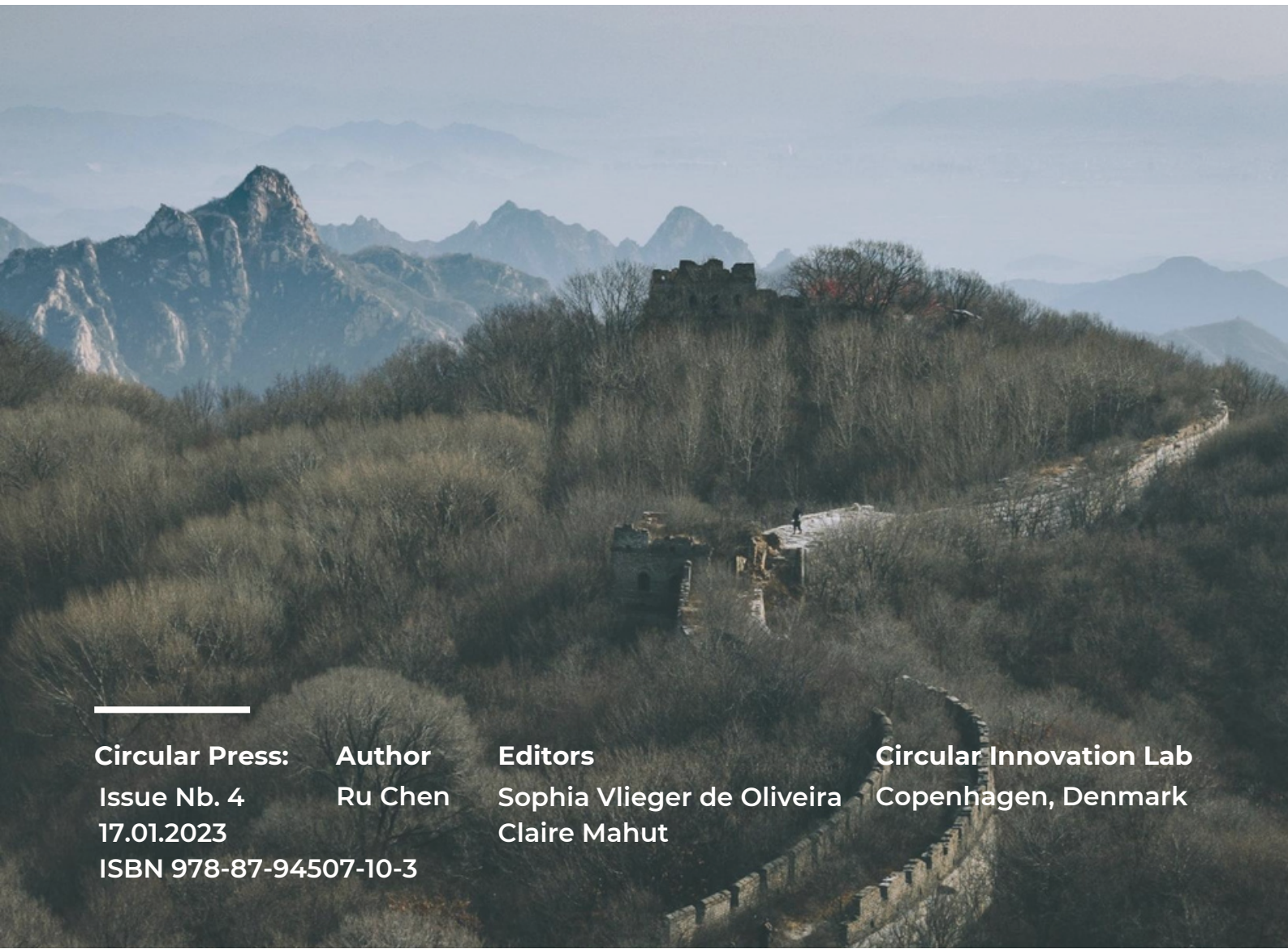


# China's Circular Economy Policies: Review and Reflection

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A CIRCULAR ECONOMY VISION



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# 01. Introduction

The concept of a circular economy (CE) was introduced in China's policies in 2002, and since then it has gradually evolved into a national strategy and a fundamental pillar of the economy. The development of CE policies can be tracked by reviewing China's Five-Year Development Plan (FYDP) and the agenda of the National Congress. It is also known that the implementation of the CE policies follows a strict institutional structure and operational framework, leading to concrete actions and measurable outcomes. While the efforts and yields are worth celebrating, issues such as coordination challenges, uneven development, unsustainable success, and a lack of fundamental research are still undermining China's CE development.

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To address the aforementioned issues, multiple efforts are put into seeking solutions. A report published by the Ellen MacArthur Foundation states that industrial or business areas present significant CE opportunities (Ellen MacArthur Foundation, 2020), which is backed up by a series of CE development recommendations (in the categories of the built environment, mobility, nutrition, textiles, and electronics). Similar to the call for a focus on business sectors, the report mentions that the lack of attention to SMEs in China is in contrast with their percentage and contribution to economic value and their impact on the environment. Therefore, proposals are made for SMEs to develop strategic partnerships with large enterprises, taking advantage of the existent industrial symbiosis, and making regulations and laws more easily understandable.





# 02. Problem Statement

There is no lack of solutions for modifying China's CE development and policies, but these tend to focus on different levels and aspects. Such efforts can add value but also add complexity for subsequent investigation due to fragmented and inconsistent research directions. In this case, a structured review of the development is considered valuable, especially when it comes to facilitating integrated management and policy modification. More importantly, advice on how to maximize such a structured development framework should be provided, including how to fill existing gaps by absorbing other research and also provide flexibility to modify the framework itself.

From these standpoints, this article intends to construct the aforementioned primary framework by reviewing China's CE policy development. Furthermore, the reflection on the implementation and performance of these CE policies will lead to some modification branches, in which the current efforts will be matched as an illustration of using the framework. Aligning with the research goal, the work in this article consists of a policy review, the implementation and the corresponding outcome, challenge identification, framework establishment, and its application.

