# China's Circular Economy Transition: Challenges and Solutions Ahead

## A CIRCULAR ECONOMY VISION

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# 01. Introduction

As part of the 14th Five-Year Plan covering the period of 2021-2025, a new development plan for China's circular economy (CE) was released on July 7, 2021. It involves several initiatives, including motivating green product design, recycling, remanufacturing, and renewable resources [1]. In addition, a series of numerical targets to be achieved by 2025 is set up and presented in Table 1. Such ambitious goals require support from previous experience as well as new visions and strategies. According to the research presented in our previous white paper "China's Circular Economy Policies: Review and Reflection", there has been a significant improvement in environmental aspects in China, including industrial reuse of water and solid waste. Meanwhile, several issues are also identified in the implementation of the past Five-Year plans, such as coordination challenges, uneven and unsustainable development, and a lack of fundamental research. These findings are used to propose which aspects of China's CE transition should be retained or optimized in the future.

When it comes to accelerating China's CE transition, the impact of critical roles like the one possessed by SMEs should be identified and used wisely. The implications for SME-related policies and management are discussed in another of our previous white papers on "The Role of SMEs in China's Circular Economy Transition," which combines the development characteristics of Chinese SMEs and their advantages in contributing to the CE transition. Two issues with China's SMEs are pointed out, including difficult financing and the distinct gap between registered patents and the application of green technologies. So far, only general suggestions are proposed in the article, like seeking alternative financing channels, applying digital technologies, and investigating the relationship between academics and industries. More specific instructions for these directions can further motivate the CE transition in SMEs, especially for those with too limited finance and resources to undertake risks.

| CE indicators | The goal in 2025 |
|---|---|
| Resource productivity | Increase by 20% compared to the level in 2020. |
| Energy consumption | Reduce per unit of GDP by 13.5 % compared to the level in 2020. |
| Water consumption | Reduce per unit of GDP by 16 % compared to the level in 2020. |
| The utilization of waste | 86% of crop stalks |
| | 60% of bulk solid waste |
| | 60% of construction waste |
| | 60 million tons of waste paper |
| | 320 million tons of scrap steel. |
| The production of recycled materials | 20 million tons of recycled non-ferrous metals. |
| The output value of the resource recycling industry | Increase the value to RMB 5 trillion (US$773 billion). |

Table 1: The goals of China's CE development by 2025

# 02. Problem Statement

Following the overarching framework for China's CE development that was proposed in our previous white paper "China's Circular Economy Policies: Review and Reflection" and that is outlined below in Figure 1, the policy focus here remains on China's (14th) Five-Year plan for its CE development. However, here the guiding goal is replaced by the targets by 2025 instead of the already obtained achievements. Based on that, this study addresses the way forward in China's CE transition, what challenges will appear, and what kind of efforts will be required. In this case, "policy review" refers to the interpretation of the latest documents and numerical goals by 2025. Notably, it is not possible to discuss the implications for improvement and modification of the current period (they should begin by 2025).

