

# CONSTRUCTION WASTE GOVERNANCE IN CHINA: POLICY ANALYSIS AND ROADMAP FOR CIRCULAR ECONOMY TRANSITION

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**Abstract.** Despite the proliferation of circular economy (CE) policies targeting construction and demolition waste – the largest urban solid waste stream in China – a critical policy-practice gap persists between regulatory frameworks and on-site recycling practices. Existing literature often lacks a systematic diagnosis of the institutional and behavioral barriers hindering this sector's transition to circularity. Drawing on policy design theory, this study formulates an integrated analytical framework that synthesizes policy instrument analysis with stakeholder-centered perspectives to address this research gap. By integrating a mixed-methods content analysis of 925 policy documents with qualitative insights from 23 expert interviews, this study identifies six systemic deficiencies in China's CE transition in the construction sector: institutional fragmentation, policy instrument imbalance, limited upstream stakeholder engagement, regional disparities, insufficient standardization, and inadequate economic incentives. To transcend these barriers, the study then proposes a novel dynamic transformation roadmap. Unlike static solutions, this framework articulates a phased evolution (short-, medium-, and long-term) that guides the transition from rigid administrative control to a market-driven, lifecycle-integrated ecosystem.

**Keywords:** construction and demolition waste, policy analysis, policy instrument, stakeholder, circular economy, China.

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## 1. Introduction

The global construction industry's significant expansion has posed a critical challenge for managing construction and demolition waste (C&DW), especially for sustainable growth in developing countries (Duan et al., 2019; Zhang et al., 2023a). China, as the world's largest construction market, generates over 2.4 billion tons of C&DW annually (Hao et al., 2020), representing 30–40% of total solid waste output (Huang et al., 2018). This massive waste generation triggers a wide range of environmental consequences, including groundwater contamination, public health risks, and significant greenhouse gas emissions (Siddiqua et al., 2022; Thomsen et al., 2019).

Confronting the escalating environmental challenges posed by C&DW pollution, the circular economy (CE) emerges as a paradigm-shifting approach, offering a comprehensive, systemic solution to sustainable development. CE is an innovative economic model built on the "reduce-reuse-recycle" principles. It expands beyond waste reduction to include strategies for designing out waste, extend-

ing product life, and regenerating natural systems. By emphasizing resource optimization, CE transcends traditional linear extraction-production-disposal models (Ellen MacArthur Foundation, 2019). For the construction sector, CE is not just about technology. It redefines the policy frameworks of governing the built environment to achieve ecological sustainability (Norouzi et al., 2021).

Recognizing the strategic importance of the CE, countries worldwide, especially developed ones, are increasingly reconfiguring their policy frameworks. The European Union, for example, has defined explicit targets (Ghaffar et al., 2020), comprehensive roadmaps, and material quality standards (Iodice et al., 2021) to promote CE within its construction sector, illustrating a mature approach to embedding circularity. Against this global backdrop, many emerging economies are also increasingly recognizing the strategic importance of CE and are actively taking measures to establish relevant policy frameworks. However, these frameworks are not yet as comprehensive or as

successful as those in developed regions, often suffering from fragmented regulations and insufficient enforcement mechanisms. China, for instance, exemplifies this dynamic. While being one of the earliest nations to adopt dedicated CE legislation and to introduce comprehensive policy frameworks to support sector-wide transformation proactively, it still confronts notable challenges in fully realizing effective CE policies and their thorough execution, particularly in its construction industry. Research indicates that existing policies in the construction industry remain insufficiently comprehensive or practical (Ma et al., 2023). Furthermore, current statistics indicate that the recycling rate of C&DW in China is merely around 50%, markedly below the standards observed in European countries (Zhang et al., 2023b). Empirical evidence from 2020 highlighted the sector's underdevelopment, with only 20 processing enterprises, predominantly manufacturing substandard recycled bricks with limited practical applications in China (Su et al., 2020). This stark aspiration-implementation gap necessitates a comprehensive, systemic approach to bridge the gap between policy and practice.

Despite the evident gap between policy aspiration and practical implementation, the mechanisms underlying this disconnection remain poorly understood. This study addresses a critical question: what drives the structural mismatch between macro-level policy design and micro-level enforcement in China's construction industry CE transition? Existing research on C&DW governance has yet to provide effective solutions (see Section 2.1). To address these critical challenges, this study systematically investigates the underlying causal dynamics of the persistent policy-practice gap and formulates targeted, evidence-based strategies for improvement. The specific objectives are to: (1) systematically analyze the trajectory and structural composition of policy governing C&DW; (2) qualitatively elucidate the institutional and behavioral obstacles encountered by principal stakeholders; and (3) construct a phased, actionable roadmap that effectively operationalizes macro-level policy ambitions within micro-level implementation contexts.

To achieve these objectives, this study proposes a paradigm shift in C&DW governance analysis characterized by three key innovations. First, transcending traditional linear assessment models, this research constructs an innovative, integrated analytical framework grounded in policy design theory to provide a multidimensional diagnosis of governance challenges. Second, methodologically, the study moves beyond single-case studies by employing a sophisticated mixed-methods approach—integrating systematic analysis of 925 policy documents with qualitative insights from expert interviews—to systematically triangulate policy intent with implementation realities. Finally, the research explicitly deconstructs the mechanisms of policy-stakeholder interaction and maps spatial heterogeneity, thereby offering a replicable analytical paradigm for understanding circular economy transitions in complex, developing contexts.

## 2. Literature review and theoretical framework

The literature review presented in this paper is divided into two distinct sections. Section 2.1 reviews the existing empirical literature on C&DW governance innovations and identifies critical gaps in current research on governance implementation and stakeholder interaction. Section 2.2 then reviews the scholarship of policy design theory to construct an integrated analytical framework. It is important to clarify that this framework is not a direct citation of prior work but a synthesis of existing theoretical perspectives of policy analysis to formulate a logical blueprint for the research design. This framework consists of three analytical dimensions, i.e., policy contexts, instruments, and stakeholders. This framework then directly guides the methodological procedures in Section 3, specifically informing the coding scheme for document analysis and the protocols for expert interviews.

### 2.1. Revisiting C&DW governance scholarship

The existing research has predominantly explored C&DW governance innovations through three strategic approaches.

The first analytical purchase centers on technological advancement in material recycling, strategically targeting resource value optimization through sophisticated processing technologies that transcend traditional linear consumption models. Scholars have comprehensively examined construction material regeneration technologies from interdisciplinary perspectives, investigating regenerative strategies for diverse waste streams, including bricks, concrete, and steel. These investigations have encompassed critical domains such as recycling process optimization (He et al., 2021), technological innovations (Talla & McIlwaine, 2024), and quality control mechanisms (Tam et al., 2021). Alongside technological validation, these studies construct integrated, closed-loop material systems that provide foundational support for sustainable industrial transformation.

The second trajectory has concentrated on developing robust sustainability assessment methodologies. Scholars have employed sophisticated analytical frameworks, including life-cycle assessment (Barbhuiya & Das, 2023), life-cycle cost assessment (De Laurentiis et al., 2024), and other multi-criteria decision-making approaches (Maeder & Fröhling, 2024). These studies systematically scrutinized the potential of regenerative materials across diverse construction contexts, rigorously examining technological feasibility, economic viability, and environmental implications.

The third stream of analysis focuses on identifying critical success factors for systemic C&DW governance. This approach represents a paradigmatic shift from narrow technological perspectives to holistic governance frameworks. Scholars have employed multidimensional, interdisciplinary analysis to unpack the complex interactions underlying CE transformation. Key investigation domains

have included policy implementation (Li et al., 2024; Mohammed et al., 2022), technological innovation (Chammout & El-adaway Islam, 2025), market mechanism optimization (Torres Curado et al., 2024), supply chain dynamics (Wuni, 2022), stakeholder collaboration (Wuni & Shen, 2022), and information dissemination strategies (Wijewickrama et al., 2021).

Despite significant contributions in the technological and managerial domains, existing research reveals significant analytical gaps that hinder a systemic understanding of implementation barriers to CE transition in the construction sector. Primarily, studies predominantly concentrate on technological solutions or end-of-pipe treatments, lacking a comprehensive theoretical framework for policy design to explain macro-level inefficiencies. Furthermore, investigations into stakeholder interaction mechanisms remain insufficient; they often fail to explore the intrinsic connections between specific policy instruments and the resulting behavioral responses of diverse actors. Moreover, research on regional heterogeneity is notably underdeveloped. The prevailing one-size-fits-all analytical approach is insufficient to address how regional developmental disparities profoundly influence policy implementation and effectiveness.

In sum, the extant scholarship lacks a systemic theoretical framework to interpret these fragmentation and interaction failures in C&DW governance. Therefore, we advocate moving from purely descriptive or technological assessments to a diagnostic policy analysis grounded in political science and governance theory. The following section introduces policy design theory as the foundational lens to construct an integrated analytical framework for this study.

## 2.2. Reviewing the policy design theory: towards an integrated analytical framework

To systematically diagnose the policy-practice gaps identified above, this study draws upon policy design theory (Howlett, 2014; Peters, 2018) as the foundational theoretical lens. Policies serve as a critical lever for CE transformation, with design quality directly determining implementation effectiveness and strategic outcomes (Li et al., 2024). From a CE transition perspective, policy design is conceptualized as a sophisticated, systematic, strategic response to complex societal challenges (Peters, 2018). Fundamentally, it represents a methodological approach that transcends policy mechanisms and practice boundaries, aiming to construct innovative solutions to complex socio-economic problems (Bobrow & Dryzek, 2010).

The theoretical foundations of policy design are rooted in the strategic selection and configuration of policy elements within specific contextual constraints, ultimately targeting precise developmental objectives (Schneider & Ingram, 1997). Contemporary policy design research reveals a sophisticated analytical framework that conceptualizes policy development as a complex, dynamic, and multilay-

ered process (Howlett, 2009), extending beyond instrumental rationality and emphasizing the intricate interactions between policy mechanisms and social dynamics. Such an approach inherently calls for contextual sensitivity, strategic precision, dynamic adaptability, and multidimensional integration to navigate complexity effectively.

Guided by these core theoretical principles (Howlett, 2009; Peters, 2018), this study constructs an integrated analytical framework (Figure 1). Rather than adopting a preexisting model from a single author, this framework is a tailored synthesis designed to address the specific complexities of the C&DW sector. Following the seminal literature in policy analysis which posits that governance outcomes are determined by the alignment between institutional settings and technical choices (Hall, 1993; North, 1990), this research transcends traditional single-dimensional assessments by offering a nuanced understanding of the interactions between policy contexts (Howlett, 2009), policy instruments (Howlett, 2014; Mickwitz, 2003), and stakeholders (Freeman, 1984; Ghisellini et al., 2018), which are critical for effective and sustainable C&DW governance.

The framework's first analytical dimension, policy context, operationalizes contextual sensitivity by conceptualizing the policy environment as a dynamic, multifaceted institutional landscape profoundly configuring C&DW governance. Drawing upon institutionalist perspectives that emphasize the path-dependent nature of policy change and the constraints of administrative structures (Hall & Taylor, 1996), this study argues that a comprehensive context analysis must encompass three pillars: (1) Institutional evolution: Informed by historical institutionalism, this aspect traces trajectories and transformative mechanisms within C&DW policy to reveal how previous problem framing shapes current options (Liao, 2016; Theodoulou & Kofinis, 2004). (2) Governance structures and power dynamics: Reflecting the multi-level governance theory and

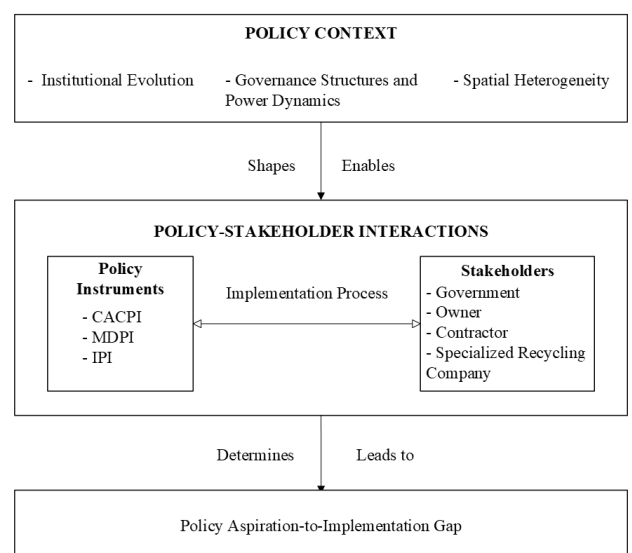


Figure 1. An integrated analytical framework for C&DW governance

the specific administrative logic in China, this pillar focuses on hierarchical interdependencies and departmental coordination (Hooghe & Marks, 2003; Ongaro et al., 2019). (3) Spatial heterogeneity: Recognizing the decentralized nature of environmental implementation in large emerging economies, this dimension accounts for significant regional disparities in policy landscapes and institutional capacities (Kostka, 2014; Wang et al., 2023).

