

# 20 Cities Towards Zero Waste

## Hangzhou City



Population: 12,520,000

Hangzhou, Zhejiang Province, China

### Why this city?



As one of the ecological civilization cities in China, Hangzhou has leveraged digital technology to enhance municipal solid waste (MSW) separation and resource utilization, innovated recycling models for low-value recyclables, and promoted green living through the dissemination of the zero-waste concept.

## Impact & Sustainability

As a mega-city with a GDP exceeding \$300 billion and a population of over 12 million living in 13 districts and counties, Hangzhou has made remarkable progress in MSW management. Between 2021 and 2024, the growth rate of MSW dropped from 4.67% to 3.58%, waste generation decreased from 1.06 to 0.99 kg/(cap·day), and the recycling rate rose from 36.3% to 40.58%. Since the end of 2020, MSW treatment has achieved zero land-filling.

## Partnership & Collaboration

Hangzhou classifies MSW into 4 categories: recyclables, household hazardous waste (HHW), kitchen waste, and residual waste. However, even after sorting, recyclables often remain a complex mixture with residual waste or kitchen waste, making recycling difficult. Through a tripartite collaborative model of "government leadership, enterprise implementation, and public participation," Hangzhou has developed a demonstration case that emphasizes the integration of smart technologies such as "Internet Plus" into the construction of a recyclable recovery system. This approach has significantly enhanced the recycling efficiency of low-value recyclables like Tetra Paks, single-use plastic food containers, and milk tea cups.

### Case 1. Whale Spirit Recycling Bus: Multi-Scenario Classification and Transportation Model for Low-value Recyclables

The Whale Spirit Recycling Bus is a multi-scenario collection and resource recovery project for low-value recyclables operated by the district-owned enterprise (Xihu Environmental Group) in Xihu District, Hangzhou, in collaboration with private enterprise. It adopts a strategy, starting with high-

frequency generators such as restaurants, commercial complexes, office buildings, and residential communities. The strategy enables pre-sorting of residual waste before incineration for energy, reduces the amount of residual waste sent for incineration for energy recovery, and effectively compensates for resource loss caused by front-end sorting errors and public awareness limitations. At present, the project consistently and reliably operates across 459 collection points in 11 towns/sub-districts of Xihu District, covering 3 sectors: 60 restaurants (e.g., KFC, Starbucks), 79 commercial complexes and office buildings, and 162 residential communities. From 2022 to 2024, the Whale Recycling Bus collected and transported 529.24 metric tons of recyclables, helping Xihu District to save approximately 3.13 million RMB annually in waste disposal costs.

In terms of Public-Private cooperation, Xihu District innovatively established a PPP model characterized by "government leadership, state-owned enterprise coordination, and private operation". The Xihu District Government acts as the regulator and service purchaser, outsourcing processing services at a fixed total price. A state-owned sanitation enterprise (Xihu Environment Group) plays a core coordination, interfacing between the government and the recycling enterprise, ensuring standardized and efficient project supervision. The recycling enterprise, as a private stakeholder, focused on residual waste sorting and developing markets for the low-value recyclables. This innovative cooperation reduced government operational costs by 31%.

In chain catering outlets, a "store staff packaging - recycling enterprise personnel door-to-door collection and transportation" model is adopted. In commercial complexes and office buildings, a "store collection - property management transfer to waste storage rooms - sanitation enterprise collection and transportation - recycling enterprise sorting of recyclables from residual waste" model is implemented. In residential communities, a "guider-assisted sorting - property management temporary storage in residual waste bins - sanitation enterprise collection and transportation - recycling enterprise sorting of recyclables from residual waste" model is used. Specific practices are detailed in Annex 5.

## **Case 2. "Huge" Door-to-Door Collection: Community-Driven and 'Internet Plus' Approaches**

Zhejiang Huge Waste Management Co., Ltd. has established recycling stations covering residential communities, storefront businesses, and government institutions in Yuhang District and Linping District, with each station serving approximately 2,000 households. Each station is staffed with dedicated promotional personnel ("Huge-Tiger Moms") and recycling collectors ("Huge-Tiger Brothers"), forming a comprehensive recycling network by connecting points into networked areas. Huge provides each household with a recyclable's storage rack and dedicated recycling bags, and collect 2 types of MSW (recyclables and HHW). Residents can use an app to "call with one click" for Huge to provide door-to-door pickup within 1 hour. In return, residents receive "eco-credits" based on the weight of recyclables collected. These credits can be used to purchase goods in the online Huge Mall or withdrawn as cash.