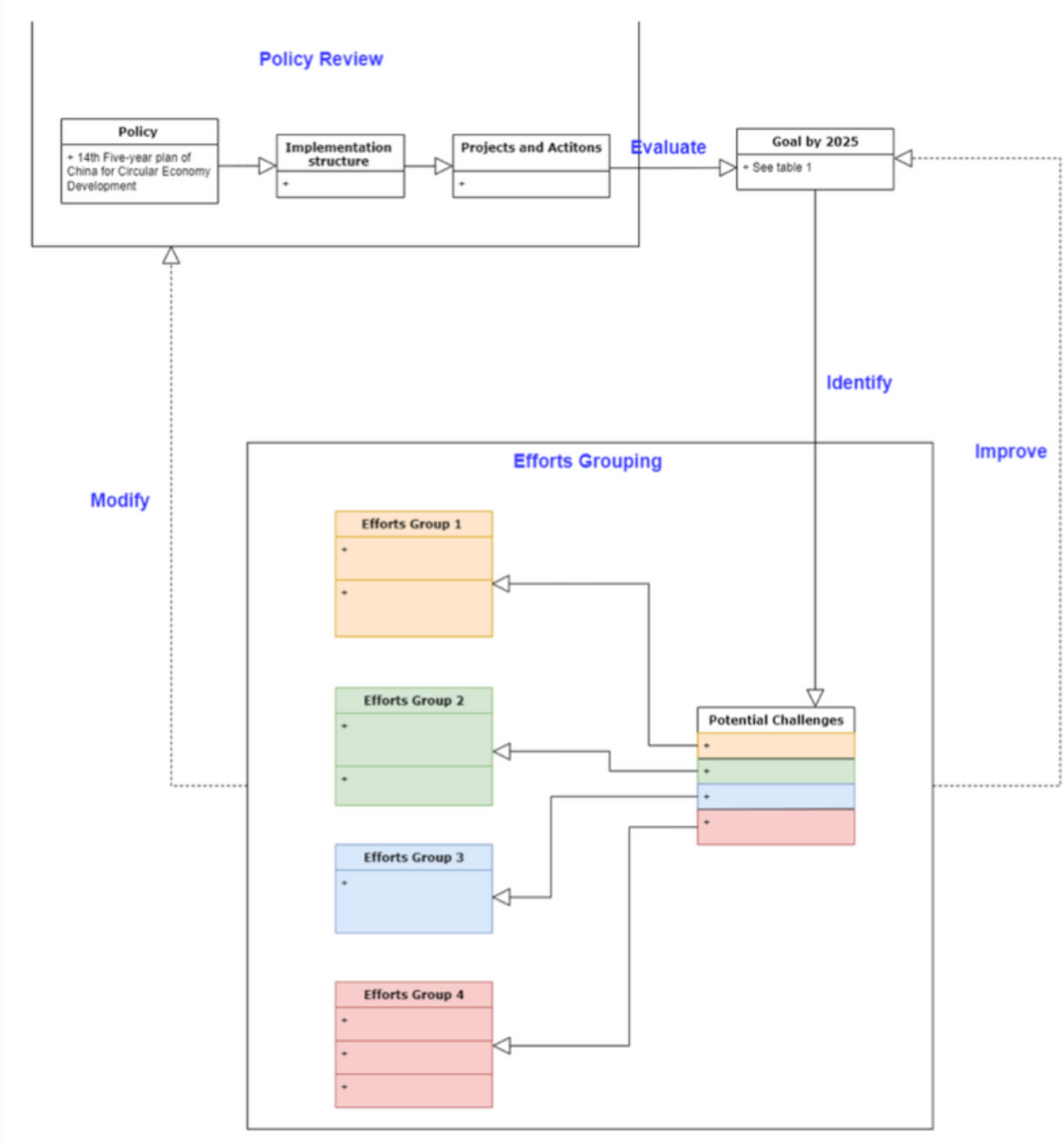



Figure 1: Framework on the way forward for China's CE transition

# 03. Policy Interpretation

### 3.1 Implementation Structure

As organized in Table 2, the key CE projects and the corresponding departments assigned to implement the projects are extracted from China's 14th Five-Year plan for CE development [2]. Notably, the National Development and Reform Commission is responsible for coordinating among all the departments. Other relevant organizations need to assist with the work and procedures of the key departments listed in Table 2.

| CE Project | Accountability Department |
|---|---|
| The construction project of urban waste materials recycling system | • National Development and Reform Commission<br>• Ministry of Commerce<br>• Ministry of Natural Resources<br>• Ministry of Industry and Information Technology<br>• Ministry of Housing and Urban-Rural Development |
| The circular development project of the industrial parks | • National Development and Reform Commission<br>• The Ministry of Industry and Information Technology |
| Demonstration project of comprehensive utilization of bulk solid waste | • National Development and Reform Commission<br>• Ministry of Industry and Information Technology<br>• Ministry of Ecology and Environment<br>• Ministry of Agriculture and Rural Affairs<br>• The National Forestry and Grassland Administration |
| Demonstration project of resource utilization of construction waste | • The Ministry of Housing and Urban-Rural Development<br>• National Development and Reform Commission |
| The key technology and equipment innovation project of the circular economy | • Ministry of Science and Technology<br>• National Development and Reform Commission |
| The high-quality development of the remanufacturing industry | • National Development and Reform Commission<br>• Ministry of Information Technology |
| The action to improve the quality of waste from electrical and electronic products | • National Development and Reform Commission<br>• Ministry of Ecology and Environment<br>• Ministry of Industry and Information Technology<br>• Ministry of Commerce<br>• Supply and Marketing Cooperatives |
| The promotion of automobile use lifecycle management | • National Development and Reform Commission<br>• Ministry of Commerce<br>• Ministry of Industry and Information Technology<br>• Ministry of Public Security<br>• Ministry of Ecology and Environment<br>• Ministry of Transport<br>• General Administration of Customs |
| The special action for the whole chain of plastic pollution control | • National Development and Reform Commission<br>• Ministry of Ecology and Environment<br>• Ministry of Industry and Information Technology<br>• Ministry of Commerce<br>• Ministry of Housing and Urban-Rural Development<br>• Ministry of Agriculture and Rural Affairs<br>• The General Administration of Supervision<br>• The State Post Bureau<br>• The Supply and Marketing Cooperatives |
| The green transformation of express packaging | • National Development and Reform Commission<br>• The State Post Bureau in conjunction with industry<br>• Ministry of Information Technology<br>• Ministry of Ecology and Environment<br>• Ministry of Transport<br>• Ministry of Commerce<br>• State Administration for Market Regulation |
| The recycling action of waste power batteries | • Ministry of Industry and Information Technology<br>• National Development and Reform Commission<br>• Ministry of Ecology and Environment |
| The improvement of the circular economy statistical evaluation system | • National Development and Reform Commission<br>• National Bureau of Statistics<br>• Ministry of Industry and Information Technology<br>• Ministry of Commerce<br>• Ministry of Ecology and Environment |