The second analytical dimension, policy instrument-stakeholder interaction, scrutinizes the dynamic processes through which policies are operationalized. This is consistent with the “policy mix” scholarship, which suggests that no single tool is sufficient for complex environmental transitions (Borrás & Edquist, 2013). We explore the C&DW policy mix – encompassing command-and-control regulations, market-driven incentives, and informational instruments (Milios, 2018; Weber et al., 2014) – to move beyond mere typology. Crucially, this dimension transcends purely instrumental rationality by conceptualizing stakeholders as active interpreters of policy signals (Grimble & Wellard, 1997). The interaction is thus understood as a negotiated process, in which instruments’ effectiveness depends on their resonance with stakeholders’ behavioral logics.

### 2.2.1. Policy context of C&DW governance

Policy context analysis represents a sophisticated methodological approach to deconstructing the macro-governance logic of China’s CE transition in the construction industry. By systematically exploring institutional evolution, government governance structures, and spatial heterogeneity, this multidimensional analytical framework provides critical insights into the complex policy landscape of C&DW governance (Hall, 1993).

Institutional evolution analysis is dedicated to tracing the historical transformation trajectory of C&DW governance policies from embryonic stages to systematic transformation (North, 1990). For developing countries undergoing rapid socio-economic transitions, such analysis transcends traditional academic research, emerging as a critical paradigm for comprehending policy dynamics (Liao, 2016). By reconstructing policy evolution narratives, this approach unveils the profound governance logic underlying policy transformations, offering nuanced insights into institutional motivations and strategic adaptations. The CE, as an emerging sustainable development paradigm, fundamentally shapes national-level transformations in resource, environmental, and economic governance (Geng & Doberstein, 2008). Through a comprehensive examination of policy trajectories, the research provides critical theoretical foundations for understanding the complex mechanisms of implementation that characterize China’s CE transition in the C&DW governance sector.

Government structure and power dynamics analysis focuses on China’s distinctive multi-level administrative governance model (Hooghe & Marks, 2003). China’s multi-level administrative governance model represents more than an administrative framework – it is a complex system filled

with tension and negotiation (Ongaro et al., 2019). Different government levels’ role positioning, incentive mechanisms, and behavioral logics significantly influence policy outcomes. This dimension explores the roles of central and local governments in CE transformation, revealing institutional challenges within existing governance systems (Kostka, 2014). It provides crucial academic insights into analyzing institutional difficulties in policy execution and offers theoretical perspectives for optimizing governance mechanisms and coordinating intergovernmental relationships.

Spatial heterogeneity analysis is a particularly crucial analytical dimension given China’s vast territorial diversity and significant regional variations (Wang et al., 2023). The country’s complex landscape – spanning from north-eastern regions to southern areas, from developed coastal zones to underdeveloped inland regions – demonstrates profound differences in economic development, industrial structures, resource endowments, and institutional environments (Fan et al., 2023). This analytical approach challenges traditional “one-size-fits-all” policy thinking, providing a sophisticated framework for understanding how regional variations fundamentally shape policy design and implementation.

### 2.2.2. Policy instruments of C&DW governance

Policy design theory provides analytical tools for examining the specific mechanisms governments employ to achieve policy objectives. Central to this perspective is Howlett’s (2009) emphasis on the principle that effective policy instruments must be designed to function within specific governance environments rather than applied universally.

The analytical framework systematically categorizes policy instruments into three fundamental typologies. Command-and-control policy Instruments (CACPIs) represent the most direct form of governmental intervention, enacting mandatory regulations that enforce compliance through sanctions (Weber et al., 2014). These instruments include standards, bans, permits, and zoning restrictions (Mickwitz, 2003). In China’s C&DW governance context, CACPIs include waste reduction targets, disposal regulations, and technical standards for recycled materials.

Market-driven policy instruments (MDPIs) strategically harness economic incentives to modulate stakeholder behavior by recalibrating cost-benefit structures through mechanisms such as targeted subsidies, tax strategies, and dynamic pricing frameworks (Krause et al., 2019). These instruments fundamentally aim to internalize environmental externalities while simultaneously leveraging market dynamics to promote substantive behavioral transformations. Within the C&DW governance ecosystem, MDPIs are exemplified by tools such as subsidies, preferential tax schemes, and graduated waste-disposal fee structures.

Information policy instruments (IPIs) focus on voluntary compliance through information provision and communication strategies (Kautto & Lazarevic, 2020). Distin-

guished by their non-coercive nature, these instruments operate through persuasive knowledge transfer rather than formal enforcement mechanisms. In the construction sector’s contextual landscape, IPLs encompass comprehensive technical guidelines, targeted professional training programs, and emblematic demonstration projects.

Critically, the instrumental efficacy of these policy approaches is fundamentally contingent upon their seamless alignment with prevailing institutional architectures and nuanced stakeholder characteristics. Consequently, an integrative analytical approach that synthesizes multiple theoretical perspectives becomes important for conducting comprehensive and rigorous policy analysis.

**2.2.3. Stakeholder roles in C&DW governance**

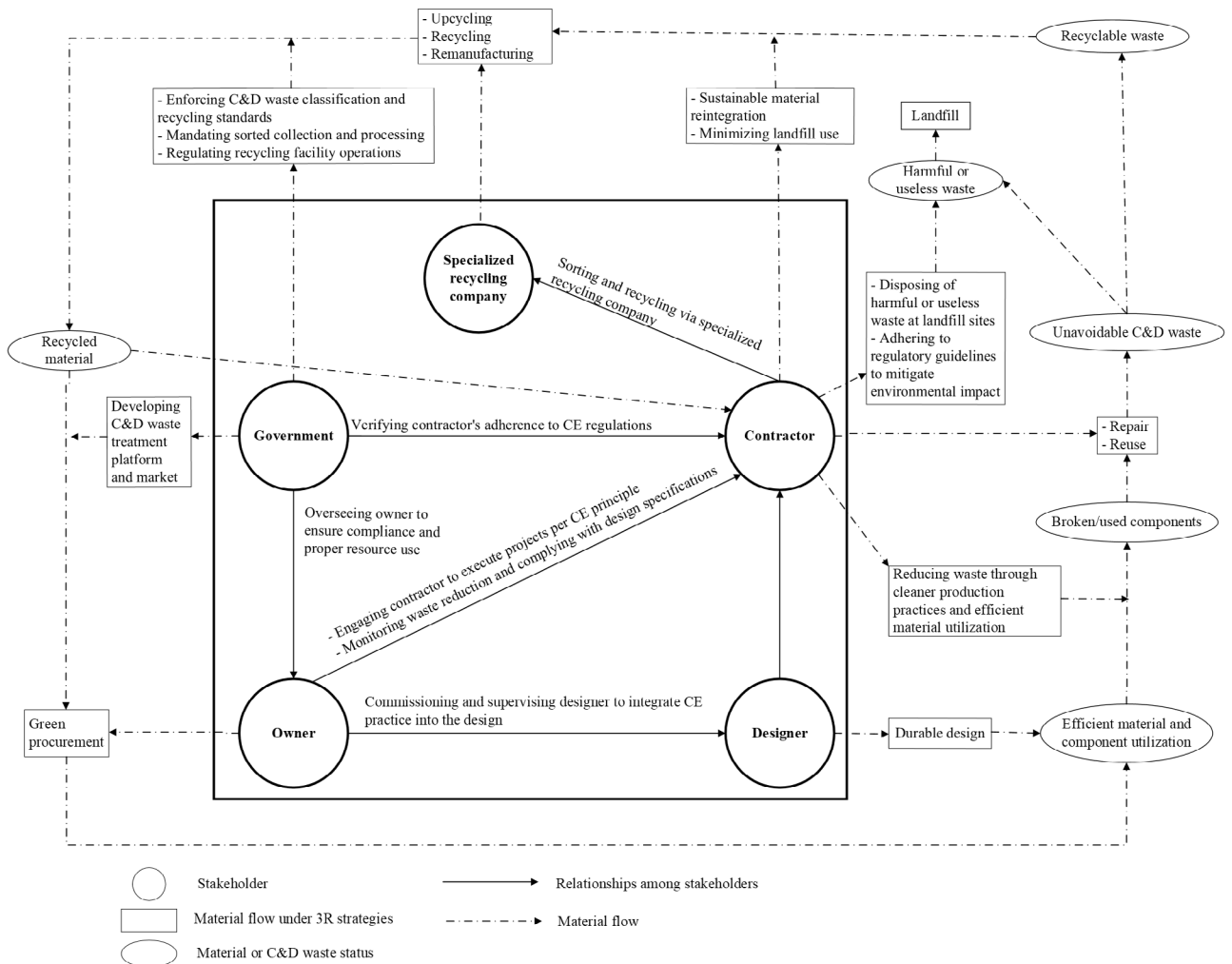
Stakeholder analysis provides a sophisticated theoretical lens for examining the intricate interactions among diverse actors within policy implementation ecosystems (Freeman, 1984; Grimble & Wellard, 1997), revealing the complex interdependencies that shape material flows and C&DW governance practices (Ghisellini et al., 2018; Lu & Yuan, 2010). This perspective illuminates key actors and the mechanisms through which they influence material flows and waste governance practices (Su et al., 2020).

The stakeholder landscape comprises four key actor categories, each playing a distinctive and strategically significant role in the C&DW governance system (as depicted in Figure 2).

Governments at multiple levels establish the regulatory framework by formulating policies, setting standards, and monitoring compliance (Milios, 2018). These include national ministries, provincial departments, and municipal agencies with varying jurisdictions over C&DW governance.

Project owners hold decisive authority over resource allocation and strategic project goals (e.g., budget and scheduling) (Cheng et al., 2022). While they typically rely on designers for technical support, their cost-driven decision-making often overrides sustainable design proposals, thereby creating a structural bottleneck for CE implementation. Their decisions regarding building specifications and contractual requirements significantly influence waste generation throughout the project life cycle.

Contractors operationalize waste governance practices on construction sites by implementing sorting procedures, waste-reduction techniques, and disposal protocols (Liu et al., 2022). Their technical knowledge and operational practices directly affect waste diversion rates and recycling outcomes.



**Figure 2.** Policy relevance for the industrial chain and stakeholders

Specialized recycling companies provide the technical infrastructure for processing C&DW into reusable materials (Tam et al., 2021). Their capacity and technological capabilities determine the economic viability of circular material flows in the construction sector.

Throughout different phases of material flow, including design, procurement, construction, demolition, and recycling, these stakeholders interact through complex networks of contracts, regulations, and market transactions (Antwi-Afari et al., 2022; Laovisutthichai et al., 2022). Their collective actions determine whether construction materials move through linear disposal pathways or circular recovery systems.