In this model, the government purchases services for supervision and assessment, while Huge is responsible for the construction of facilities such as collection sites, clearing logistics and sorting centers, and for training and organizing professional staffs to provide operational services. The company also establishes a digitalized supervision platform ("Internet Plus" platform) for government regulators and accepts full-process supervision from them. The government pays Huge for its

services based on the results of operational performance evaluations. Between 2022 and 2024, Huye recycled approximately 400,000 metric tons of recyclables, achieved a carbon emission reduction of around 162,000 metric tons, and distributed approximately 110 million RMB in eco-incentives across Yuhang District and Linping District. Their services covered 559,000 households, with about 553,000 households participating in MSW sorting activities. The operation included 307 service stations and 1 sorting center.

Concerning community engagement, "Huge-Tiger Moms" (female staff) provide new channels for community interaction, increasing the residents' awareness for MSW sorting. Additionally, Huye regularly organizes "Huge Green Classroom" events in schools, using fun and educational methods to teach young students about MSW sorting and environmental protection through knowledge sessions, interactive activities, and field visits. These activities have been held over 2,000 times, reaching more than 97,000 participants, significantly improving waste sorting accuracy and environmental awareness among students. The "children-led influence" further extends to families and communities, encouraging more households to participate in waste sorting. Specific practices are detailed in Annex 6.

### **Case 3. Milk Cartons Recycling: A Synergistic Network Centered in Schools**

Under the coordination and guidance of the Hangzhou Communist Youth League, Municipal Ecological Environment Bureau, and Municipal Education Bureau of Hangzhou, Hangzhou Fulun Ecological Technology Co., Ltd. has established a milk cartons recycling and disposal network in more than 230 schools across Hangzhou. Over 200,000 teachers and students have participated in milk carton recycling, indirectly spreading the zero-waste concept to more than 400,000 families. Schools have set up a "Resource Bank" system, where waste meal boxes and milk cartons collected by students are weighed and automatically recorded in the system, earning energy points. Students can use these points to exchange for 43 types of recycled products, such as recycled motorcycles and recycled notebooks made by paper. Through processes including mechanical crushing, paper-plastic separation, aluminum-plastic separation, purification, and refining, discarded cartons are transformed into products like recycled aluminum, paper, and plastic. Fulun has successfully built a mature and stable market demand for recycled paper, plastic, and aluminum products, effectively integrating the entire chain from collection and production to utilization of recycled products. Recycling system activities also strive to enhance re-cycling awareness among youth in order to increase recycling rates. From 2022 to 2024, the Hangzhou Young Pioneers Working Committee, Hangzhou Youth Activity Center, and Fulun jointly organized four "Resource Bank" enterprise visits and practice activities, attracting representatives from 21 schools in Shangcheng District comprising a total of 221 Young Pioneers. Activities mainly included tours of the paper-plastic-aluminum separation workshop and recycled paper production line, as well as undertaking hands-on experiences in making recycled paper and eco-friendly crafts.

Each stakeholder in the recycling system has a clear role and collaborates closely. As the core operator, Fulun is responsible for transportation, discarded cartons recycling, connecting with downstream enterprises, and organizing environmental education activities. Schools take on organizational and educational roles by setting up collection points, supervising sorting, and integrating recycling into labor education courses. Students act as active participants and advocate, they clean and sort milk cartons, extend environmental awareness to families and communities

through the "children-led influence" effect, and help promote intergenerational transmission of sustainability values.

## Inclusiveness & Social Equity

Hangzhou has systematically advanced the development of Zero-waste Cells, energizing participation from diverse groups across society. From 2021 to 2024, the city established 2,809 Zero-waste cells spanning 33 categories, including Zero-waste Communities and Zero-waste Schools, with 2,155 of these established between 2022 and 2024. Detailed information could be seen in Annex 7. The rapid expansion of Zero-waste Cells has relied on widespread public support and action. The successful hosting of the Zero-waste Asian Games in 2023 particularly elevated the zero-waste concept to new prominence, leveraging the event to promote green lifestyles among all residents. Throughout this process, students actively promoted waste reduction, sorting, and recycling in their schools and communities, and jointly launched zero-waste initiatives within schools. The continuous expansion and improvement of the recycling network within the zero-waste city framework have also created more opportunities for waste collectors in terms of resource recycling and reemployment.

