Bangkok, Thailand

City Waste Management Profile

URBAN OCEAN

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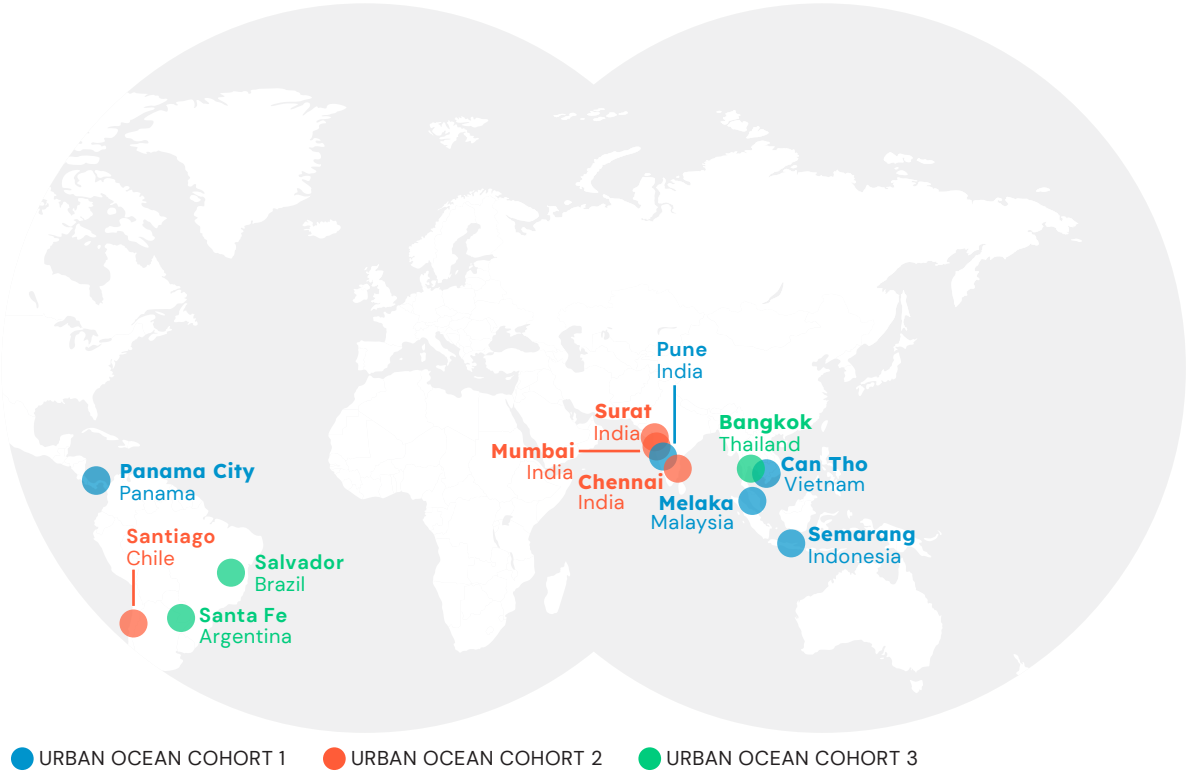
Contents

1. Introduction to Urban Ocean

Urban Ocean is a capacity-building and accelerator program for cities that champions circular economy principles, builds awareness of ocean plastic pollution, and assesses waste management systems. The program works with city leaders to bring new ideas, partners, and resources together to solve interrelated resilience challenges associated with waste management, reducing plastic leakage, and protecting water bodies. It demonstrates how actions to improve waste management and recycling can provide resilient and sustainable solutions that reduce ocean plastic pollution while addressing key city priorities such as improving public health, supporting economic development, and reducing greenhouse gas emissions. Furthermore, Urban Ocean provides cities with the opportunity to showcase leadership and share knowledge and experience across the Resilient Cities Network community and beyond.