### 3. Methodology

This study employed a mixed-methods approach combining policy analysis, both qualitative and quantitative, and semi-structured expert interviews to investigate China's CE transition in the C&DW sector. Given the complex and underexplored nature of the policy implementation gaps in this context, this research adopts a diagnostic and exploratory design rather than a confirmatory approach rooted in hypothesis testing. As emphasized in seminal methodological literature, whereas confirmatory studies require a priori hypotheses to test established theories (J. W. Creswell & J. D. Creswell, 2017), exploratory mixed-methods inquiries are better served by flexible research questions and analytical frameworks to uncover complex, emergent phenomena without prematurely narrowing the scope (Bryman, 2016; Tashakkori & Teddlie, 2010). Therefore, rather than validating or rejecting hypotheses, this study relies on the integrated analytical framework developed in Section 2 to guide the empirical inquiry.

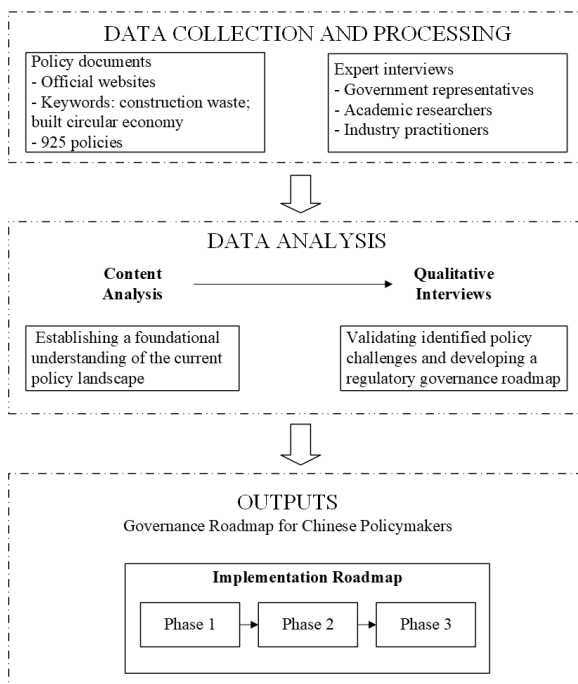


Figure 3. Evidence-based research design

### 3.1. Policy document collection and content analysis

Policy analysis is an overarching research domain, within which content analysis is employed as the primary analytical tool – incorporating both policy document collection and a mixed quantitative-qualitative coding approach. In this study, content analysis was employed to systematically examine and characterize the structure, patterns, and evolution of China's C&DW policy framework across multiple governance levels. Content analysis offers a systematic and objective method for classifying and evaluating communication materials (Singh, 2017). It has been widely used in government policy research across various domains (Liao, 2016; Luo et al., 2021; Lv, 2020)

Reflecting China's hierarchical governance structure (Miliou, 2018), this study collected policy data from the central government, provincial authorities, and provincial capital governments. The administrative framework examined included 23 provincial governments, 5 autonomous regional governments, and 4 directly administered municipal governments, excluding special administrative regions like Hong Kong due to their distinct political and legal systems. Policy documents were systematically retrieved from official governmental websites between September 2023 and March 2025 using the specific keywords, 'construction waste' and 'built circular economy'. After filtering out irrelevant materials, the study identified 925 policy documents – all of which were published on these official sites up to the end of March 2025 – distributed as follows: 47 at the national level, 598 at the provincial level (comprising 440 from provinces/autonomous regions and 158 from directly administered municipalities), and 280 from provincial capitals.

The coding framework was developed based on the theoretical framework. The theoretical lens informed the construction of a comprehensive coding table (Table 1) with multiple dimensions: (1) policy typology, (2) governance level and regional distribution, (3) temporal evolution, (4) policy instrument classification, and (5) targeted stakeholders.

Following data collection, each document underwent rigorous examination through a structured coding process that categorized and simplified recorded materials into distinct codes based on a theoretically grounded coding table. The coding process employed a systematic two-stage approach. In the initial stage, all collected documents underwent preliminary categorization by issuance date, administrative level, geographical region, and typology to establish baseline data for longitudinal and spatial analysis. The second stage involved in-depth qualitative coding of policy content. To capture the multifaceted nature of policies, multiple codes were permitted for individual texts, particularly when policies employed diverse instrument types or targeted multiple stakeholders simultaneously. For instance, as detailed in Table 1, if a specific clause stipulated 'tax exemptions for recycled products', it was systematically identified and coded as an MDPI.

**Table 1.** Coding framework for C&DW policies

Coding Dimension	Subcategory	Definition/Description	Policy Text Example
Policy Typology	Policies Directly Addressing Circular Economy (PDACE)	Policies explicitly targeting CE as a core objective	"2006 Action Plan for Accelerating Circular Economy Development and Building Resource-Conserving Cities" (Beijing Development and Reform Commission, 2006)
	Technical Implementation Guidelines (TIG)	Policies providing specific implementation methodologies and technical standards	"Guidelines for Construction Waste Reduction at Construction Sites" (Ministry of Housing and Urban-Rural Development, 2020)
	Normative Documents (ND)	Policies regulating industry behaviors without a legally binding force	"Notice on Promoting Government Procurement Support for Green Building Materials to Enhance Building Quality" (Ministry of Finance of the People's Republic of China & Ministry of Housing and Urban-Rural Development of the People's Republic of China, 2020)
	Formal Local Laws, Legislation & Regulations (FLL&R)	Legally binding regulations enacted by local legislative bodies	"Beijing Construction Waste Disposal Management Regulations" (Beijing Municipal Government, 2020)
Governance Level	Central Government		
	Municipality Directly under the Central Government		
	Provincial Government		
	Municipal Government		
Regional Distribution	Eastern Region	Beijing, Tianjin, Shanghai, Jiangsu, Zhejiang, Fujian, Shandong, Guangdong, Hainan	
	Central Region	Hebei, Shanxi, Anhui, Jiangxi, Henan, Hubei, Hunan	
	Western Region	Sichuan, Guizhou, Yunnan, Tibet, Shaanxi, Gansu, Qinghai, Ningxia, Xinjiang, Inner Mongolia, Guangxi	
	Northeastern Region	Liaoning, Jilin, Heilongjiang	
Policy Instruments	CACPI	Mandatory provisions enforcing compliance through strict administrative regulations and sanctions	"For government-funded investment projects, the proportion of recycled materials should, in principle, not be less than 40% of similar building material products." (Shandong Province)
	MDPI	Economic measures leveraging market forces to incentivize behavioral change through subsidies, taxation, or pricing	"Tax exemption shall be granted for products such as unfired bricks, blocks, wall panels, and concrete with construction waste incorporation rates exceeding 30%." (Shaanxi Province)
	IPI	Informational clauses promoting voluntary compliance through guidance, training, and communication strategies	"Promote C&DW resource utilization technologies, and construct a batch of demonstration projects for C&DW resource recycling." (Shandong Province)
Target Stakeholders	Government	Government departments at various levels	
	Owner	Entities responsible for planning, constructing, repairing, renovating, or demolishing buildings that they own	
	Contractor	Entities with the necessary technical expertise to execute construction work	
	Specialized Recycling Company	Enterprises specializing in construction waste recycling and processing	
	Unspecified	Policies without explicit targeting of specific stakeholders	

To ensure validity and reliability in the analytical process, several measures were implemented. First, the coding scheme was cross-validated by two independent experts familiar with C&DW governance and CE implementation in China. Second, two trained researchers independently coded the materials, with discrepancies resolved through consultation with the first author. Finally, inter-coder reliability was assessed using the Kappa coefficient, which exceeded 0.8, indicating good reliability of the content analysis. This methodical approach to coding policy documents enabled the systematic identification of patterns,

gaps, and inconsistencies in China's current C&DW governance policy framework.

Based on the coded data, a comprehensive analysis was conducted. First, descriptive statistics were employed to calculate the frequency and distribution of different policy instruments over time, revealing temporal evolutionary trends. Second, spatial analysis was used to map the geographical distribution of policy intensity across provinces, generating heat maps to diagnose regional heterogeneity. Third, co-occurrence analysis was applied conceptually to examine interactions among different instrument types and stakeholder targets.

### 3.2. Expert interview process and analysis

To explicitly build on and deepen insights from the initial content analysis, this study employed semi-structured interviews to investigate China's CE transition in construction. Leveraging their capacity for capturing nuanced perspectives with structured flexibility (Barriball & While, 1994) – essential for exploring complex policy dimensions often missed by textual analysis alone – these interviews served a threefold, interconnected purpose directly related to the preceding content analysis findings. Primarily, they enabled an in-depth investigation of deep-seated, often unwritten, challenges and root causes that impede policy efficacy, thereby exploring the 'why' and 'how' behind patterns and gaps initially identified through the systematic review of policy documents. Concurrently, this qualitative engagement systematically validated, contextualized, and enriched policy issues pinpointed during the content analysis phase, confirming their real-world significance and uncovering diverse manifestations through expert insights. Finally, and crucially, it facilitated the collaborative development of an empirically grounded, actionable policy optimization roadmap, drawing upon both the mapped policy landscape from the content analysis and the practical, expert-derived understandings from the interviews to propose strategic solutions and interventions.

The interview framework was structured around three core themes: (1) effectiveness and challenges of existing C&DW governance policies; (2) specific barriers encountered by different stakeholders during policy implementation; and (3) potential policy optimization pathways and intervention measures. The questions were developed based on preliminary findings from policy document analysis and reviewed by two independent researchers to ensure validity and relevance. The interview guide comprised 10 main questions, each with corresponding probing questions, allowing researchers to adjust as the interview progressed based on the interviewees' expertise and conversation flow.

To ensure comprehensive and representative data collection, experts were selected based on multidimensional criteria: (1) extensive professional experience in C&DW governance or CE; (2) involvement in relevant policymaking, evaluation, or implementation; (3) affiliation with representative institutions or organizations; and (4) geographical distribution covering Eastern, Central, Western, and Northeastern China to reflect regional development disparities. This theoretical sampling approach ensured both breadth and depth of collected perspectives (Benaquisto & Given, 2008), representing diverse regional and stakeholder viewpoints.

The study ultimately engaged 23 experts (Table 2), including government representatives ( $n = 6$ ), academic researchers ( $n = 6$ ), and industry practitioners (contractor company:  $n = 6$ , owner:  $n = 5$ ). These experts were distributed across the Eastern ( $n = 6$ ), Central ( $n = 5$ ), Western ( $n = 6$ ), and Northeastern ( $n = 6$ ) regions, with professional experience ranging from 3 to 32 years, forming a diverse,

**Table 2.** Profile of expert interviewees for framework validation

No.	Place of work	Position	Years of work experience
1	Contractor company	Engineer	32 years
2	Research institutions	Scholar	5 years
3	Government	Officer	5 years
4	Government	Officer	15 years
5	Research institutions	Scholar	4 years
6	Owner	Engineer	5 years
7	Research institutions	Scholar	3 years
8	Contractor company	Engineer	5 years
9	Owner	Engineer	17 years
10	Contractor company	Engineer	7 years
11	Government	Officer	13 years
12	Owner	Engineer	10 years
13	Owner	Engineer	25 years
14	Owner	Engineer	16 years
15	Research institutions	Scholar	5 years
16	Government	Officer	3 years
17	Government	Officer	5 years
18	Government	Officer	12 years
19	Research institutions	Scholar	5 years
20	Contractor company	Engineer	21 years
21	Contractor company	Engineer	9 years
22	Contractor company	Engineer	4 years
23	Research institutions	Scholar	7 years

experienced expert pool. The number of participants was determined according to data saturation, with the sample size deemed sufficient when additional interviews ceased to yield significant new information.

For the qualitative interview data, a hybrid deductive-inductive thematic analysis (Braun & Clarke, 2006) was adopted. The interview transcripts were systematically reviewed to identify recurring patterns related to implementation barriers and stakeholder behaviors. This process involved synthesizing raw textual evidence into higher-level conceptual themes; for instance, specific observations regarding "Market mechanisms are too weak to drive voluntary compliance" (as highlighted by Expert 2) were conceptually codified as the "policy instrument imbalance" in policy execution. Finally, these qualitative insights were triangulated with the policy data to explain the underlying mechanisms behind statistical patterns, providing deep contextual evidence for the identified governance paradoxes.