To improve the accuracy of waste sorting, most community property management companies mobilize cleaning staff to serve part-time as waste sorting guides at trash bins. These workers sort out misplaced recyclables and sell them to supplement their income. As low-income earners, cleaning staff not only earn extra income but also play a role in promoting and guiding residents in waste sorting practices. Furthermore, the recycling industry for low-value recyclables has created diversified job opportunities, including positions such as recycling personnel, sorting workers, and technical operators. This industry absorbs labour from various backgrounds and provides new employment pathways for groups facing job-seeking difficulties. For example, the "Huge" company recruits female residents aged 50 to 60 from local communities to work close to home. From 2022 to 2024, the number of employees working in Hangzhou reached 1,327. Through standardized management, the company offers regulated job opportunities for people with employment difficulties and provides social insurance contributions, enhancing the professional identity and pride of workers in the recycling industry.

## Innovation & Technology

### **(1) Digital-Intelligent Governance Platform for MSW Management**

Hangzhou has established a city-wide Digital-Intelligent Governance Platform for MSW Management, which integrates full-process data for recyclables, kitchen waste, residual waste, and household hazardous waste. The platform enhances supervision across the entire lifecycle – collection, transportation, disposal, and recycling. Key metrics such as total waste growth rate, recycling rate, sorting accuracy rate, and waste disposal rate are clearly displayed on the platform. Through backend data analysis, managers can gain comprehensive insights into waste generation trends across neighborhoods, communities, and enterprises, identify patterns and issues, and optimize the layout of waste disposal points and resource allocation. As the starting point of the waste sorting process, real-time sorting data from 7,361 waste collection points across the city are uploaded to the platform.

The collection times and operational status of all 1,780 waste trucks in the city are clearly visible. By installing GPS modules on the trucks, the platform accurately records each vehicle's departure time, route, and task duration, while providing timely alerts for abnormal activities, significantly improving collection efficiency. At the disposal stage, the platform integrates data from 9 energy-from-waste plants, 11 kitchen waste treatment facilities, enabling 24/7 monitoring of all 4 categories of MSW.

## **(2) Fly Ash Water Washing Dechlorination Combined with Cement Kiln Co-processing**

Hangzhou has deployed and constructed resource utilization projects for fly ash generated from MSW incineration, with the total processing capacity essentially matching the amount of generation. There are 4 enterprises in the city with a total processing capacity of 185,000 tons per year. Taking Huihong Environmental Technology Co., Ltd. in Fuyang District as an example, the company processes approximately 150 metric tons of fly ash from MSW incineration each day. Through processes such as deep washing and cement kiln co-processing, it extracts industrial salts including calcium chloride, sodium chloride, and potassium chloride from the fly ash. The resulting dechlorinated fly ash is then transported to cement plants to be used as raw material. This innovative technology achieves harmless treatment and resource utilization of fly ash, substituting another approach where landfilling was previously the only disposal method. It represents a sustainable solution for cities that are densely populated and space-constrained.

## **(3) Black Soldier Fly Larvae in Converting Kitchen Waste**

Black Soldier Fly Larvae Bioconversion Technology was recognized as an economical and efficient method to reduce organic waste emissions in 2023, at the meeting convened by UNEP with the Technology and Economic Assessment Panel (CCAC-TEAP) of the Climate and Clean Air Coalition. In June 2024, Binfu Biotechnology Co., Ltd. in Fuyang District established the first standardized black soldier fly breeding facility. After kitchen waste is processed to extract oil and biogas through fermentation, the remaining residues are transported to Binfu for treatment. Using intelligent breeding workshops, the company achieves 100% biodegradation of organic waste with black soldier flies, producing approximately 200 kg of fresh larvae and 300 kg of frass from every 20 tons of kitchen waste residue. Each of the 8 enclosed climate-controlled breeding workshops is equipped with intelligent monitoring devices for odor, temperature, and humidity that can be accessed remotely and are fitted with alarm systems, enabling unmanned operation. Meanwhile, advanced technologies and equipment are used to refine and extract micronutrients from the flies, such as antimicrobial peptides, crude protein, crude fat, and various amino acids, for application in feed additives, pharmaceuticals, cosmetics, soil improvement, and other fields.

