governance, (2) conducting structured niche experiments to generate practical evidence and stakeholder confidence, (3) building essential digital and knowledge infrastructures to address transaction cost and coordination barriers, (4) reforming regulatory frameworks that currently inhibit reuse, and (5) establishing iterative monitoring mechanisms to ensure ongoing alignment and scalability. This systematic approach provides clear, actionable pathways for embedding reuse into Swedish building production, advancing theoretical understanding of stagnation phases, and offering practical guidance for achieving a circular built environment.

This paper contributes to transitions theory by illustrating how upscaling reuse requires simultaneous action across niche, regime, and institutional layers. We show that transition stagnation can occur even under favourable landscape pressures (e.g., circular economy policies), if niche innovations lack legitimation, institutional alignment, and clear role distributions. The proposed five-step approach implements this insight into a roadmap for stalled transitions. A key limitation is our study's reliance on a single meta-analytical source rather than first-hand empirical data. While Mjörnell (2025) offers a valuable synthesis of research and practice across Sweden, future work should validate and extend our findings through primary data collection, (e.g., ethnographic studies, project case research). Such follow-ups could also explore the transferability of our roadmap to other national or sectoral contexts.

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