**Table 2: CE projects and corresponding departments**

### 3.2 Projects and Actions

Looking more closely at the CE projects in Table 2, the construction project of an urban waste materials recycling system entails arranging delivery points, transfer stations, and sorting centers for urban waste materials in nearby communities, supermarkets, schools, and offices. The circular development project of the industrial parks intends to promote the application of distributed energy and photovoltaic energy storage integrated systems, centralized sewage collection, and material flow management. In the demonstration project of comprehensive utilization of bulk solid waste, the focus is on fly ash, coal gangue, metallurgical slag, industrial by-product gypsum, and tailings, among others. The goal of the demonstration project for resource utilization of construction waste is to establish 50 construction waste source utilization demonstration cities. Concrete actions include promoting construction waste source reduction, establishing a construction waste classification management system, and standardizing the construction and operation of construction waste storage.

Furthermore, the CE's key technology and equipment innovation project aims to support the demand for new green technologies in other CE projects. For example, the promotion of industrial intelligence, digital transformation, and robots is emphasized in the plan for the high-quality development of the remanufacturing industry. For some CE projects, their scope is narrowed down to products involving waste electrical and electronic products, automobiles, plastic, express packaging, and waste power batteries. Last but not the least, the modification of the CE development is considered in the plan for the improvement of the circular economy statistical evaluation system. In general, all projects and actions (except the improvement of the circular economy statistical evaluation system) are divided into three levels, as shown below in Table 3: macro, meso, and micro.

**The goal of the demonstration project for resource utilization of construction waste is to establish 50 construction waste source utilization demonstration cities.**

| Level | CE projects | Implementation scope |
|---|---|---|
| Macro | • The construction project of urban waste materials recycling system<br>• The circular development project of the industrial parks<br>• Demonstration project of comprehensive utilization of bulk solid waste | Country |
| Meso | • Demonstration project of resource utilization of construction waste<br>• The key technology and equipment innovation project of the circular economy<br>• The high-quality development of the remanufacturing industry | Industry |
| Micro | • The action to improve the quality of waste electrical and electronic products<br>• The promotion of automobile use lifecycle management<br>• The special action for the whole chain of plastic pollution control<br>• The green transformation of express packaging<br>• The recycling action of waste power batteries<br>• The improvement of the circular economy statistical evaluation system | Product |

Table 3: CE projects on three levels

# 04. Identification of Potential Challenges

### 4.1 High investment in recycling facilities

There will appear to be significant demands on environmental and recycling facilities in implementing the construction project of an urban waste materials recycling system, the circular development project of the industrial parks, and the demonstration project of comprehensive utilization of bulk solid waste. The construction of these facilities and the establishment of an information-sharing platform will cost a large amount of money, labour, and time. In addition, locating suitable premises to build these facilities can be challenging in both urban and rural areas. In pilot cities like Beijing, Tianjin, and Shanghai, huge costs and efforts are required in obtaining the permit for land use and the cooperation of residents in the neighborhood. In some underdeveloped areas, sound transportation systems should be ensured first for a good connection between the facilities on the blueprint.