The program is jointly led by Resilient Cities Network, Ocean Conservancy, and the Circulate Initiative, in partnership with Bangkok Metropolitan Administration (BMA) and King Mongkut's University of Technology Thonburi.

FIGURE 1
Urban Ocean cities map



Overview of the Urban Ocean Challenge

Cities are home to over half of the global population and account for nearly three-quarters of greenhouse gas emissions. Neither climate nor social targets will be met without a deep transformation of urban centers towards a more inclusive, sustainable and, ultimately, resilient path. Approaching urban waste management systems through a resilience lens reveals complex, interrelated ramifications for social, economic and environmental systems. The International Labor Organization estimates that the waste management sector alone has the potential to create 45 million jobs globally by 2030 while reducing greenhouse gas emissions by 15 to 20 percent. Additionally, within the same time frame, circular economies offer a $4.5 trillion USD economic opportunity by reducing waste, stimulating innovation, and creating employment (World Resources Institute, 2021). Currently, plastic usage continues to grow, remaining a threat to public and environmental health in the ocean and in cities. City governments have a unique opportunity to implement policies and projects that promote a more resilient and circular waste sector in their cities. Now is the time to set out on the path towards a more resilient urban–ocean relationship that highlights the importance of preventing marine plastic debris.

Urban Ocean Cities

Urban Ocean works closely with cities to demonstrate tangible solutions and highlight progress in addressing waste management challenges. The first cohort of Urban Ocean cities, launched in 2020, included Pune (India), Can Tho (Vietnam), Panama City (Panama), Semarang (Indonesia) and Melaka (Malaysia). In 2022, the program expanded to four additional cities in Cohort 2 – Chennai, Surat, and Mumbai (all in India) and Santiago (Chile), and then in 2023 to Cohort 3 – Salvador (Brazil), Bangkok (Thailand), and Santa Fe (Argentina). This expansion aimed to broaden the program's geographic scope, strengthen waste management, circular economy, and resilience ecosystems, increase collaboration with local governments, and establish effective waste-management systems that generate environmental, social and economic co-benefits for cities.

Program Objective

Urban Ocean provides a platform for ocean advocates, city leaders and allies to join forces with other collaborators in developing comprehensive solutions that meet the needs and priorities of cities and their communities, creating meaningful and sustainable impact. The program provides and coordinates baseline assessments to gauge the efficacy, challenges and opportunities of existing waste management systems. Urban Ocean sparks critical conversations that help participating cities identify, develop and implement solutions to improve waste management and reduce plastic pollution through circular and resilient lenses that also promote social inclusion, public health, environmental protection and reductions in greenhouse gas emissions. Once opportunities are identified, Urban Ocean supports cities to attract support to implement solutions.

Program Approach

Urban Ocean provides support for cities to develop strategies and projects designed to address the interrelated challenges of ocean plastics and community resilience. The program approach in cities is shown in figure 2.

FIGURE 2
Urban Ocean Program Approach

Gap Assessment

- Circularity Assessment Protocol (CAP)
- Opportunity Assessment Tool
  - -Framing workshop
  - -Participatory workshop
  - -Solutioning workshop
- Waste Profile

Project Design and Implementation

- Project proposal development
- Project pitching
- Catalytic seed funding for pilot implementation
- Fundraising through dialogues with private sector

Capacity Building

- Knowledge sharing through on-demand sessions
- Peer learning with fellow program cities

Methodology

This city profile summarizes the information collected to develop a resilience-oriented analysis of the urban waste management system in Bangkok, Thailand. The information was collected through desk research, interviews, and collaborative workshops with city stakeholders. Table 1 presents the stakeholders who were consulted as part of the program.