## 4. Results and discussion

### 4.1. Policy overview and contextual analysis

#### 4.1.1. Institutional evolution of China's C&DW governance policy

China's C&DW governance has evolved through four key stages, reflecting continuous policy refinement and institutional transformation. The Initial Stage (2004–2008) marked a fundamental shift in China's macro-level approach to CE governance. A critical transition occurred in 2004 when the National Development and Reform Commission (NDRC) assumed leadership of CE affairs from the Ministry of Ecology and Environment (MEE), signaling an evolution from purely environmental protection to an integrated economic development model (McDowall et al., 2017). The State Council's 2005 directive, "Several Opinions on Accelerating the Development of a Circular Economy", established the foundational policy framework (State Council of PRC, 2005), followed by the incorporation of CE principles into the 11th Five-Year Plan in 2006. The promulgation of the Circular Economy Promotion Law in 2008 consolidated the legal framework, establishing a comprehensive regulatory foundation for CE implementation (State Council of PRC, 2008).

The developmental phase (2008–2014) is characterized by the emergence of a sophisticated multi-sectoral collaborative governance framework at the meso-policy level, with governmental responsibilities strategically delineated and institutionalized. The Ministry of Housing and Urban-Rural Development assumed responsibility for policy formulation and coordination, while the Ministry of Industry and Information Technology focused on standards and industrial planning (Geng & Doberstein, 2008). Supporting roles were assigned to various ministries, including Science and Technology and Finance. The 2010s State Commission Office of Public Sectors Reform [SCOPSR] notification clarified departmental responsibilities (SCOPSR, 2010), while technical standards for C&DW recycling were implemented through various technical codes and regulations. These meso-level institutional arrangements translated macro objectives into operational policy structures.

The advancement stage (2015–2018) increasingly explored MDPIs at the micro-level. This stage introduced a comprehensive policy suite, including tax incentives through "the Catalogue of Preferential Value-Added Tax for Products and Services of Comprehensive Resource Utilization and the Regulatory Conditions" (Ministry of Finance and State Taxation Administration, 2015) and strategic government procurement policies. Specifically, the government implemented targeted procurement support mechanisms that prioritized recycled construction materials and enterprises demonstrating advanced resource utilization capabilities. The 13th Five-Year Plan elevated C&DW resource utilization to a strategic national priority, accompanied by improvements in standardization systems and evaluation mechanisms.

The current systemic transformation stage (2019–present) is characterized by comprehensive policy development that integrates policies across three hierarchical levels. The implementation of the "zero-waste cities" pilot project has catalyzed industry transformation (MHURD, 2020), establishing specific targets such as limiting C&DW emissions to 300 tons per 10,000 square meters for new construction sites and 200 tons for prefabricated construction. A multi-tiered policy system has emerged, encompassing national strategic planning (macro), provincial implementation guidelines (meso), and municipal execution plans (micro).

This evolution represents more than a simple timeline of new policies; it marks a fundamental shift in China's approach to C&DW governance. Initially perceived narrowly as a waste-disposal challenge requiring basic regulatory oversight (Phases 1 & 2), the problem definition has expanded. The transition towards Phase 3 and particularly Phase 4, marked by the NDRC's leadership and the integration into broader CE and 'dual carbon' strategies, signals a significant reconceptualization of C&DW from a mere environmental burden to a potential resource reservoir and an integral component of sustainable economic development models. This evolving understanding at the macro level has profound implications for the types of policy instruments favored, the institutional responsibilities assigned, and the expected engagement from various stakeholders. However, translating this high-level conceptual shift into consistent and effective micro-level practices remains a central challenge, as discussed later.

#### 4.1.2. Governance structure and power dynamics in C&DW management

China's C&DW governance operates within a distinctive multi-level administrative governance paradigm, featuring both vertical and horizontal dimensions (Figure 4). Vertically, a top-down policy transmission pathway extends from central government strategic direction through provincial interpretation to municipal-level implementation. This hierarchical structure, typical of China's administrative system, aims to ensure national strategies are cascaded effectively. The State Council of PRC, through detailed administrative power allocation, establishes a multi-level policy system encompassing national strategic planning, provincial guidelines, and municipal execution plans. This provides a framework for macro-control while allowing local governments to adapt.

Horizontally, a collaborative governance network is intended to facilitate the CE transition in the construction industry. At the central level, the National Development and Reform Commission (NDRC) acts as the primary coordinating department for CE, with the Ministry of Housing and Urban-Rural Development (MOHURD) leading, in collaboration with entities like the Ministry of Industry and Information Technology (MIIT) and the Ministry of Ecology and Environment (MEE). This collaboration is mirrored at the local level, where Development and Reform Commissions

coordinate macroeconomic policy, and urban governmental departments often serve as operational hubs, integrating resources from various specialized departments (e.g., land use, quality standards, transportation, environmental assessment). This network aims to refine C&DW governance through mechanisms such as information sharing, joint supervision, and performance evaluation under unified local government leadership.

However, despite this structured architecture, the governance framework has inherent limitations that significantly

impede its effectiveness. For instance, the identified discretionary gap in policy implementation between national directives and local adaptations often results in inconsistent enforcement and diluted policy impact, particularly when local economic priorities override environmental concerns. Furthermore, departments often focus narrowly on specific tasks, such as collection, transportation, or disposal (see Figure 4). This fragmentation hinders the development of integrated recycling and reuse systems. Moreover, the lack of a strong central authority

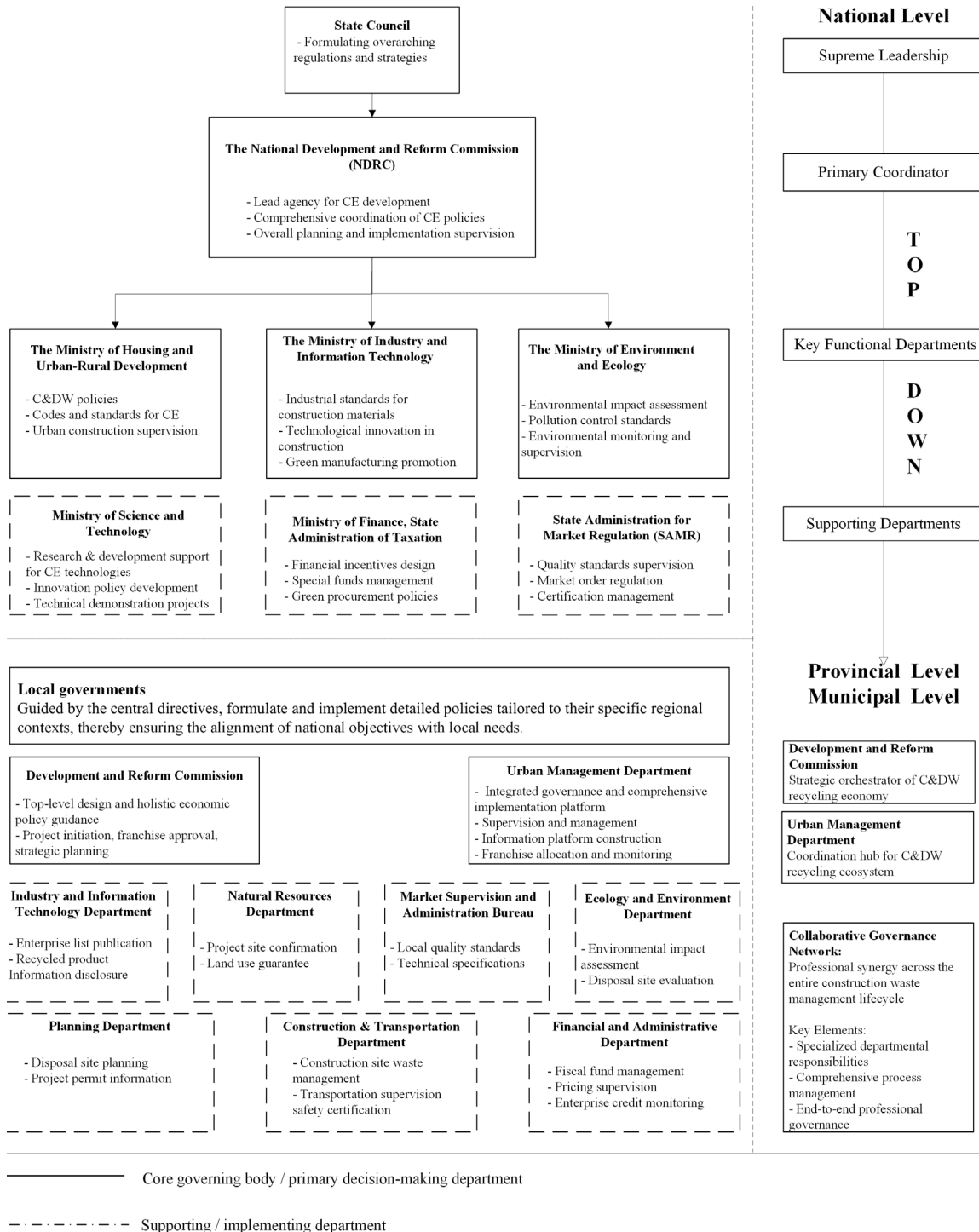


Figure 4. C&DW governance structure in China

to manage the entire waste life-cycle results in inconsistent and ineffective coordination between sectors. Consequently, opportunities for resource recovery are lost, reinforcing the traditional linear ‘take-make-dispose’ model.

Therefore, while China’s C&DW governance framework demonstrates an evolving capacity to navigate vertical hierarchies and horizontal coordination, its progression towards comprehensive circular utilization is hampered by these structural weaknesses. Addressing these challenges requires strategic interventions to refine interdepartmental synergy, enhance policy precision for implementation, and fundamentally reorient waste governance from linear disposal to a truly circular model. Overcoming these limitations is crucial for China to fully leverage its institutional learning and activate local innovation potential in pursuit of sustainable C&DW governance.

**4.1.3. Spatial heterogeneity of C&DW policy**

China’s C&DW policy landscape exhibits significant spatial and temporal heterogeneity, reflecting a complex interplay of institutional, economic, and developmental factors. A spatiotemporal heat map (Figure 5, part A) reveals distinct regional variations in policy implementation intensity.

Significant temporal and spatial dynamics fundamentally characterize the policy landscape. After 2019, a notable increase in policy intensity was observed, particularly in more developed regions, demonstrating a sophisticated pattern of policy evolution. The Eastern provinces emerged as early adopters of central government initiatives, consistently positioning themselves at the forefront of policy innovation. In contrast, northeastern regions generally exhibited slower trajectories of policy development. This temporal and spatial distribution exemplifies what

Kjaer and Vetterlein (2018) identify as asymmetric power relations in regulatory governance, where regions with superior economic and institutional capacities can more effectively translate central directives into localized implementation strategies.

The provincial distribution of policy typology, as depicted in Figure 5, part B, provides a sophisticated illustration of how institutional power relations shape policy development trajectories. Municipalities under direct central government administration exhibit the most comprehensive policy frameworks, characterized by a balanced distribution across multiple policy types. This reflects their privileged administrative positioning, which facilitates enhanced access to resources, specialized expertise, and direct communication channels with central authorities (Wang et al., 2021).

Regional characteristics emerge from the complex interplay of multifaceted factors. Economic development, industrial composition, local governance capabilities, and environmental consciousness collectively shape the spatial variations in C&DW governance policies. Developed regions typically exhibit greater policy innovation drive and resource mobilization, enabling more agile responses to national strategic imperatives. Conversely, economically lagging regions often adopt more conservative, reactive approaches to policy development and implementation.