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# 03. Policy Review

Since the 1970s, especially after the proposal of the policy on “Reform and opening up”, China’s GDP has increased from \$106 billion to \$2.4 trillion in 30 years, reaching the fourth-largest economy in the world (Yap, 2005). Along with such rapid development and transformation, daunting environmental challenges have been emerging due to rapid industrialization, urbanization, and lax environmental oversight. In 2002, an even more ambitious development agenda was pledged at the 16th National Congress of the Chinese Communist Party (NCCCP). Meanwhile, in a cleaner production strategy, the concept of the circular economy was formally adopted, though various sustainability initiatives have been implemented since 1973. At the time, the introduction of CE was more about giving guidance about future directions and undertaking it as an aspirational strategy to achieve continuous economic development through environmental and resource protection. Since then, the policies and objectives of CE strategies have evolved, as shown in Figure 1 (Biwei Su, 2012; Ogunmakinde, 2019; Raimund Bleischwitz, 2022).

A policy framework including principles, main objectives, and key tasks was not legally proposed until the 2005 publication of "Opinions on Accelerating the Development of the Circular Economy." Following closely, the 11th Five-Year Development Plan (FYDP), including the implementation of CE, was initiated. “The Circular Economy Promotion Law” (CEPL) was subsequently published and came into effect in 2008

and 2009 respectively, with a focus on 3R strategies (Reduce, Reuse, Recycle).

The official interpretation of CE began with a holistic approach, intending to align national environments and development while also learning from Japan and European countries. While European countries focused on the waste hierarchy and product policies, China had been struggling with a range of issues like water pollution and air pollution.

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The earlier related policies based on the Circular Economy Promotion Law (2008) focused on the improvement of resource productivity, especially on energy. Afterwards, the 18th NCCCP brought CE to a new strategic level by making the establishment of a full-fledged resource recycling system part of building a moderately prosperous society by 2020. Later policies, such as the Revised Indicators of Circular Economy Promotion Law (2017), placed a greater emphasis on the circularity of industrial systems. The 13th Five-Year Plan (2016-2020) further validated the importance of CE as a national policy and a fundamental pillar of the economy. The Circular Development Leading Action Plan (CDLAP), released in 2016 by the National Development and Reform Commission (NDRC), aims to address drivers of environmental and social externalities and stress opportunities in new digital solutions. It also targets influencing the broader value chain by highlighting the potential to integrate CE principles into the design stage of products and business models.

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**CE [is] an approach to tackling climate change and achieving carbon neutrality by 2060.**

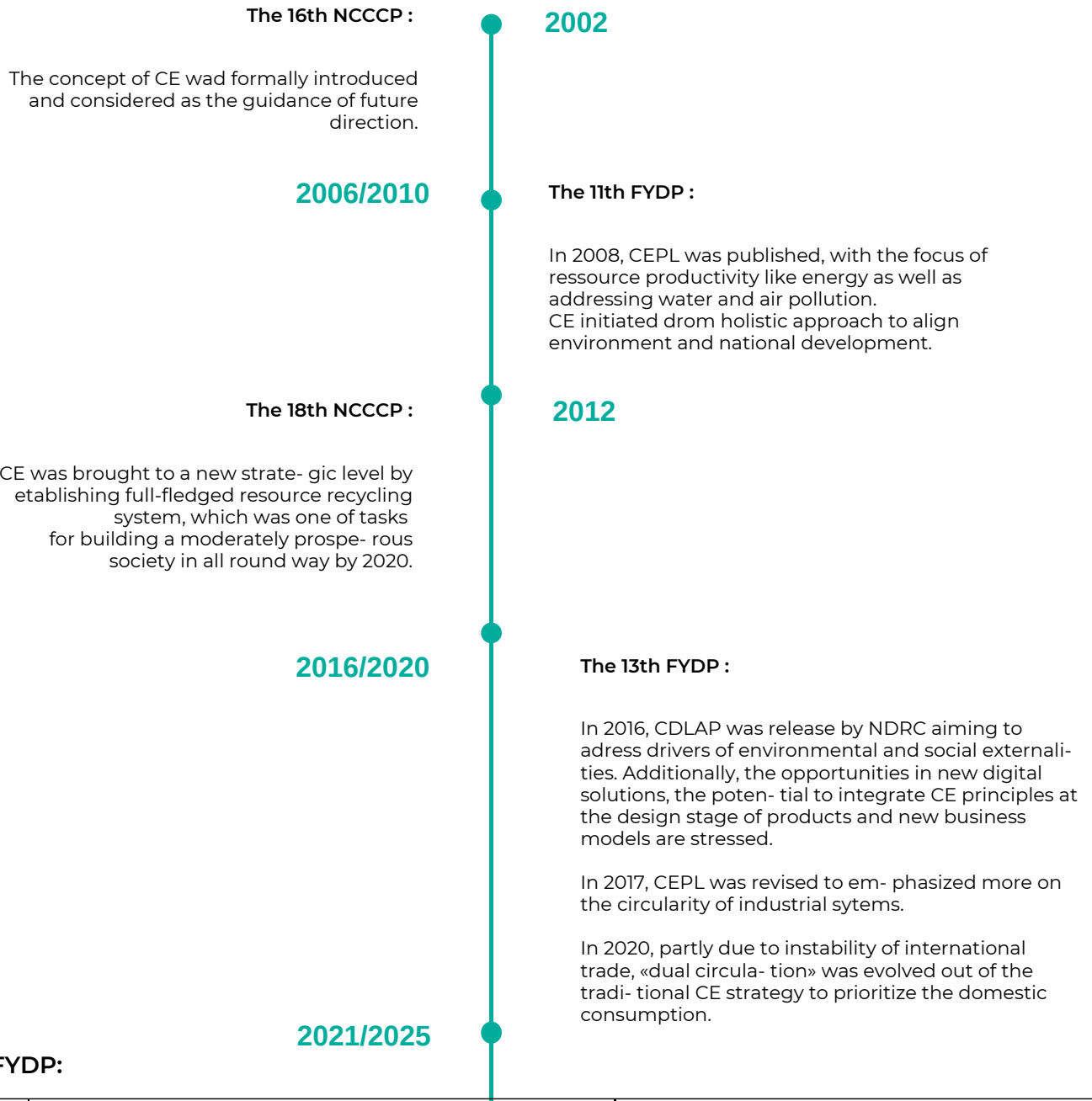
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**The recent 14th FYDP on circular economy continues to promote resource conservation and recycling by setting targets to ensure national resource security.**

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As a national strategy to reorient the economy, the 'dual circulation' (domestic-international circulation) was proposed in 2020 to prioritize internal circulation. The recent 14th FYDP on circular economy (2021-2025) continues to promote resource conservation and recycling by setting targets to ensure national resource security. More importantly, it clearly states the importance of CE as an approach to tackling climate change and achieving carbon neutrality by 2060. In the 14th FYDP, a number of numerical targets are set and three key tasks are listed (see Figure 1).