Consistency and standardization in the operation and facility are critical to fulfilling a sound waste recycling system; otherwise, much rework and repetition will be required. This means that once an area is decided to be converted with such a system, the cost of these facilities will grow exponentially because they should all have the same quality and be compatible with each other. For example, the classification of waste at the public delivery point should remain the same as at the transfer point and central point. Another concerning aspect is the increase in maintenance costs when a high population leads to high usage of these facilities. So far, in the policy, there is no clear commitment as to which parties will cover these costs. However, whatever parties will provide the financial support, attention should also be paid to the high risk of greenwashing and corruption.

### 4.2 Lack of CE talent

Employees equipped with CE methodologies, tools, and skills will play an important role in CE projects on meso or industrial level, which refers to the demonstration project of resource utilization of construction waste, the key technology and equipment innovation project of the circular economy, and the high-quality development of the remanufacturing industry. It is commonly admitted that the sustainable performance of the construction industry in China is far behind that of northern European countries due to rapid urbanization and industrialization [3]. The cause behind this can be partly attributed to the features of the Chinese education system. Students who do not have CE and sustainability awareness will not automatically become employees who do. In general, there is a lack of good education for sustainable development in Chinese universities. A case study of Beijing Normal University (BNU) revealed that Environmentally Sustainable Development (ESD) has not been well adsorbed into China's educational sectors. ESD was emphasized more as a label due to its frequent mention in national policies [4]. The fundamental meaning of sustainable development is unclear, and there is a plethora of fragmented ESD research rather than systematic ESD implementation in the educational sector. A global, even symbolic, ideal of

sustainable development (presented by the central government) is followed by the education department [4], without a concrete conceptualization of what ESD entails. As one of the top universities in China, the issues faced by BNU are likely to exist in other universities as well, especially when uneven educational resources among different regions are a long-lasting problem in China.

### 4.3 Lack of CE public awareness

As stated in previous research [5], there is low consumer awareness and interest, even in one of the pilot cities, Tianjin, where only 16.7% of people who responded to a survey had heard of the concept of a CE. This will impose challenges in implementing urban waste materials recycling systems in the long term. Although the importance of public participation in CE practices is emphasized a lot by researchers, the Chinese government does not consider any projects involving CE public education and other education sectors in the 14th Five-Year plan for the CE. Such ignorance of public awareness seems contradictory when there are so many CE projects focused on products, like the action to improve the quality of waste electrical and electronic products, the promotion of automobile use lifecycle management, the special action for the whole chain of plastic pollution control, the green transformation of express packaging, and the recycling action of waste power batteries. Without public CE awareness, these CE actions can not form a sustainable business model because the downstream Chinese consumers do not have a welcoming attitude toward these products yet.

There is a high risk that failure to promote circular products will crush the confidence of business sectors toward the CE transition as well.

# 05. Classification of Efforts

Following the interpretation of the policy and the identification of challenges, the needed efforts are proposed. As displayed in Figure 2, the efforts are grouped according to which challenges they can cope with. Details are given in the following sections.