This regional divergence transcends a static spatial pattern and represents a dynamic evolutionary trajectory. Crucially, this spatial heterogeneity, as illustrated by Experts 18 and 23, appears to be driven by factors beyond mere economic development levels. While developed regions like Shanghai and Guangdong demonstrate more comprehensive policy portfolios, the underlying reasons

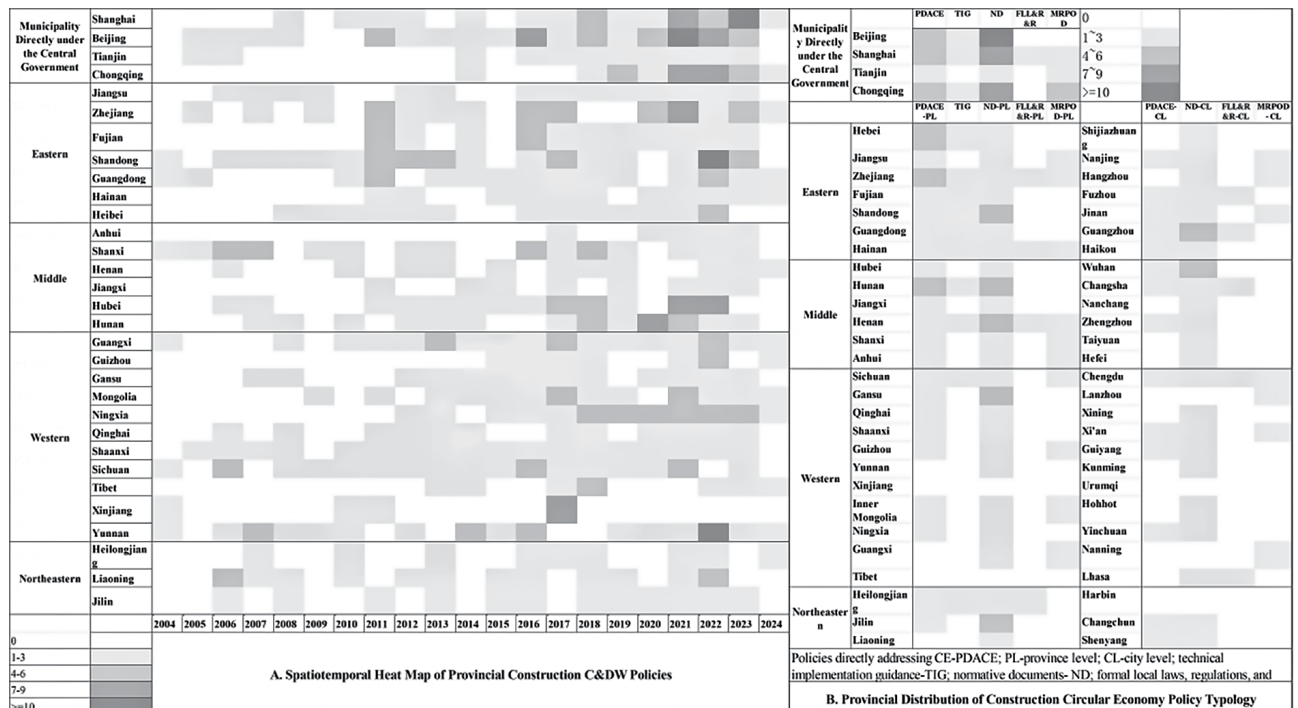


Figure 5. Spatiotemporal heat map

for these disparities are likely rooted in more fundamental differences in institutional innovation capacity, the proactiveness of local governance in environmental matters, and prevailing developmental philosophies. For example, regions that have internalized a 'green development' or 'circular economy' philosophy into their core administrative logic tend to exhibit more comprehensive and stringently enforced C&DW policies, irrespective of minor variations in GDP. This observation aligns with findings in regional environmental governance research (Ma et al., 2023; Wang et al., 2023), which indicate that local institutional capacity, specifically the ability to overcome administrative fragmentation through cross-departmental coordination, is often a stronger predictor of policy implementation success than fiscal affluence alone. This suggests that fostering a shared vision and enhancing local governance capabilities are as critical as economic investment for achieving national C&DW governance goals.

## 4.2. Policy instruments and stakeholder interaction analysis

### 4.2.1. Interaction mechanisms between policy instruments and stakeholders

A stakeholder-oriented analysis of C&DW governance policies reveals significant imbalances in the distribution of instruments and critical deficiencies in stakeholder interaction. The policy-stakeholder matrix (Figure 6) immediately highlights a fundamental systemic weakness: most policies lack explicit stakeholder-specific targeting. This ambiguity leads to diffuse responsibilities and incentives, diluting accountability and fostering reactive rather than proactive engagement from key actors who lack clear, role-specific mandates and performance indicators.

Among policies that do target specific actors, specialized recycling companies are a primary focus. However, a particularly striking and novel finding of this research is the systematic marginalization of upstream stakeholders, especially designers. As Expert 3 and Expert 5 emphasized, designers are pivotal for source reduction and enabling disassembly/recycling, yet current policies offer them few incentives or mandates to integrate C&DW minimization into initial blueprints. Expert 3 noted that current policies focus primarily on end-of-pipe treatment, lacking guidance for upstream design. Expert 5 echoed this view, describing the system as reflecting a "traditional mindset" that diverges from the comprehensive life-cycle approach advocated by CE principles. This empirical finding corroborates the theoretical concerns raised in recent frontier studies by Antwi-Afari et al. (2022) and Laovisutthichai et al. (2022), who argued that the construction industry's circular transition is fundamentally stalled by the design-implementation gap, in which theoretical concepts such as Design for Deconstruction fail to materialize into binding policy mechanisms. This oversight represents a significant missed opportunity, as design decisions create profound lock-in effects on waste generation and recyclability, perpetuating system inefficiencies from inception and directly constraining C&DW reduction and resource valorization objectives.

The policy instrument landscape is characterized by a predominance of IPIs, followed by CACPIs, with MDPIs underdeveloped. Expert 18 viewed this phenomenon as reflecting policymakers' strategic considerations regarding resource utilization and long-term governance. Although IPIs are relatively slow to take effect and have low policy intensity, their unique advantages make them an indispensable component of policy instrument combinations. As a low-cost, low-invasive policy instrument, IPIs require minimal administrative resources and fiscal investment. Moreover, Expert 12 emphasized the long-term effects of IPIs: "Through continuous information dissemination and awareness cultivation, these policy instruments can fundamentally transform stakeholders' behavioral patterns and mindsets. For instance, most provinces have incorporated CE into construction as a critical indicator for green building and civilized construction site assessments, and this subtle guidance is significant for developing sustainable development concepts". This view is strongly supported by recent behavioral research in C&DW governance (Ghaffar et al., 2020; Liu et al., 2022; Yu et al., 2021), which posits that while informational interventions exhibit a more extended latency period compared to mandatory regulations, they are indispensable for cultivating the subjective norms and environmental attitudes that underpin sustained voluntary compliance.

CACPIs in China are predominantly designed to target project owners and contractors, with typical practices including mandatory procurement of recycled materials for government-invested projects and setting C&DW emission quotas. Expert 13 explained the institutional rationale behind this targeting. Project owners and contractors play critical roles at critical decision-making points throughout a building's life-cycle: owners primarily control project planning and resource allocation, while contractors directly implement waste reduction and classification strategies. Compared to other stakeholders, they are more susceptible to administrative directives, allowing regulatory influences to be effectively enforced through project approval processes and contractual provisions. This observation is consistent with Liu and Teng (2023), who found that mandatory regulations in China are most effective when applied to stakeholders with direct operational control over waste generation. Conversely, existing MDPIs primarily target specialized recycling companies, guiding corporate participation through economic incentives such as tax preferences and fiscal subsidies, aiming to generate technological innovation through institutional economic incentive mechanisms, reduce recycled material production costs, and achieve dynamic market competitiveness reconstruction (Cheng et al., 2022).

These issues are underpinned and exacerbated by several interconnected institutional and governance challenges that constrain effective C&DW governance. A crucial impediment is the absence of specialized C&DW management indicators within government performance appraisal systems. As Expert 2 and Expert 19 highlighted, this "institutional vacuum creates a systemic disincentive for proactive waste management", leading to lower prior-

itization and resource allocation for C&DW issues. This is compounded by a prevailing approach that couples strong administrative guidance with weak market incentives, creating what Expert 1 termed a “governance paradox of high expectations and low substantive support”, where policies often favor encouraging rhetoric over substantive financial incentives or penalties strong enough to motivate standardized recycling practices (Expert 19, Expert 3). This empirical finding aligns with the latest evolutionary game analysis by Yuan et al. (2023) and Zhuang et al. (2026), which demonstrated that without dynamic subsidy mechanisms, stakeholders inevitably gravitate towards cost-saving behaviors (e.g., illegal dumping) rather than compliance, thereby theoretically explaining the implementation failures observed in our study.

Fundamentally, current policies exhibit a single-stakeholder orientation and lack systematically designed mechanisms for stakeholder interaction. Policies tend to address groups in isolation, failing to foster collaborative platforms and information-sharing channels essential to a circular economy, thereby hindering the development of an efficient CE operational system. The root of many such challenges lies in deep-seated cognitive biases among governance entities. As Expert 17 pointed out, C&DW governance is often framed as a “traditional administrative task rather than a complex socio-technical system requiring market-oriented resource regeneration strategies”. This mindset leads to policy designs misaligned with market dynamics and manifests operationally in fragmented approaches, such as a “single-focused transportation supervision” (Expert 6), that neglect source reduction and comprehensive recycling processes. Further compounding these issues are the lack of strategic planning for recycling infrastructure – which Expert 10 argued should be “critical urban infrastructure requiring comprehensive planning” – and, as Expert 9 highlighted, “serious deficiencies in recycled building material professional standards”, creating supply chain uncertainties. This echoes the recent assessment by Oluleye et al. (2023), who emphasized that the lack of integrated spatial planning for waste facilities remains a critical bottleneck for achieving CE transition. Finally, the interaction among existing policy instruments can even be counterproductive, with Expert 15 noting instances in which “certain tax policies or procurement practices might unintentionally undermine waste reduction policy objectives”.

In summary, the interaction between policy instruments and stakeholders in China’s C&DW governance is characterized by the marginalization of key upstream actors, an imbalanced policy portfolio weak in market-based drivers, and a range of deep-seated institutional and cognitive barriers. Addressing these multifaceted deficiencies requires a paradigm shift in policy design. Future efforts must transcend traditional single-stakeholder perspectives to construct a multi-actor collaborative governance framework, design balanced and complementary policy instrument combinations that activate intrinsic stakeholder motivation and drive the transformation from a linear disposal paradigm to an ecological circular utilization system (see Figure 6).

#### 4.2.2. Regional variations in policy instruments-stakeholder interaction

At the regional level, the interaction between policy instruments and stakeholders reveals significant spatial heterogeneity, profoundly mapping the multidimensional differentiation characteristics of different regions in China across economic development levels, institutional innovation capabilities, and governance performance.

From a regional perspective, eastern provinces and municipalities directly under the central government exhibit a more systematic and holistic combination of policy instruments. These regions not only exhibit diversity in regulatory mechanisms but also demonstrate greater strategic precision in setting policy objectives. In contrast, Western regions’ policy instruments predominantly rely on IPis and CACPIs, with the absence of MDPIs directly constraining the systematic transformation of CE in the construction sector.

Deeper regional differences are reflected in the sophistication of policy instruments and the intensity of implementation. Eastern provinces and municipalities directly under the central government focus not only on the diversity of policy instruments but also on the synergy and complementarity among them. Their implementation in CACPIs often goes beyond general norms, with detailed implementation guidelines, technical standards, and rigorous monitoring clauses. The application of MDPIs in these regions, though still relatively limited, has begun to explore differentiated waste processing fee mechanisms and priority procurement strategies. In comparison, Western regions’ policy instruments implementation remains more focused on surface-level constraints and restrictions, lacking substantive incentive and guidance mechanisms. This policy orientation reflects the profound structural differentiation in governance capabilities and developmental concepts across regions.

The regional variations in law enforcement intensity and approach further highlight the diversity of governance models. Eastern provinces and municipalities typically adopt a more institutionalized, standardized enforcement approach, including routine inspections, rigorous compliance verification, and differentiated administrative penalties. Western and Northeastern regions tend towards a more flexible, guidance-oriented enforcement approach, emphasizing process-oriented guidance rather than punitive measures and embodying localized governance wisdom.