Objectives	Numerical targets	Key tasks
Content	<p><b>01</b> Increasing resources productivity by 20 percent compared to 2020 levels.</p> <p><b>02</b> Reducing energy consumption and water consumption per unit of GDP by 13,5 percent and 16 percent, respectively, compared to the 2020 levels.</p> <p><b>03</b> Reaching a utilization rate of 86 percent for crop stalks, 60 percent for bulk solid waste, and 60 percent for construction waste.</p> <p><b>04</b> Utilizing 60 million tons of waste paper and 320 million tons of scrap steel.</p> <p><b>05</b> Producing 20 million tons of recycled non-ferrous metals</p> <p><b>06</b> Increasing the output value of the resource recycling industry to RMB 5 trillion (US\$773 billion)</p>	<p><b>01</b> Building a resource recycling industry system and improving resource utilization efficiency.</p> <p><b>02</b> Building a recycling system for waste materials and fostering a recycling-oriented society.</p> <p><b>03</b> Deepening the development of the agricultural circular economy and establishing circular agricultural production</p>

**Figure 1: Chinese CE policies**



# 04. Implementation and Outcome

In order to present a holistic review of how CE is implemented in China, the following section describes the situation regarding implementation structure, projects and actions, and outcomes, respectively.

## 4.1 Implementation Structure

Traditionally, the Chinese central government and the National People's Congress play leading roles in governance. Besides that, there is horizontal coordination among ministries and agencies, as well as a strict vertical structure between the central government and the provincial governments. Figure 2 depicts the institutional structure and operational framework of China's CE implementation, along with agencies, policies, and the level of policymaking involved (Raimund Bleischwitz, 2022). Notably, the National Development and Reform Commission (NDRC) is the leading CE agency in developing basic CE regulations, while other ministries are in charge and overlook their respective programs.

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**Critical Projects and Actions in the 14th Five-year Plan of China for Circular Economy Development**

	Municipal Waste recycling system building project	Industrial park recycling development project	Solid waste comprehensive utilization demonstration project	Construction waste reutilization demonstration project	Key circular economy technology and equipment innovation project	Actions on the high-quality development of remanufacturing industry	Actions on improving the recycling of waste electronic products	Actions on promoting vehicles' life cycle management	Special actions on controlling the whole chain of plastic pollution	Actions on promoting the green transformations of express packaging	Actions on waste battery recycling	Improve the statistical evaluation system for circular economy
National Development and reform Commission												
Ministry of Commerce												
Ministry of Nature Ressources												
Ministry of Industry and Information Technology												
Ministry of Ecology and Evironement												
Ministry of Housing and Urban-Rural Development												
Ministry of Agriculture and Rural Affairs												
Ministry of Science and Technology												
Ministry of Public Security												
Ministry of Transport												

**Figure 2: The institutional structure and operational framework (Raimund Bleischwitz, 2022).**

## 4.2 Projects and Actions

Based on the aforementioned top-down initiatives, CE projects and actions are promoted in China on three levels: micro (countries, provinces and cities); meso (symbiotic associations, including eco-industrial parks (EIPs), and supply chains); and macro (single organizations, like their products and services) (Biwei Su, 2012; Ogunmakinde, 2019). In addition, CE practices can be categorized into four areas, as shown in Figure 3.

Consistent with the 14th FYDP, continuous efforts have been made towards building robust recycling systems for industrial resources, agricultural operations, and waste materials. The macro implementation of CE features government-driven approaches and path dependency, of which the representative one is the notion of “experimentation under hierarchy.” The uneven progress of CE promotion allows provincial officials to interpret CE policies with a certain degree of flexibility and make trade-offs based on local conditions. Under such a strategy, cooperative networks between industries and industrial parks emerge extensively in the production area. The 3R principles are implemented by redesigning and rearranging a city’s infrastructure and industrial layout, considering regional characteristics, as well as phasing out heavily polluting enterprises while supporting high-tech industries like the bio-farming and tourism industries (Biwei Su, 2012).

Looking more closely at the meso level, Chinese Eco-Industrial Parks (EIPs) have been established since 2001 (in collaboration with the United Nations Environment Programme (UNEP)), stepping ahead in terms of scale and pace. Higher resource utilization, the construction of green factories, and the creation of eco-industrial demonstration parks are pursued all the time in the area of industrial parks. The second-hand commodity market is another development focus, targeting more standardized development with the accompanying frequency of internet trading. Attention is also paid to the remanufacturing sector, which includes the industries of auto parts, construction machinery, and robotics, amongst others. Additionally, the agricultural CE is strengthened by utilizing waste (such as crop straw, livestock manure, and other forestry waste) and guiding farmers to participate in building recycling facilities in villages. At the micro level, efforts focus on improving design guidelines and classification, mandatory and voluntary audits, and the establishment of incentives and punishments. Other practices highlighted in grey in Figure 3 consist of non-government organizations and more fundamental practices like business models and digital solutions.