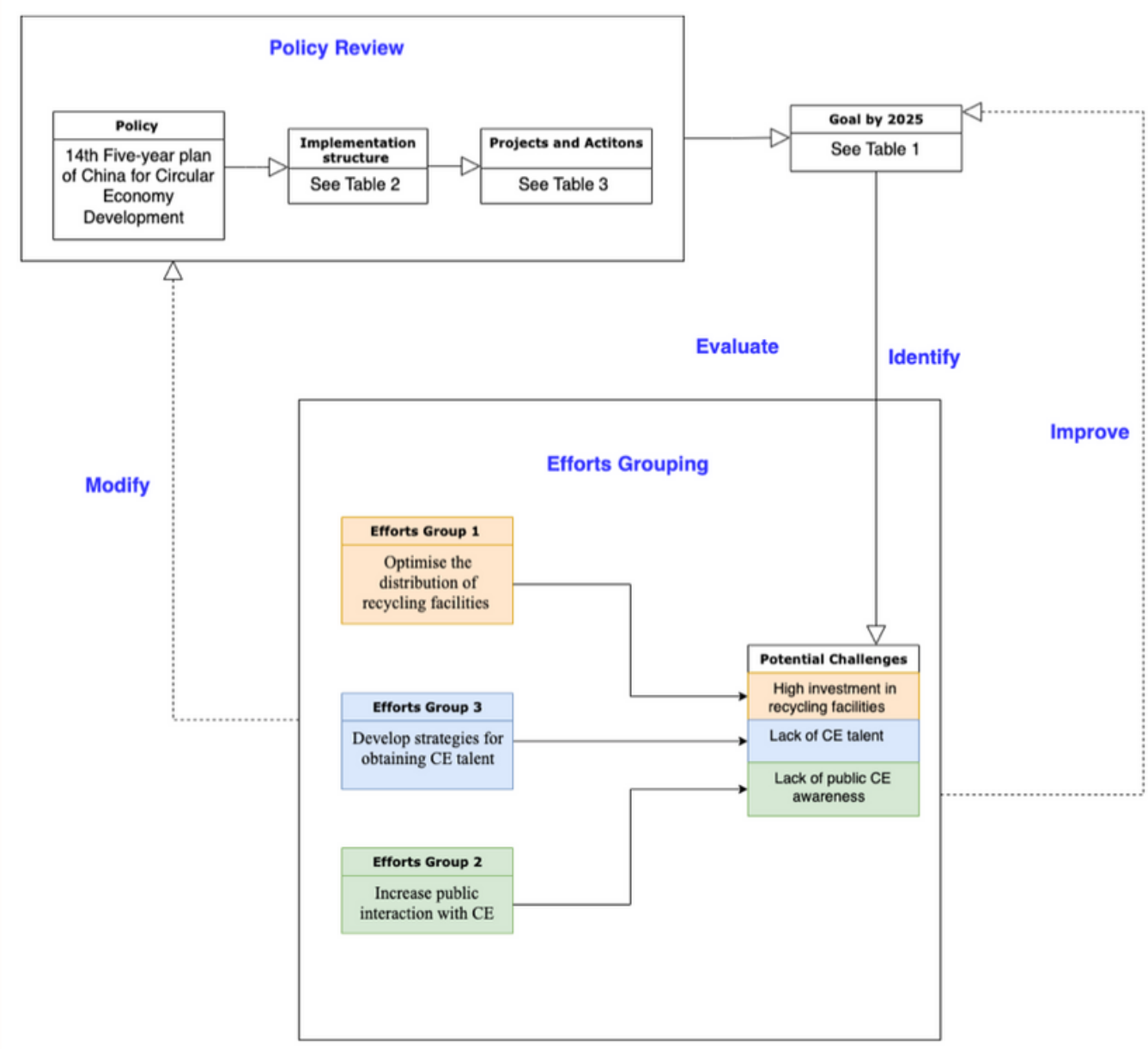



Figure 2: The way forward in China's CE transition

### 5.1 Optimize the distribution of recycling facilities

To cope with the high demands of recycling facilities, the location of these facilities should be selected smartly to maximize their accessibility. Mathematical optimization algorithms can be applied to assist with decisions on the distribution of the facilities. As presented in previous research [6], a model for choosing locations for constructing recycling centres is proposed. In this study, the objectives are set to decrease the total distance among all the centres and increase the overall suitability index. So according to the demands, the objectives can also be set to decrease the total transportation routes and decrease the total construction costs.

In addition, it is pointed out that the impact of facility accessibility on recycling behaviour has been examined and confirmed in several empirical studies [7]. Hence, the accessibility of residents to these recycling facilities should also be considered in the objectives of the optimization model. Meanwhile, different priorities can be given to the different objectives by using weighting factors. Such flexibility in the method can be very beneficial when the financial situations and urban development vary a lot among different regions in China.

### 5.2 Develop strategies for obtaining CE talent

When it comes to supporting the CE transition timely, focusing on training current employees and introducing new talent can be more efficient than expecting a change to occur in the educational system. It is suggested that "systems thinkers who understand the big picture of finite resources, overburdened ecosystems and the need to reduce social inequality will be the ones to forge the critical links in the value chain that provide the solutions for sustainable business" [8]. For different stages of the CE transition, different traits are needed from employees in companies.