The implementation of C&DW policy instruments in China presents prominent regional heterogeneity. Multiple experts note that limited understanding of the CE concept among technical personnel in less developed regions is a key factor contributing to regional disparities. Expert 6 further emphasizes that even in relatively developed eastern regions, existing policy instruments still struggle to ensure comprehensive compliance.

More critically, these regional differences reflect deeper institutional challenges. Expert 6 indicates that regional differentiation in policy instruments stems not only

		CACPI					MDPI					IPI					0															
		C	SC	O	D	NM	C	SC	O	D	NM	C	SC	O	D	NM	1-3															
		Municipality Directly under the Central Government															4-6															
Municipality Directly under the Central Government	Beijing																															
	Shanghai																															
	Tianjin																															
	Chongqing																															
		Provincial-Level															Capital City-Level															
Eastern	Hebei																Shijiazhuang															
	Jiangsu																Nanjing															
	Shandong																Jinan															
	Zhejiang																Hangzhou															
	Guangdong																Guangzhou															
	Fujian																Fuzhou															
	Hainan																Haikou															
Middle	Anhui																Hefei															
	Hubei																Wuhan															
	Hunan																Changsha															
	Henan																Zhengzhou															
	Shanxi																Taiyuan															
	Jiangxi																Nanchang															
Western	Ningxia																Yinchuan															
	Guangxi																Nanning															
	Tibet																Lhasa															
	Gansu																Lanzhou															
	Qinghai																Xining															
	Shaanxi																Xi'an															
	Sichuan																Chengdu															
	Guizhou																Guiyang															
	Yunnan																Kunming															
	Xinjiang																Urumqi															
	Inner Mongolia																Hohhot															
	Northeastern	Heilongjiang																Harbin														
Jilin																	Changechun															
Liaoning																	Shenyang															

CACPI: command-and-control policy instrument; MDPI: market-driven policy instrument; IPI: information policy instrument; Contractor: C, Specialized recycling company: SC; Owner: O; Designer: D; Not mention: NM.

Figure 6. Local policy relevance for diverse stakeholders

from variations in economic development levels but also from deeper-rooted differences in institutional innovation, governance capabilities, and developmental philosophies across regions. For instance, developed regions often possess stronger institutional resilience and policy experimentation capabilities, enabling them to address complex circular economy governance challenges more flexibly. In contrast, less developed regions are typically constrained by resource limitations and institutional inertia, making it difficult for them to construct a systematic policy innovation framework. This constraint aligns with the broader literature on environmental governance in China, which suggests that implementation gaps in less developed provinces are often structural consequences of limited administrative capacity and fiscal dependence, rather than mere unwillingness to comply (Wang et al., 2021, 2022).

## 5. Roadmap development: Strategic pathways for China's CE transition

### 5.1. Structural assessment of policy-practice gaps

Based on a comprehensive analysis of C&DW governance policies in China, this research identifies six primary structural policy practice gaps that critically impede CE transi-

tion. These gaps comprehensively reveal the systemic challenges in current policy frameworks.

First, institutional fragmentation represents a significant systemic challenge. The current policy governance system demonstrates pronounced inefficiencies in inter-departmental coordination mechanisms, resulting in blurred responsibility boundaries and inadequate information sharing. This fragmentation substantially constrains holistic C&DW governance approaches and undermines the effective implementation of CE initiatives.

Second, policy instrument design exhibits a critical imbalance between different policy approaches. The existing policy landscape predominantly relies on IPIs, with significant underdevelopment of MDPIs. This structural imbalance fundamentally undermines stakeholders' intrinsic motivation and compromises the overall effectiveness of policy implementation strategies.

Third, stakeholder engagement mechanisms remain severely limited, particularly in upstream design phases. The prevailing policy approach concentrates narrowly on end-of-pipe treatment stages, lacking practical guidance for source-level design interventions. This unidimensional perspective perpetuates traditional linear processing models, thereby obstructing comprehensive waste-reduction and value-creation strategies.

Fourth, significant regional disparities exist in policy innovation and implementation capabilities. Centrally administered cities and eastern provinces exhibit more comprehensive and innovative policy frameworks, while central and western regions exhibit relatively lagging policy development and governance performance. These variations reflect nuanced differences in economic development, institutional capacity, and configurations of environmental priorities.

Fifth, standardization mechanisms exhibit significant deficiencies. The current policy landscape lacks systematic professional standards and technical specifications, creating substantial uncertainty in the recycled building materials market. This absence of robust standardization frameworks impedes market development and undermines confidence in CE approaches.

Sixth, existing incentive mechanisms suffer from fundamental design limitations. The current policy environment lacks effective economic incentives and penalty mechanisms, failing to mobilize stakeholder engagement and motivation adequately. This deficiency critically undermines the potential for comprehensive CE transformation.

These structural gaps expose profound challenges within China's CE transition in the construction sector. They provide critical research perspectives for subsequent policy optimization, necessitating a comprehensive reimagining of existing governance frameworks.

## 5.2. Transformation roadmap: A multidimensional and phased systematic governance framework

In response to the previously identified policy-practice gaps, this research develops a comprehensive transformation roadmap for China's C&DW governance (Table 3). The roadmap, representing a sophisticated institutional innovation strategy, was developed through an iterative process that synthesized insights from the systematic analysis of policy documents and in-depth expert interviews. Its validity rests on its direct relevance to the identified gaps, the incorporation of expert knowledge, and its logical coherence in addressing the multifaceted challenges of C&DW governance in China. This roadmap transitions from fragmented governance to a systematic, multidimensional approach that addresses the complex challenges of CE implementation in the construction sector. This transformation is articulated through six interconnected strategic dimensions, each representing a critical lever for systemic change.

At the institutional coordination level, the approach moves beyond siloed administrative practices towards a cross-departmental, multi-level collaborative governance framework. This strategic evolution is conceptualized through a phased implementation strategy: short-term efforts focus on establishing foundational coordination platforms, medium-term efforts develop comprehensive multi-level governance systems, and long-term objectives aim

to cultivate a market-oriented, internationally aligned governance model.

Policy instrument innovation emerges as a crucial mechanism for driving transformative change. The roadmap proposes a transition from passive regulatory approaches to proactive policy guidance, strategically optimizing tax policies, refining standardization frameworks, and expanding market incentive mechanisms. This approach seeks to develop a diversified, balanced policy portfolio that effectively stimulates CE transitions in the construction industry.

Recognizing China's complex regional landscape, the roadmap adopts a precision-oriented transformation strategy characterized by contextual adaptability. By acknowledging inherent regional heterogeneity, the approach develops differentiated policy combinations tailored to specific regional economic development levels and governance capacities. The ultimate objective is to develop replicable, scalable regional transformation models that can be systematically disseminated across diverse geographical contexts.

Stakeholder engagement represents another critical dimension of the roadmap, shifting from passive participation to active collaborative value co-creation. By explicitly defining stakeholder roles and establishing normalized dialogue mechanisms, the framework promotes collaborative governance throughout the entire C&DW life-cycle. This approach recognizes the importance of multi-actor engagement in driving systemic innovation and sustainable transformation.

Technological innovation and capacity advancement are positioned as fundamental drivers of change. The roadmap advocates moving beyond imitative approaches towards original innovation, emphasizing the construction of a deeply integrated innovation ecosystem that combines production, academic, and research capabilities. The strategic objective is to enhance technological innovation capabilities, specifically within the C&DW domain, fostering a culture of continuous improvement and adaptive learning.

Financial incentive mechanisms undergo a comprehensive transformation, evolving from a singular financing model to a diverse and dynamic investment ecosystem. The strategy involves progressively expanding green financial channels and designing innovative mechanisms to attract broad social capital participation. This approach aims to create a robust financial support framework that can sustain and accelerate CE transitions in the construction sector.

Ultimately, this multidimensional roadmap represents a sophisticated, holistic approach to addressing the intricate challenges of China's C&DW governance. By offering a systematic and adaptive governance framework, the research provides a nuanced strategy for navigating the complex institutional, technological, and economic landscape of circular-economy implementation in the construction industry.

**Table 3.** Phased roadmap for China's CE transition in the construction industry

6 Strategic Dimensions to Improve	Advancing Institutional Coordination and Governance	Innovating Policy Instruments	Implementing Regionalized Differentiated Policies	Enhancing Stakeholder Engagement	Advancing Technological Innovation and Capacity	Enhancing Financial Incentive Mechanisms
Short-term Phase ↓	<ul style="list-style-type: none"> <li>■ Establishing a cross-departmental coordination platform;</li> <li>■ Clarifying departmental responsibility boundaries;</li> <li>■ Establishing a preliminary information sharing mechanism.</li> </ul>	<ul style="list-style-type: none"> <li>■ Establishing special funds for CE transition in the construction industry;</li> <li>■ Optimizing tax incentive policies;</li> <li>■ Improving the classification management system;</li> <li>■ Adjusting government procurement policies;</li> <li>■ Developing a credit evaluation system.</li> </ul>	<ul style="list-style-type: none"> <li>■ Conducting regional policy adaptability research;</li> <li>■ Identifying policy execution characteristics across different regions;</li> <li>■ Developing differentiated implementation guidelines.</li> </ul>	<ul style="list-style-type: none"> <li>■ Clarifying stakeholder roles;</li> <li>■ Conducting stakeholder capacity training;</li> <li>■ Establishing preliminary communication mechanisms.</li> </ul>	<ul style="list-style-type: none"> <li>■ Establishing a technology innovation center;</li> <li>■ Developing technical specification standards;</li> <li>■ Conducting key technology breakthroughs;</li> <li>■ Building industry-academia-research innovation platform.</li> </ul>	<ul style="list-style-type: none"> <li>■ Establishing special guidance funds;</li> <li>■ Developing financial insurance products;</li> <li>■ Establishing a third-party guarantee mechanism;</li> <li>■ Optimizing credit support policies.</li> </ul>
Medium-term Phase ↓	<ul style="list-style-type: none"> <li>■ Establishing comprehensive inter-departmental governance frameworks;</li> <li>■ Refining the multi-level governance system;</li> <li>■ Establishing an inter-departmental performance evaluation mechanism.</li> </ul>	<ul style="list-style-type: none"> <li>■ Optimizing fiscal subsidy mechanisms;</li> <li>■ Integrating carbon peak strategy;</li> <li>■ Exploring the emission rights trading mechanism.</li> </ul>	<ul style="list-style-type: none"> <li>■ Establishing regional demonstration zones;</li> <li>■ Customizing policy support for different regions;</li> <li>■ Conducting inter-regional policy experience exchange.</li> </ul>	<ul style="list-style-type: none"> <li>■ Constructing a multi-stakeholder collaborative platform;</li> <li>■ Popularizing the full life-cycle management concept;</li> <li>■ Improving stakeholder participation mechanisms.</li> </ul>	<ul style="list-style-type: none"> <li>■ Implementing technology demonstration projects;</li> <li>■ Promoting technology industrialization;</li> <li>■ Establishing an innovation fund.</li> </ul>	<ul style="list-style-type: none"> <li>■ Promoting green financial support;</li> <li>■ Improving investment guidance mechanisms;</li> <li>■ Designing performance reward mechanisms;</li> <li>■ Encouraging capital market participation.</li> </ul>
Long-term Phase	<ul style="list-style-type: none"> <li>■ Promoting regional collaborative governance;</li> <li>■ Expanding pilot demonstration scope;</li> <li>■ Advancing marketized governance model.</li> </ul>	<ul style="list-style-type: none"> <li>■ Integrating with green building, zero-waste city, and carbon emission strategies;</li> <li>■ Developing international standard alignment.</li> </ul>	<ul style="list-style-type: none"> <li>■ Forming replicable regional implementation models;</li> <li>■ Establishing inter-regional policy collaborative mechanisms.</li> </ul>	<ul style="list-style-type: none"> <li>■ Establishing normalized stakeholder dialogue mechanisms;</li> <li>■ Promoting cross-subject collaborative innovation;</li> <li>■ Optimizing stakeholder incentive systems.</li> </ul>	<ul style="list-style-type: none"> <li>■ Establishing an international technology innovation alliance;</li> <li>■ Advancing technology standard internationalization;</li> <li>■ Establishing continuous innovation incentive mechanisms.</li> </ul>	<ul style="list-style-type: none"> <li>■ Constructing a diversified investment and financing system;</li> <li>■ Introducing international capital;</li> <li>■ Improving the financial service ecosystem.</li> </ul>

## 6. Conclusions

This study addresses the critical policy-practice gap in China's C&DW governance by systematically diagnosing the systemic drivers impeding the CE transition. Through a sophisticated mixed-methods approach—integrating content analysis of 925 policy documents with qualitative expert interviews—the research reveals that the stagnation

in C&DW resource utilization is not merely a technological issue but a structural governance failure. Specifically, the study identifies critical institutional and stakeholder barriers, including institutional fragmentation, a 'governance paradox' of high expectations versus low substantive support, policy instrument imbalance (over-reliance on

IPIs), and the systemic marginalization of upstream stakeholders. These findings confirm that current 'end-of-pipe' governance strategies are insufficient to address the complex implementation dynamics of the construction sector, thereby necessitating and grounding the targeted 'Phased Transformation Roadmap' developed in this study as a critical mechanism to bridge these gaps.