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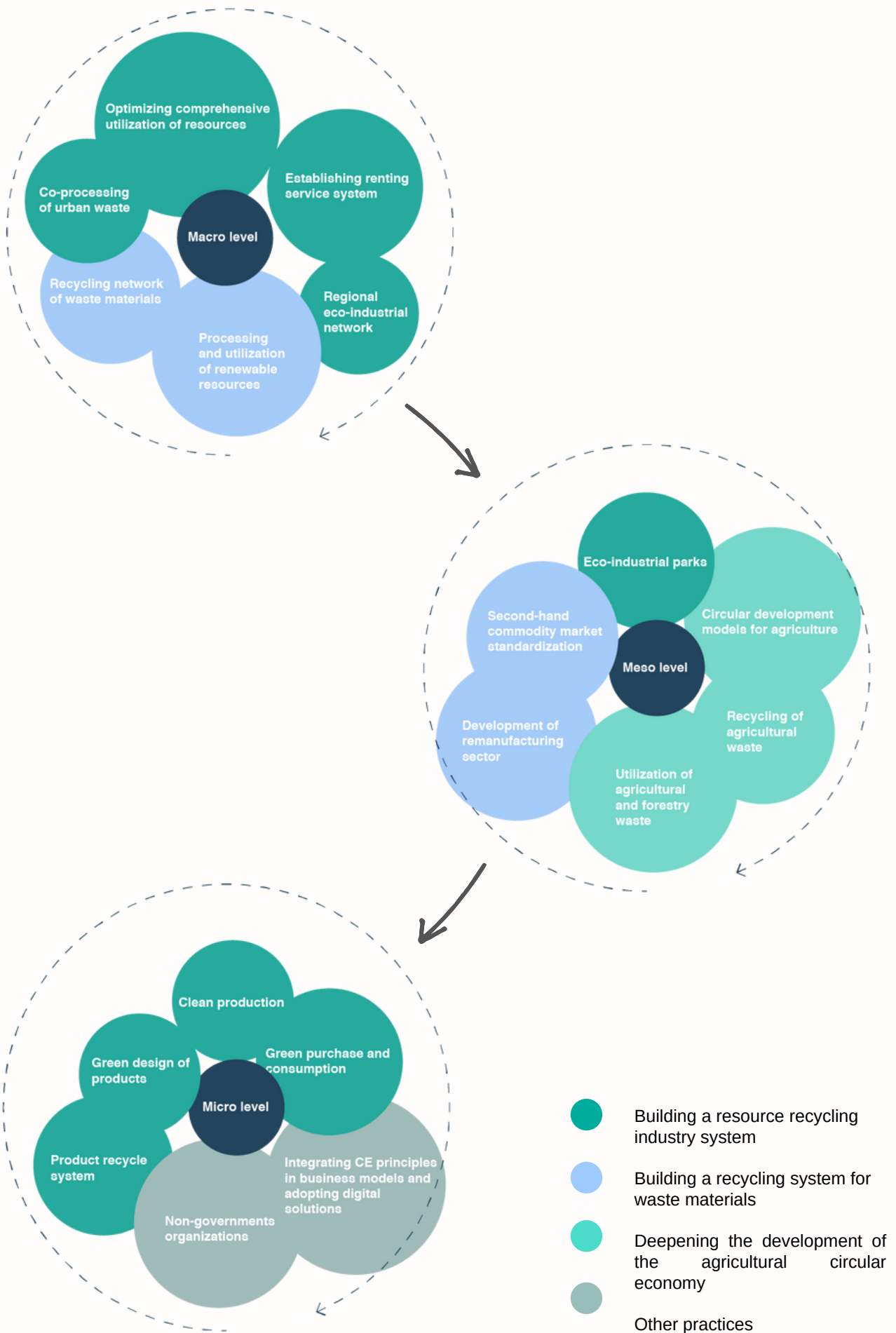


Figure 3: Chinese CE practices at three levels

### 4.3 Outcomes

The comprehensive CE policies and implementation strategies in China yielded measurable outcomes in resource productivity and circularity (Heming Wang, 2020). An increase of 26% in resource productivity was achieved from 2015 to 2020 by reviewing the data published by the NDRC. In general, energy consumption per unit of gross domestic product (GDP) continued to drop dramatically, and water consumption per unit of GDP decreased by 28%. The ability to utilize renewable resources has been sharply enhanced as well. In 2020, the comprehensive utilization rate of crop straw, bulk solid and construction waste reached 86%, 56%, and 50%, respectively, in addition to the utilization of approximately 54.9 million tons of waste paper and 260 million tons of scrap steel.

During the 12th FYDP (2011–2015), NDRC synthesized 60 best practices from the pilot projects at the enterprise, industrial park, and regional levels. These projects have been examined through an assessment scheme, consisting of four criteria: 1) a CE's operational efficiency mode; 2) the development of a CE standard; 3) the application and readiness of CE standard dissemination; and 4) the development of a CE standard information platform. Successful demonstration projects can be transitioned into eco-industrial demonstration parks with the assistance of national funding. By the end of 2020, China has supported 100 key industrial parks and promoted 75% of national parks and 50% of provincial parks to

carry out a circular transformation (Raimund Bleischwitz, 2022).

Achievements of those EIPs were also remarked on by the World Bank (see Table 1) (Bank, 2019). However, the proportion of IPs certified under the three standards is still low, averaging less than 5% of the total number of Chinese IPs (Table 2).

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<b>Environmental performance indicators</b>	<b>Improvement</b>
Land use per unit of industrial added value	↓ by 30.1%
Energy consumption per unit of industrial added value	↓ by 32.7%
Fresh water use per unit of industrial added value	↓ by 33.6%
Industrial water reuse rate	↑ to 90%
Comprehensive utilization rate of industrial solid waste	↑ to 94.1%

Source: World Bank, based on Shi et al. (2016).

Note: eco/green and circular economy demonstration pilot parks are demonstration industrial parks approved by the relevant Chinese government ministries (MEE, MIIT and NDRC in this context) to promote resource efficiency, clean energy use, pollution control, and the circular use of resources within industrial parks.

**Table 1 : Improvement in the environmental performance of EIPs and demonstration pilot parks in China, 2011-15 (Bank, 2019).**

	<b>MEE-certified</b>	<b>NDRC-certified</b>	<b>MIIT-certified</b>
No. of certified IPs	93	138	46 (100 by 2020)
Total no. of IPs	2,543	2,543	2,543
% of IPs certified	3.7%	5.4%	1.8% (3.9% by 2020)

Sources: World Bank calculations based on NDRC (2013, 2015a, 2016a, 2018); NDRC and MOF (2014, 2017a, 2018); MIIT (2017, 2018); MEE (2018); projections for 2020 from MIIT (2016d).