## **Scalability & Transferability**

Hangzhou's systematic solution for MSW sorting and recycling is well-suited for application to large and medium-sized cities. Based on its established MSW sorting and recycling system, Hangzhou successfully implemented this solution during the 19th Asian Games in 2023, accumulating valuable experience for Zero-waste Asian Games that can be replicated by other cities hosting major events.

**The Games established rules and measures in the preparation phase.**

- i. "Zero-waste Asian Games Implementation Guideline": the guideline was formulated, specifying key waste-reduction measures for the pre-event, during-event, and post-event phases. Twenty-three indicators were established, such as per capita MSW generation, MSW recycling rate, and e-ticket usage rate, to comprehensively evaluate the effectiveness of the Zero-waste Asian Games after the event.
- ii. Digital Management: An online platform was developed to integrate solid waste data (including MSW) from Asian Games venues and the Athletes' Village. This platform enabled real-time monitoring of dynamic data, achieving an overview of Zero-waste Asian Games initiatives and centralized management of environmental safety.

### **The Games prioritized source reduction through multiple measures.**

- i. Venue Optimization: Among the 56 competition venues, 44 were renovated or temporarily built, while 12 new venues were designed with post-event use in mind.
- i. Kitchen Waste Reduction: Per capita kitchen waste decreased by 20% compared to similar-scale events, achieved through centralized ingredient preparation, precise demand forecasting, and buffet-style dining to minimize waste.
- ii. Sustainable Sponsorship: Sponsors adopted recyclable/ renewable materials for licensed products and simplified packaging designs.

### **The Games emphasized "rent not buy" and reuse principles to promote circularity.**

- i. Equipment Rental: Facilities and equipment were leased where possible, with post-event recycling maximized.
- ii. Waste Repurposing: Over 50% of event materials were recycled. Initiatives included transforming discarded water bottles into park benches and converting paper tableware into folding fans as souvenirs.
- iii. Creative Recycling: Production scraps from mascot manufacturing ("Memories of Jiangnan") were repurposed into unique, colorful figurines.

### **Cultural promotion played a key role:**

- i. Multi-Channel Outreach: A series of campaigns, launched at the 1-year, 100-day, 60-day, and 7-day countdowns, reached over 14 million people via media.
- ii. Iconic Advocacy: A mascot made from bamboo shoot shells (the Zero-waste Asian Games Cheering Duck) gained popularity and recognition from Olympic Council of Asia officials.
- iii. Public Engagement: Ten citizen-friendly zero-waste tips were promoted, encouraging personal action and social sharing. A participatory platform with reward incentives further boosted involvement.

## Summary

Key points	Summary
Key achievements	Hangzhou has significantly reduced waste generation and improved recycling performance. Between 2021–2024, MSW growth dropped from <b>4.67% to 3.58%</b> , per capita waste decreased, and recycling rates increased to <b>over 40%</b> . The city achieved <b>zero landfill for MSW</b> and expanded “Zero-Waste Cells” (2,800+), including communities and schools, demonstrating strong public participation and systemic change.
Policies & governance	A comprehensive policy framework guides Hangzhou’s zero-waste transition, including the <b>Zero-Waste City Work Plan (2020)</b> and updated 2023 strategy. Regulations on waste classification, economic instruments (tiered charging, ecological compensation), and <b>digital monitoring systems (MRV)</b> support implementation. Strong governance combines government leadership, PPP models, and community engagement, with full-chain traceable recycling systems.
Practices & innovations	Hangzhou applies innovative, scalable solutions such as <b>digital waste tracking platforms</b> , “Internet+ recycling systems,” and PPP-based collection models. Flagship initiatives include the <i>Whale Recycling Bus</i> , door-to-door smart collection systems, and school-based recycling networks. Advanced technologies like <b>black soldier fly bioconversion</b> and <b>fly ash co-processing</b> enhance resource recovery and circularity.

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