Theoretically, this research contributes a novel integrative analytical framework that transcends traditional linear assessment models. Unlike existing studies that predominantly focus on singular dimensions, such as technical feasibility or static policy outputs, this study innovatively integrates policy design theory with stakeholder interaction analysis. By deconstructing the institutional mechanisms underlying the identified gaps, the framework unveils the intrinsic logic of why specific policy instruments fail to trigger expected behavioral changes. This offers a replicable analytical paradigm for scholars to understand CE transitions in developing contexts, shifting the research focus from simple outcome evaluation to deep mechanism diagnosis.

Practically, the study moves beyond generic governance calls by proposing a targeted transformation roadmap. This roadmap offers substantial guidance for policy-makers by delineating a precise, phased trajectory (short-, medium-, and long-term) to bridge the gap between policy aspirations and practical implementation. Crucially, the research challenges the one-size-fits-all approach by highlighting regional heterogeneity and advocating differentiated policy portfolios that align with local institutional innovation capacities. Furthermore, by pinpointing the design-implementation gap, the study provides actionable levers for integrating upstream designers into the responsibility chain, thereby facilitating a fundamental shift from terminal waste disposal to life-cycle resource governance.

While providing robust diagnostic insights, this study acknowledges inherent limitations. The current research primarily relies on cross-sectional data, providing a static snapshot of the policy landscape. Consequently, it does not longitudinally track the evolutionary effectiveness of the proposed roadmap. Future research should adopt a longitudinal perspective to assess the dynamic evolution of policy instruments and stakeholder responses. Additionally, integrating quantitative simulation methods could further validate the roadmap by modeling the long-term economic and environmental impacts of different policy intervention scenarios.

Ultimately, the CE transformation of China's construction industry demands a paradigm shift beyond traditional administrative tasks. By resolving the systemic conflicts between policy design and implementation, this research serves as a blueprint for reimagining C&DW as a valuable urban resource, contributing essential insights to the global discourse on sustainable development.

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## References

- Antwi-Afari, P., Ng, S. T., & Chen, J. (2022). Developing an integrative method and design guidelines for achieving systemic circularity in the construction industry. *Journal of Cleaner Production*, 354, Article 131752. <https://doi.org/10.1016/j.jclepro.2022.131752>
- Barbhuiya, S., & Das, B. B. (2023). Life cycle assessment of construction materials: Methodologies, applications and future directions for sustainable decision-making. *Case Studies in Construction Materials*, 19, Article e02326. <https://doi.org/10.1016/j.cscm.2023.e02326>
- Barriball, K. L., & While, A. (1994). Collecting data using a semi-structured interview: A discussion paper. *Journal of Advanced Nursing*, 19(2), 328–335. <https://doi.org/10.1111/j.1365-2648.1994.tb01088.x>
- Beijing Development and Reform Commission. (2006). *Action plan for accelerating circular economy development and building resource-conserving cities*.
- Beijing Municipal Government. (2020). *Beijing construction waste disposal management regulations*.
- Benaquisto, L., & Given, L. M. (Eds.). (2008). *The SAGE encyclopedia of qualitative research methods*. SAGE Publications.
- Bobrow, D., & Dryzek, J. (2010). *Policy analysis by design*. University of Pittsburgh Press. <https://doi.org/10.2307/jj.12639074>
- Borrás, S., & Edquist, C. (2013). The choice of innovation policy instruments. *Technological Forecasting and Social Change*, 80(8), 1513–1522. <https://doi.org/10.1016/j.techfore.2013.03.002>
- Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, 3(2), 77–101. <https://doi.org/10.1191/1478088706qp0630a>
- Bryman, A. (2016). *Social research methods* (5th ed.). Oxford University Press.
- Chammout, B., & El-adaway, I. H. (2025). Circular economy in construction: Decision-making factors and future research avenues. *Journal of Construction Engineering and Management*, 151(6), Article 04025059. <https://doi.org/10.1061/JCEMD4.COENG-15063>
- Cheng, B., Huang, J., Li, J., Chen, S., & Chen, H. (2022). Improving contractors' participation of resource utilization in construc-

- tion and demolition waste through government incentives and punishments. *Environmental Management*, 70(4), 666–680. <https://doi.org/10.1007/s00267-022-01617-8>
- Creswell, J. W., & Creswell, J. D. (2017). *Research design: Qualitative, quantitative, and mixed methods approaches* (5th ed.). SAGE Publications.
- De Laurentiis, V., Caldeira, C., Sala, S., & Tonini, D. (2024). Life cycle thinking for the assessment of waste and circular economy policy: Status and perspectives from the EU example. *Waste Management*, 179, 205–215. <https://doi.org/10.1016/j.wasman.2024.02.037>
- Duan, H., Miller, T. R., Liu, G., & Tam, V. W. Y. (2019). Construction debris becomes growing concern of growing cities. *Waste Management*, 83, 1–5. <https://doi.org/10.1016/j.wasman.2018.10.044>
- Ellen MacArthur Foundation. (2019). *The circular economy: A user's guide*. Routledge.
- Fan, J., Zhou, K., Sheng, K., Guo, R., Chen, D., Wang, Y., Liu, H., Wang, Z., Sun, Y., Zhang, J., Wu, J., & Zhao, H. (2023). Territorial function differentiation and its comprehensive regionalization in China. *Science China Earth Sciences*, 66(2), 247–270. <https://doi.org/10.1007/s11430-022-1004-0>
- Freeman, R. E. (1984). *Strategic management: A stakeholder approach*. Pitman.
- Geng, Y., & Doberstein, B. (2008). Developing the circular economy in China: Challenges and opportunities for achieving “leapfrog development.” *International Journal of Sustainable Development & World Ecology*, 15(3), 231–239. <https://doi.org/10.3843/SusDev.15.3:6>
- Ghaffar, S. H., Burman, M., & Braimah, N. (2020). Pathways to circular construction: An integrated management of construction and demolition waste for resource recovery. *Journal of Cleaner Production*, 244, Article 118710. <https://doi.org/10.1016/j.jclepro.2019.118710>
- Ghisellini, P., Ripa, M., & Ulgiati, S. (2018). Exploring environmental and economic costs and benefits of a circular economy approach to the construction and demolition sector: A literature review. *Journal of Cleaner Production*, 178, 618–643. <https://doi.org/10.1016/j.jclepro.2017.11.207>
- Grimble, R., & Wellard, K. (1997). Stakeholder methodologies in natural resource management and environmental policy: A review of concepts and a practical guide to participatory analysis. *Agricultural Systems*, 55(2), 173–193. [https://doi.org/10.1016/S0308-521X\(97\)00006-1](https://doi.org/10.1016/S0308-521X(97)00006-1)
- Hall, P. A. (1993). Policy paradigms, social learning, and the state: The case of economic policymaking in Britain. *Comparative Politics*, 25(3), 275–296. <https://doi.org/10.2307/422246>
- Hall, P. A., & Taylor, R. C. R. (1996). Political science and the three institutionalisms. *Political Studies*, 44(5), 936–957. <https://doi.org/10.1111/j.1467-9248.1996.tb00343.x>
- Hao, J. L., Cheng, B. Q., Lu, W. S., Xu, J., Wang, J. J., Bu, W. C., & Guo, Z. P. (2020). Carbon emission reduction in prefabrication construction during the materialization stage: A BIM-based life-cycle assessment approach. *Science of the Total Environment*, 723, Article 137870. <https://doi.org/10.1016/j.scitotenv.2020.137870>
- He, Z., Shen, A., Wu, H., Wang, W., Wang, L., Yao, C., & Wu, J. (2021). Research progress on recycled clay brick waste as an alternative to cement for sustainable construction materials. *Construction and Building Materials*, 274, Article 122113. <https://doi.org/10.1016/j.conbuildmat.2020.122113>
- Howlett, M. (2009). Governance modes, policy regimes, and operational plans: A multi-level nested model of policy instrument choice and policy design. *Policy Sciences*, 42, 73–89. <https://doi.org/10.1007/s11077-009-9079-1>
- Howlett, M. (2014). Policy design: What, who, how, and why?. In C. Halpern, P. Lascoumes, & P. Le Galès (Eds.), *L'instrumentation de l'action publique: Controverses, résistance, effets* (pp. 281–316). Presses de Sciences Po. <https://doi.org/10.3917/scpo.halpe.2014.01.0281>
- Hooghe, L., & Marks, G. (2003). Unraveling the central state, but how? Types of multi-level governance. *American Political Science Review*, 97(2), 233–243. <https://doi.org/10.1017/S0003055403000649>
- Huang, B. J., Wang, X. Y., Kua, H. W., Geng, Y., Bleischwitz, R., & Ren, J. Z. (2018). Construction and demolition waste management in China through the 3R principle. *Resources, Conservation and Recycling*, 129, 36–44. <https://doi.org/10.1016/j.resconrec.2017.09.029>
- Iodice, S., Garbarino, E., Cerreta, M., & Tonini, D. (2021). Sustainability assessment of construction and demolition waste management applied to an Italian case. *Waste Management*, 128, 83–98. <https://doi.org/10.1016/j.wasman.2021.04.031>
- Kautto, P., & Lazarevic, D. (2020). Between a policy mix and a policy mess: Policy instruments and instrumentation for the circular economy. In M. Brandão, D. Lazarevic, & G. Finnveden (Eds.), *Handbook of the circular economy* (pp. 207–223). Edward Elgar Publishing. <https://doi.org/10.4337/9781788972727.00025>
- Kjaer, P. F., & Vetterlein, A. (2018). Regulatory governance: Rules, resistance and responsibility. *Contemporary Politics*, 24(5), 497–506. <https://doi.org/10.1080/13569775.2018.1452527>
- Kostka, G. (2014). Barriers to the implementation of environmental policies at the local level in China, 2013–14. *World Development*, 70, 12–27. <https://doi.org/10.1596/1813-9450-7016>
- Krause, R. M., Hawkins, C. V., Park, A. Y. S., & Feiock, R. C. (2019). Drivers of policy instrument selection for environmental management by local governments. *Public Administration Review*, 79(4), 477–487. <https://doi.org/10.1111/puar.13025>
- Laovisutthichai, V., Lu, W., & Bao, Z. (2022). Design for construction waste minimization: Guidelines and practice. *Architectural Engineering and Design Management*, 18(3), 279–298. <https://doi.org/10.1080/17452007.2020.1862043>
- Li, K., Salleh, H. B., Wang, R., & Yang, Y. (2024). How do different policy instruments influence circular economy implementation in the construction sector? *Building Research & Information*, 53(3), 359–374. <https://doi.org/10.1080/09613218.2024.2426466>
- Liao, Z. (2016). The evolution of wind energy policies in China (1995–2014): An analysis based on policy instruments. *Renewable and Sustainable Energy Reviews*, 56, 464–472. <https://doi.org/10.1016/j.rser.2015.11.097>
- Liu, J., Chen, Y., & Wang, X. (2022). Factors driving waste sorting in construction projects in China. *Journal of Cleaner Production*, 336, Article 130397. <https://doi.org/10.1016/j.jclepro.2022.130397>
- Liu, J., & Teng, Y. (2023). Evolution game analysis on behavioral strategies of multiple stakeholders in construction waste resource industry chain. *Environmental Science and Pollution Research*, 30(7), 19030–19046. <https://doi.org/10.1007/s11356-022-23470-2>
- Lu, W., & Yuan, H. (2010). Exploring critical success factors for waste management in construction projects in China. *Resources, Conservation and Recycling*, 55(2), 201–208. <https://doi.org/10.1016/j.resconrec.2010.09.010>
- Luo, T., Xue, X., Wang, Y., Xue, W., & Tan, Y. (2021). A systematic overview of prefabricated construction policies in China. *Journal of Cleaner Production*, 280, Article 124371. <https://doi.org/10.1016/j.jclepro.2020.124371>
- Lv, H. (2020). Examining construction waste management policies in mainland China for potential performance improvements.