Note: IPs = industrial parks; MEE = Ministry of Ecology and Environment; MIIT = Ministry of Industry and Information Technology; and NDRC = National Development and Reform Commission.

**Table 2: Number and proportion of certified EIPs in China (Bank, 2019).**

The situation can be further clarified by comparing regional development, similar to what has been analyzed for the Chinese Non-Ferrous Metals Industry or CNMI (Xing Chen, 2020). As illustrated in Figure 4, the energy intensity of the CNMI shows a downward trend in all regions, varying in degree. With the help of other related indicators, including the Energy-Carbon Performance Index, a conclusion can be drawn that the eastern provinces are at the frontiers of production technology, reaching the saturation level, while other regions still have much room for improvement in environmental performance. More results suggest that large gaps still exist in the development level of CE in different regions (Yupeng Fan, 2020). Only 23% of the provinces are relatively efficient in implementing CE policies, and the rest are inefficient.

Moving on to the micro level, no specific studies have been conducted to investigate the relationship between CE and NGOs in China, although NGOs are rapidly developing in China. The total number of NGOs increased from 2768 in 2005 to 3539 in 2008, and they are heavily involved in the transnational environmental movement (Xie, 2011). When it comes to developing green supply chain management (GSCM), small and medium enterprises (SMEs) in China are more likely to fail in comparison to large companies. The Chinese Ministry of Industry and Commerce reported that 16,500 SMEs are registered daily, but their average life span is 2.9 years due to the difficulty in balancing economic, environmental, and social aspects (Kuo Jui Wu, 2019).

Nearly half of the Chinese consumers from representative cities (including Beijing, Shanghai, Wuhan, and Shenzhen) are willing to pay an extra amount of no more than 5% for green products, which is lower than the given premium price for green products relative to non-green ones. However, the actual premium price of green products in China exceeds this level in general, giving green products a less advantageous position in markets (Yan Li, 2016).

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**(...) the eastern provinces are at the frontiers of production technology, reaching the saturation level, while other regions still have much room for improvement in environmental performance.**

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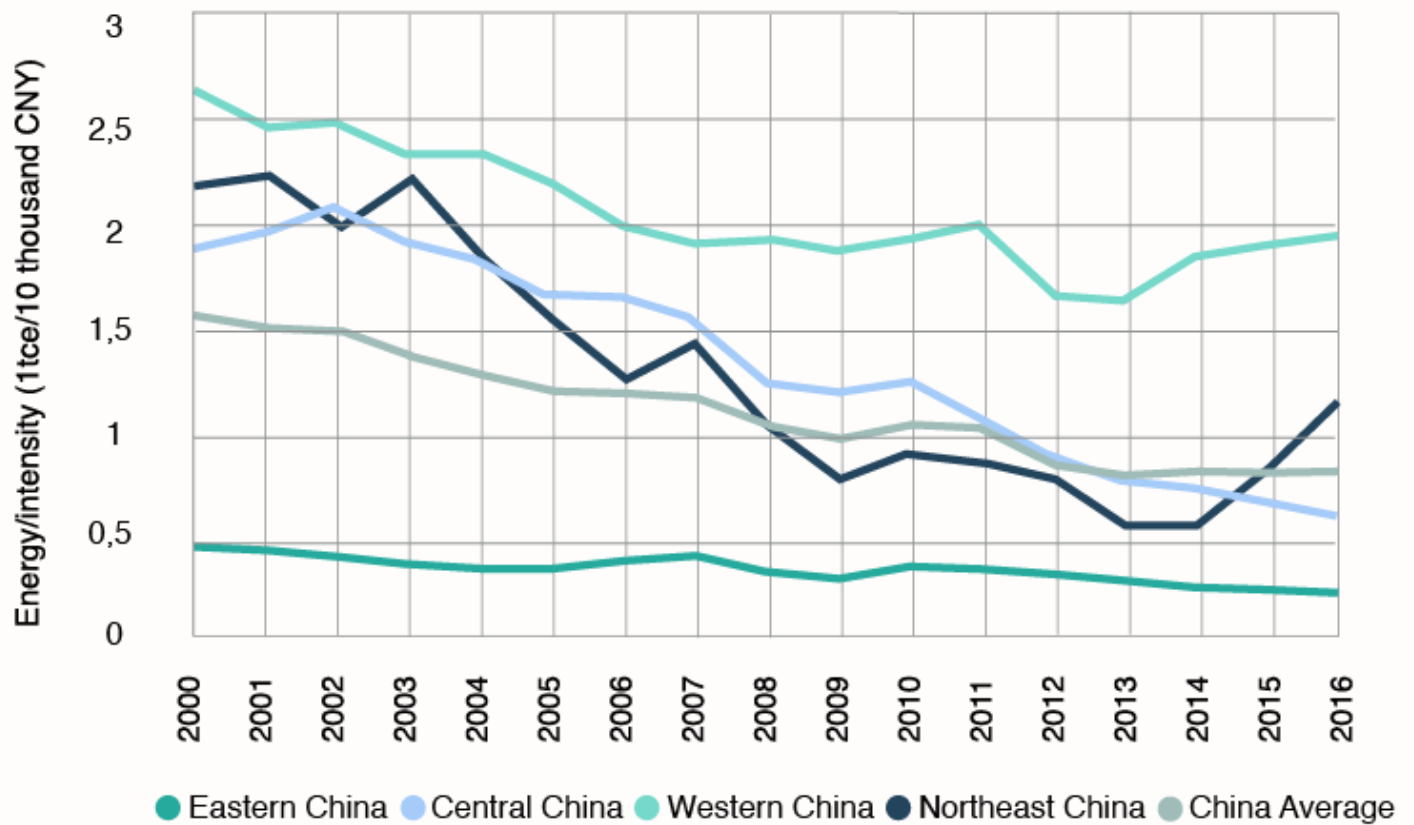


Figure 4: Regional energy intensity of CNMI during 2000-2016

# 05. Challenges and Opportunities

Based on the research above, the challenges in Chinese CE development can be detected in terms of coordination challenges, uneven development, unsustainable success, and a lack of fundamental research.