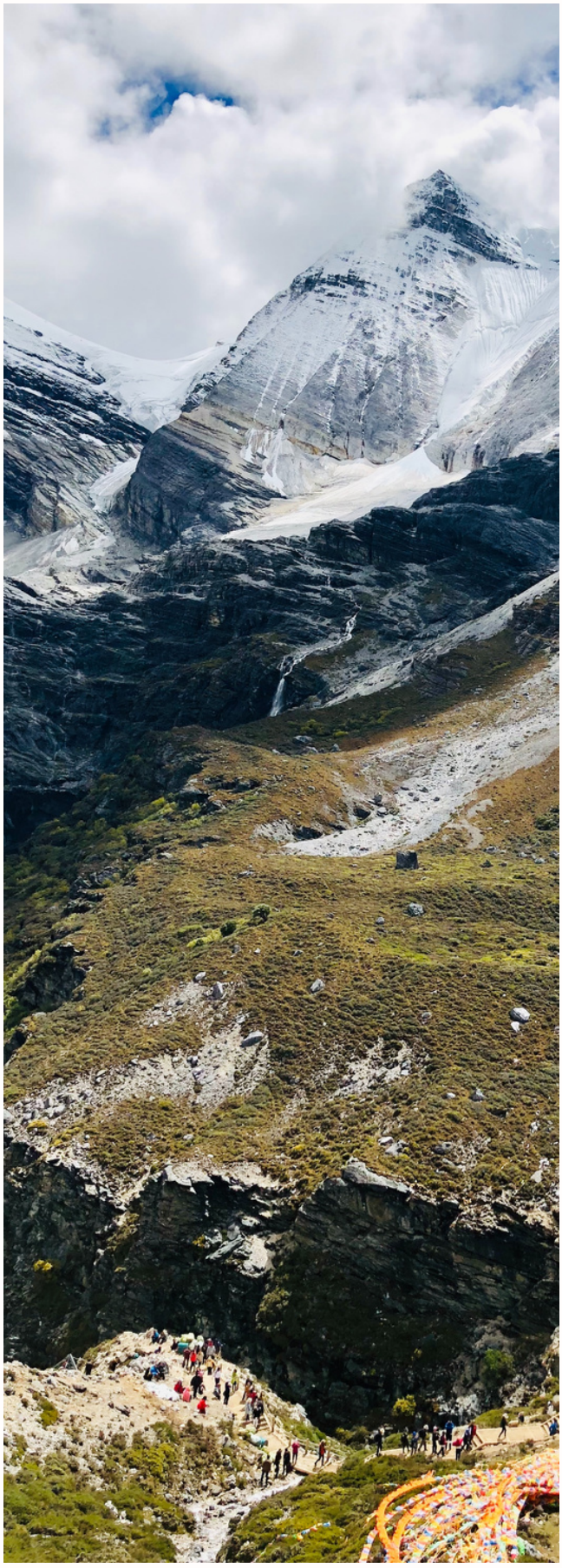
If the company has not started its CE transition yet, employees who are good at translating new concepts, collaborating, having long-term visions, and motivating others will be suitable candidates to undertake the new required CE jobs. Once the company has initiated its CE transition, the focus on the traits of employees will be directed to strategic innovation, exploration, and inclusiveness. If the company is already on board with a CE and has developed a roadmap to move forward, the employees should be expected to be good connectors and leaders, along with having a dynamic and positive attitude. According to different stages, companies should seek the corresponding traits among employees, making it more targeted to achieve their goals. The strategies are suitable for both choosing a training direction for current employees and recruiting new employees.

### 5.3 Increase public interaction with CE

A good way to improve public awareness about CE in China is to increase people's interaction with the concept and relevant actions. The interaction should be initiated by the various parties and levels that are already aware of the importance of CE. Individuals with a certain understanding of the concept can share information about the circular economy on social media and other online platforms, using hashtags and other tools to make their posts visible. Local businesses, governments, and other organizations devoted to a CE can organize relevant educational events and campaigns. In addition, non-governmental organizations (NGOs) in China providing CE services should realize their important role in public awareness creation and exert their influence appropriately.

# 06. Conclusion

Based on the 14th Five-Year development plan that was released in 2021, the way forward for China's CE transition was discussed using the overarching framework shown in Figure 1. Three aspects were focused on including the interpretation of the policy, the identification of potential challenges, and the classification of the needed efforts. It is suggested that, in general, there is an organized implementation structure of CE projects and actions, although some departments like education sectors are not involved in the framework. Aiming at the goals by 2025, some challenges are likely to occur, such as high investments in recycling facilities, lack of CE talent and public CE awareness. Correspondingly, suggestions were proposed under three categories aimed to "optimize the distribution of recycling facilities", " develop strategies for obtaining CE talent", and "increase public interaction with CE ".



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