- Clean Technologies and Environmental Policy*, 23, 445–462. <https://doi.org/10.1007/s10098-020-01984-y>
- Ma, M., Tam, V. W. Y., Le, K. N., Butera, A., Li, W., & Wang, X. (2023). Comparative analysis on international construction and demolition waste management policies and laws for policy makers in China. *Journal of Civil Engineering and Management*, 29(2), 107–130. <https://doi.org/10.3846/jcem.2023.16581>
- Maeder, M., & Fröhling, M. (2024). Conceptualizing circular economy policy instruments: The case of recycled content standards. *Sustainable Production and Consumption*, 52, 333–346. <https://doi.org/10.1016/j.spc.2024.11.009>
- McDowall, W., Geng, Y., Huang, B., Barteková, E., Bleischwitz, R., Türkeli, S., Kemp, R., & Doménech, T. (2017). Circular economy policies in China and Europe. *Journal of Industrial Ecology*, 21(3), 651–661. <https://doi.org/10.1111/jiec.12597>
- Ministry of Finance and State Taxation Administration. (2015). *The catalogue of preferential value-added tax for products and services of comprehensive resource utilization and the regulatory conditions*. [https://www.mof.gov.cn/gkml/caizhengwengao/wg2015/wg201508/201601/t20160107\\_1645702.htm](https://www.mof.gov.cn/gkml/caizhengwengao/wg2015/wg201508/201601/t20160107_1645702.htm)
- Ministry of Finance of the People's Republic of China, & Ministry of Housing and Urban-Rural Development of the People's Republic of China. (2020). *Notice on promoting government procurement support for green building materials to enhance building quality*.
- Ministry of Housing and Urban-Rural Development. (2020). *Guidelines for reducing construction waste on construction sites*. [https://www.mohurd.gov.cn/gongkai/zhengce/zhengcefilelib/202005/20200515\\_245455.html](https://www.mohurd.gov.cn/gongkai/zhengce/zhengcefilelib/202005/20200515_245455.html)
- Mickwitz, P. (2003). A framework for evaluating environmental policy instruments: Context and key concepts. *Evaluation*, 9(4), 415–436. <https://doi.org/10.1177/135638900300900404>
- Milios, L. (2018). Advancing to a circular economy: Three essential ingredients for a comprehensive policy mix. *Sustainability Science*, 13(3), 861–878. <https://doi.org/10.1007/s11625-017-0502-9>
- Mohammed, M., Shafiq, N., Al-Mekhlafi, A.-B. A., Rashed, E. F., Khalil, M. H., Zawawi, N. A., Muhammad, A., & Sadis, A. M. (2022). The mediating role of policy-related factors in the relationship between practice of waste generation and sustainable construction waste minimisation: PLS-SEM. *Sustainability*, 14(2), Article 656. <https://doi.org/10.3390/su14020656>
- Norouzi, M., Chafer, M., Cabeza, L. F., Jimenez, L., & Boer, D. (2021). Circular economy in the building and construction sector: A scientific evolution analysis. *Journal of Building Engineering*, 44, Article 102704. <https://doi.org/10.1016/j.job.2021.102704>
- North, D. C. (1990). *Institutions, institutional change and economic performance*. Cambridge University Press. <https://doi.org/10.1017/CBO9780511808678>
- Oluleye, B. I., Chan, D. W. M., Olawumi, T. O., & Saka, A. B. (2023). Assessment of symmetries and asymmetries on barriers to circular economy adoption in the construction industry towards zero waste: A survey of international experts. *Building and Environment*, 228, Article 109885. <https://doi.org/10.1016/j.buildenv.2022.109885>
- Ongaro, E., Gong, T., & Jing, Y. (2019). Toward multi-level governance in China? Coping with complex public affairs across jurisdictions and organizations. *Public Policy and Administration*, 34(2), 105–120. <https://doi.org/10.1177/0952076718799397>
- Peters, B. G. (2018). *Policy problems and policy design*. Edward Elgar Publishing. <https://doi.org/10.4337/9781786431356>
- Schneider, A. L., & Ingram, H. M. (1997). *Policy design for democracy*. University Press of Kansas.
- Siddiqua, A., Hahladakis, J. N., & Al-Attiya, W. A. K. A. (2022). An overview of the environmental pollution and health effects associated with waste landfilling and open dumping. *Environmental Science and Pollution Research*, 29(39), 58514–58536. <https://doi.org/10.1007/s11356-022-21578-z>
- Singh, A. (2017). Developing a conceptual framework of waste management in the organizational context. *Management of Environmental Quality: An International Journal*, 28(6), 786–806. <https://doi.org/10.1108/MEQ-07-2016-0045>
- State Commission Office of Public Sectors Reform. (2010). *Notification on the division of responsibilities for the recycling of construction waste*. [https://www.mee.gov.cn/xxgk2018/xxgk/xxgk13/201810/t20181012\\_662056.html](https://www.mee.gov.cn/xxgk2018/xxgk/xxgk13/201810/t20181012_662056.html)
- State Council of PRC. (2005). *Several opinions on accelerating the development of a circular economy*. [https://www.gov.cn/gongbao/content/2005/content\\_64318.htm](https://www.gov.cn/gongbao/content/2005/content_64318.htm)
- State Council of PRC. (2008). *Law of the People's Republic of China on the promotion of circular economy*. [https://www.mee.gov.cn/ywgz/fgbz/fl/201811/t20181114\\_673624.shtml](https://www.mee.gov.cn/ywgz/fgbz/fl/201811/t20181114_673624.shtml)
- Su, Y., Si, H., Chen, J., & Wu, G. (2020). Promoting the sustainable development of the recycling market of construction and demolition waste: A stakeholder game perspective. *Journal of Cleaner Production*, 277, Article 122281. <https://doi.org/10.1016/j.jclepro.2020.122281>
- Talla, A., & McIlwaine, S. (2024). Industry 4.0 and the circular economy: Using design-stage digital technology to reduce construction waste. *Smart and Sustainable Built Environment*, 13(1), 179–198. <https://doi.org/10.1108/SASBE-03-2022-0050>
- Tam, V. W. Y., Soomro, M., & Evangelista, A. C. J. (2021). Quality improvement of recycled concrete aggregate by removal of residual mortar: A comprehensive review of approaches adopted. *Construction and Building Materials*, 288, Article 123066. <https://doi.org/10.1016/j.conbuildmat.2021.123066>
- Tashakkori, A., & Teddlie, C. (Eds.). (2010). *The SAGE handbook of mixed methods in social & behavioral research* (2nd ed.). SAGE Publications. <https://doi.org/10.4135/9781506335193>
- Theodoulou, S. Z., & Kofinis, C. (2004). *The art of the game: Understanding American public policy making*. Wadsworth Publishing.
- Thomassen, T. B., Scheutz, C., & Kjeldsen, P. (2019). Treatment of landfill gas with low methane content by biocover systems. *Waste Management*, 84, 29–37. <https://doi.org/10.1016/j.wasman.2018.11.011>
- Torres Curado, M., Ricardo, R., & Rato, V. M. (2024). Circular economy: Current view from the construction industry based on published definitions. *Sustainability: Science, Practice and Policy*, 20(1), Article 2364954. <https://doi.org/10.1080/15487733.2024.2364954>
- Wang, H., Pan, X., & Zhang, S. (2021). Spatial autocorrelation, influencing factors and temporal distribution of the construction and demolition waste disposal industry. *Waste Management*, 127, 158–167. <https://doi.org/10.1016/j.wasman.2021.04.025>
- Wang, Z., Zhang, Z., & Liu, J. (2022). Exploring spatial heterogeneity and factors influencing construction and demolition waste in China. *Environmental Science and Pollution Research*, 29(35), 53269–53292. <https://doi.org/10.1007/s11356-022-19554-8>
- Wang, Z., Han, F., Xia, B., Liu, J., & Zhang, C. (2023). Regional differences and heterogeneity of construction and demolition waste with economic growth: Evidence from China. *Construction Management and Economics*, 41(1), 44–59. <https://doi.org/10.1080/01446193.2022.2137882>
- Weber, M., Driessen, P. P. J., & Runhaar, H. (2014). Evaluating environmental policy instrument mixes: A methodology illustrated

- by noise policy in the Netherlands. *Journal of Environmental Planning and Management*, 57(9), 1381–1397.  
<https://doi.org/10.1080/09640568.2013.808609>
- Wijewickrama, M., Rameezdeen, R., & Chileshe, N. (2021). Information brokerage for circular economy in the construction industry: A systematic literature review. *Journal of Cleaner Production*, 313, Article 127938.  
<https://doi.org/10.1016/j.jclepro.2021.127938>
- Wuni, I. Y. (2022). A systematic review of the critical success factors for implementing circular economy in construction projects. *Sustainable Development*, 30(6), 1512–1529.  
<https://doi.org/10.1002/sd.2449>
- Wuni, I. Y., & Shen, G. Q. (2022). Developing critical success factors for integrating circular economy into modular construction projects in Hong Kong. *Sustainable Production and Consumption*, 29, 574–587. <https://doi.org/10.1016/j.spc.2021.11.010>
- Yu, B., Wang, J., Liao, Y., et al. (2021). Determinants affecting purchase willingness of contractors towards construction and demolition waste recycling products: An empirical study in Shenzhen, China. *International Journal of Environmental Research and Public Health*, 18(9), Article 4412.  
<https://doi.org/10.3390/ijerph18094412>
- Yuan, H., He, L., Wu, H., & Zuo, J. (2023). Differentiated subsidy mechanism for promoting construction and demolition waste recycling. *Journal of Cleaner Production*, 405, Article 137051.  
<https://doi.org/10.1016/j.jclepro.2023.137051>
- Zhang, K., Qing, Y., Umer, Q., & Asmi, F. (2023a). How construction and demolition waste management has addressed sustainable development goals: Exploring academic and industrial trends. *Journal of Environmental Management*, 345, Article 118823.  
<https://doi.org/10.1016/j.jenvman.2023.118823>
- Zhang, M., Liu, X., & Kong, L. (2023b). Evaluation of carbon and economic benefits of producing recycled aggregates from construction and demolition waste. *Journal of Cleaner Production*, 425, Article 138946.  
<https://doi.org/10.1016/j.jclepro.2023.138946>
- Zhuang, Y., Lu, W., Peng, Z., et al. (2026). Nudge waste out: Understanding the impacts of green nudges on on-site construction waste management based on a metaverse serious game. *Environmental Impact Assessment Review*, 118, Article 108293.  
<https://doi.org/10.1016/j.eiar.2025.108293>