## 5.1 Coordination Challenges

Coordination challenges do not come as a surprise when China is a large emerging economy. Coordination issues exist at different levels of policymaking and in the alignment of the NDRC with other ministries (see Figure 2). Higher-level regulations (law > regulation > policy > standards and indicators) tend to be less specific in managing and promoting the green development and transformation of IPs - they do not target IPs when it comes to managing industrial activities, most of which focus on a broader scale like the whole industrial sector. Results indicate that provincial CE policies and energy intensity targets are conducive to reducing CO<sub>2</sub> emissions, while provincial energy-saving policies and comprehensive resource utilization policies have no significant impact (Pan Zhang, 2022). The findings confirm the effectiveness of China's target management tools, and, more importantly, provide guidance for local governments to optimize local policies.

The deficiency occurs in systems thinking on shaping the institutional and socio-cultural underpinnings of dissemination, sustainable consumption, and the system dynamics of transformations (Pesce et al., 2020).

The EU and the Organization for Economic Co-operation and Development (OECD) also face implementation gaps, but systems of policy evaluations, surveys, and litigation have been established, combined with accountability and independent scrutiny to identify gaps and inspire stragglers (Raimund Bleischwitz, 2022). Hence, the 14th FYDP calls for strengthening the legal and regulatory environment and policy enforcement. Specifically, it calls for improving circular economy laws, regulations, and standards, as well as statistics collection and industry supervision.

The large-scale and rapid development in China is undoubtedly challenging the coordination of funding and subsidies, especially when there is a high level of dependence on state finance in CE projects. A CE project would eventually collapse once the government stops providing financial support. Meanwhile, it is extremely difficult to promote CE transformation in some resource-intensive and fundamental industries, which are crucial to national development but now become an obstacle to improving environmental performance. These industries are very relevant for economic output in provinces, and they greatly contribute to job positions and social security. As a result, companies in fundamental industries receive local government support in the form of increased



subsidies and bank loans when they are environmentally unsustainable. Knowledge about the deep transformations of foundation industries will be needed to eliminate their negative environmental impact (Jiang, 2017).

## 5.2 Uneven Development

Uneven progress in EIPs and greening resource-intensive industries comes with complex coordination issues. The regional imbalance in China can be attributed to the strategy of ‘experimentation under hierarchy’ (Heilmann, 2008). Although the room for technological advancement is relatively small in eastern provinces, efforts are still prioritized in these areas by executing more strict environmental protection policies. From an industrial perspective, the high-tech and export-oriented manufacturing sectors are more advanced in greening their operations, while sectors like construction, agriculture, and others fall behind. In addition, establishing and boosting new markets for secondary materials are proven to be difficult, even in the ‘experimental Special Economic Zone (SEZ)’ in Shenzhen, due to the scepticism towards the quality of recycled construction products (Bao, 2020).

## 5.3 Unsustainable Success

It appears that policy learning in China has mainly focused on winners. Although most official documents depict the success of the CE projects in China, some recent studies indicate that many of these projects have either failed or could not persist after initial success (Hong, 2020; Huang, 2020). The case study of one CE demonstration pilot company shows that their CE implementation mainly includes the use of energy-saving technologies and lean production strategies learned from their European business partners. These approaches improved the energy and resource efficiency at the level of factories. However, many technologies and tools were not as advanced as those at similar companies in developed countries. At the meso level, many industrial symbiosis projects in EIPs have actually failed. Huang’s (2020) investigation revealed the failure of 49 CE projects in a Chinese EIP in a dominant industry in sugar refineries and its related symbiotic industries such as paper production. This study also reveals the reasons behind the failures, namely “top-down” and “government-driven” approaches, path dependency, and implementation gaps.

## 5.4 Lack of Fundamental Research

The development of NGOs is prosperous, but their power is ignored in terms of research attention. Though government regulations and industrial efforts are crucial to developing CE, a cultural shift is required throughout society. It can be driven by education, information, and the encouragement of public participation so as to increase people's awareness. NGOs, which have easy access to the grassroots, possess a large potential influence on the promotion of CE in society. Another concern is the lack of guidance at the micro level on how businesses and individuals can contribute to CE practices. As pointed out by Marco Pesce et al. (2019), little is known about how the notion of CE can be translated into practice by organizations and individuals. For organizations, establishing a new operation model and adopting digital solutions can be effective, which is emphasized in government strategies but remains at the primary stage just like the green behaviour of individuals.

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**Though government regulations and industrial efforts are crucial to developing CE, a cultural shift is required throughout society.**

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# 06. Policy Development Framework



Based on the information collected, a policy development framework is established to facilitate a holistic and structured analysis. It consists of policy, implementation structure, project and action, outcome, challenges, and grouped efforts. As shown in Figure 5, each dimension is connected in terms of the development sequence, in which the lack of any process (Evaluate, Identify, Improve and Modify) or corresponding data is regarded as a research gap. Such a mapping process provides an understandable approach to not only assessing the implemented policy but also guiding the policies to make any necessary modifications.

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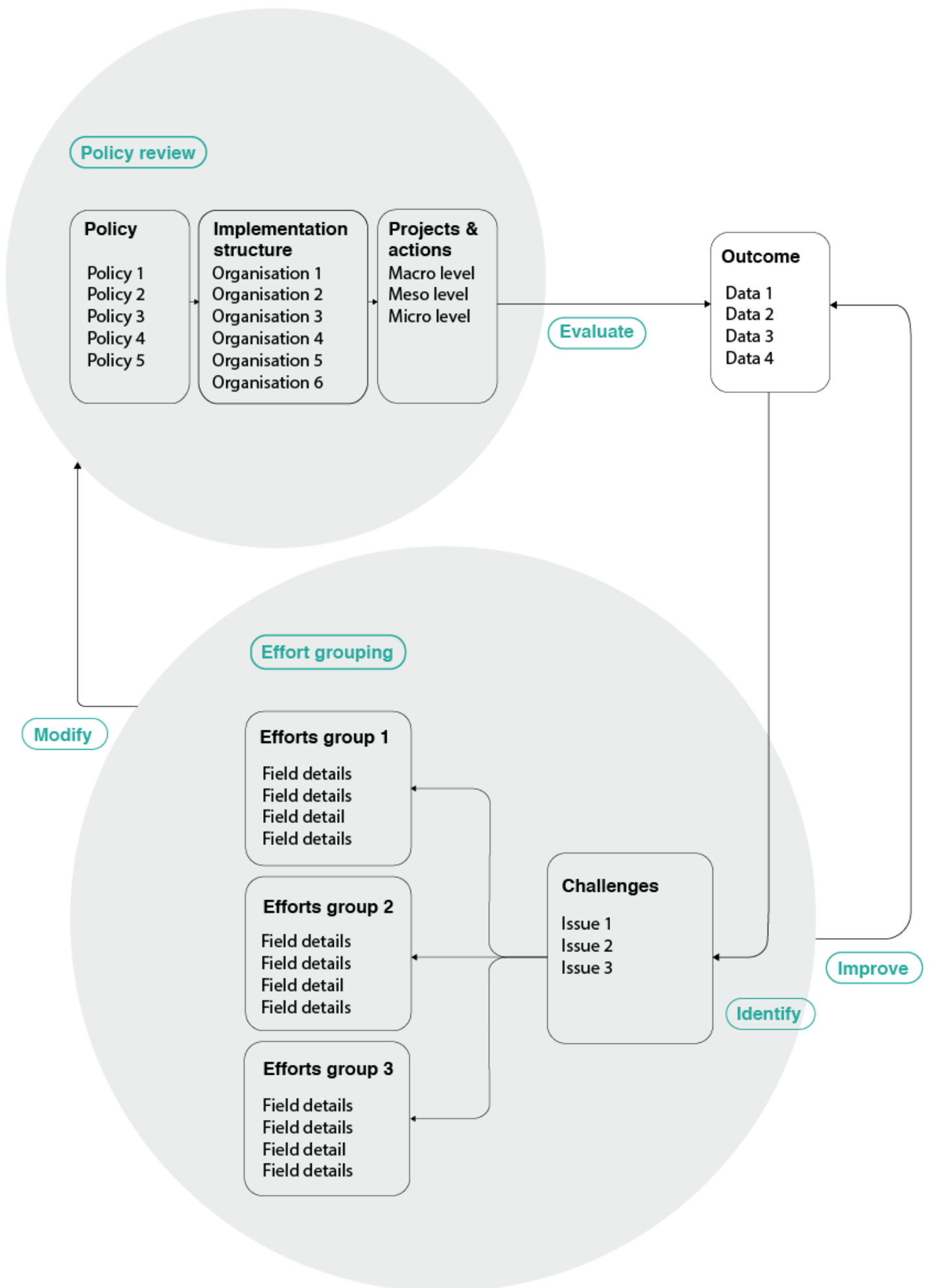


Figure 5: Policy development framework



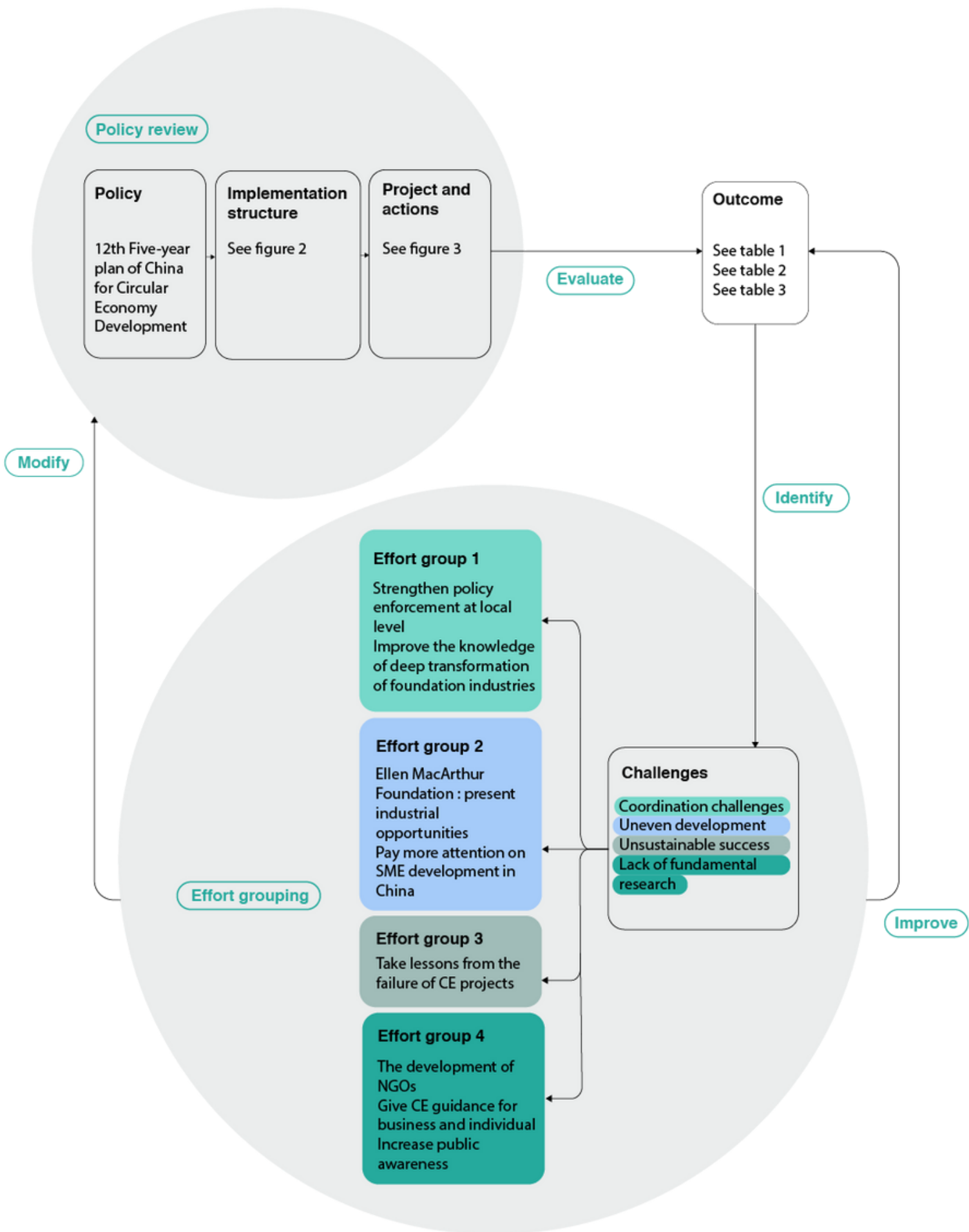
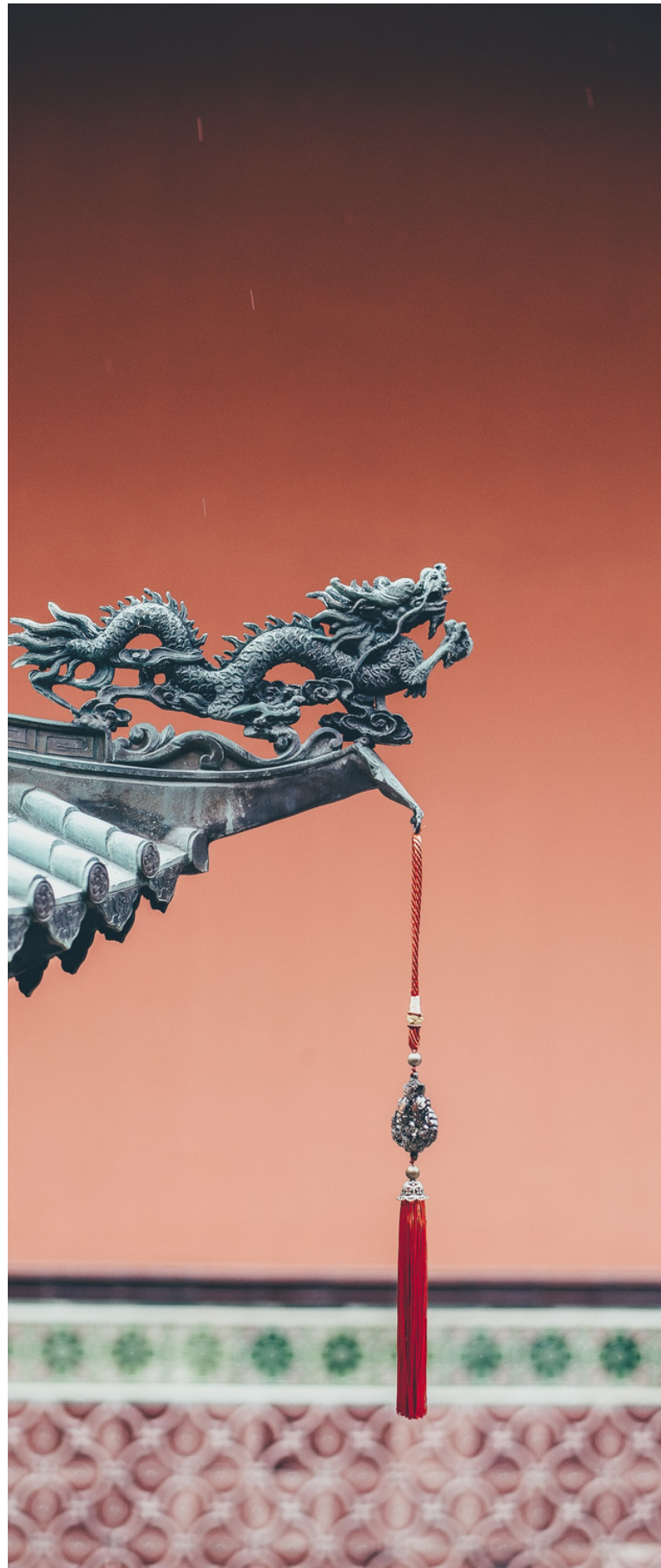


Figure 6: Application of the policy development framework

To illustrate the framework, the aforementioned Chinese CE policies and relevant information are further mapped following the structure in Figure 5. As presented in Figure 6, all the dimensions are filled with the information collected so far. If necessary, each dimension can be further specified, and diverse presentation forms are allowed, like figures, tables, etc. Notably, the efforts are grouped in terms of the challenges they seek to address. By doing this, it can be very convenient to check whether all the key challenges (by addressing them, the outcome will be improved) are identified and whether some solutions are already available. More importantly, these efforts or solutions can provide constructive suggestions for modifying the policy, its implementation, and its actions. In the case of Figure 6, it is visible that some bottom-up approaches are required in subsequent policies, including how to motivate the specific business areas to adopt CE practices, how to improve the environmental performance of SMEs, and how to encourage the development of NGOs, amongst others.

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# 07. Conclusion and Prospect

In China, a strict government structure and a large cooperative network of CE are well established. Measurable outcomes are yielded in terms of the increase in resource productivity and circularity. However, the large scale of the economy inevitably leads to coordination challenges and uneven development, which calls for strengthened policy enforcement, statistics collection, and industry supervision. Notably, too early announcements of success appear at the meso level, including the promotion of EIPs, requiring comprehensive, objective, and transparent analysis and learning from the failed cases. Limited attention is paid to fundamental development, including NGOs and the involvement of businesses and individuals, whose power could be better utilized to synergize the implementation on other levels. Furthermore, a framework for analyzing the development of CE policies has been established. From the information mapped and structured in the framework, it can be detected that subsequent policies and research may focus on the alignment of the central government with local officials on the level of policies, implementation, and achievements. Meanwhile, there is a need for a comprehensive analysis of failed EIPs and an investigation of the influence of NGOs, as well as the proposal of micro-level CE practices.

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**Measurable outcomes are yielded in terms of the increase in resource productivity and circularity.**

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