TABLE 1
Interviewed stakeholders

Government/ Public Sector Agencies

Bangkok Metropolitan Administration

Thonburi District Office

Civil Society

Thonburi District Community Leaders

Private Sector/Social Businesses

YOLO Trash Lucky PakDone

Jak Reward Technology

Recycoex

Non-governmental Organizations

Solid Waste Management Association of Thailand

Environmental Justice Foundation (Thailand)

RecyGlo (RecyGlo Thailand)

Waste Service Providers

WasteBuy Delivery

Recycoex

YOLO

Academia

King Mongkut's University of Technology Thonburi

Chulalongkorn University Chula Zero Waste

2. About the City Waste Management Profile

As part of Urban Ocean, cities create a City Waste Management Profile, in which a city's waste management systems are presented, including technical and sustainability aspects, and formal and informal actors in the system. The City Waste Management Profile examines major disturbances and stresses that impact the city's waste management system. It brings together existing data and information collected in the initial phases of the program to allow the city to assess the risks and vulnerabilities of the system, as well as support project design.

Developing such a profile provides insight for the city to better plan and identify appropriate solutions to increase the resilience of its waste management system, reduce plastic leakage into the environment and improve the city's ability to respond to, adapt to or otherwise address current and future shocks and stresses. It summarizes the baseline assessment conducted in all cities in the Urban Ocean program and highlights the most relevant data and information to address urban resilience, ocean conservation and plastic pollution.

City Waste Management Profiles encourage a more holistic approach to existing challenges and support cities in the development of solutions suited to their specific history, economy, demographics and culture while being aligned with the city's unique institutional, environmental and financial resources. An added benefit of participating in Urban Ocean is that cities can learn from each other by comparing common elements in their respective profiles.

FIGURE 3
Bangkok and the Chao Phraya River

3. Overview of Bangkok and its Resilience Journey

Bangkok, known as Krung Thep Mahanakorn in Thai, is located in central Thailand and is the country's capital and the national center of administration, education, tourism, finance and development. Rapid growth and industrial prosperity in the city have led to migration from across the country and beyond, causing a rapid increase in the city's population. Historically a small fortress town on the eastern bank of the Chao Phraya river, Bangkok has now turned into one of Southeast Asia's most prosperous and modern cities..

The region of central Thailand is known for its flat and fertile plains which are reliant on natural and artificial waterways. To this day, the river and canals are integral to the city's urban landscape and economy, with thousands of people using an extensive network of large and small river and canal boats. In the 20th century, the river and its delta developed quickly to support port facilities, warehouses, shipyards and rice mills. Over the decades and with the influence of globalization, Thailand has grown its export industries beyond agricultural products to include vehicles, electronics, heavy and light machinery, plastics and refined petroleum to become one of the major exporting countries in the region (Resilient Cities Network, 2016).

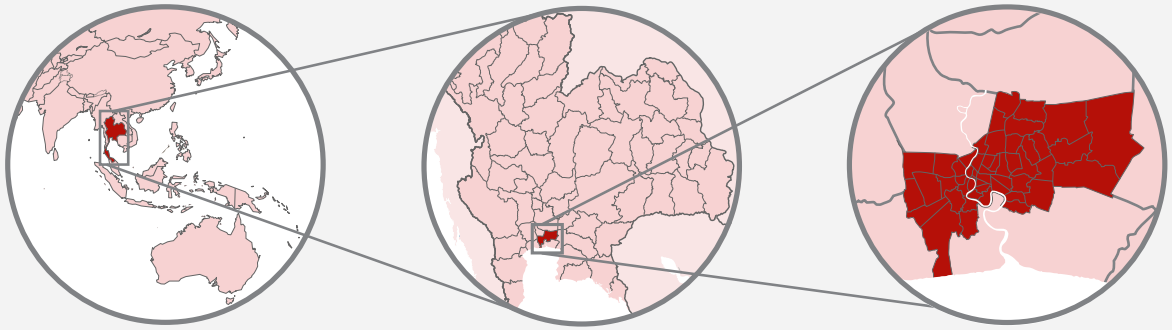


FIGURE 4
Socio-demographic indicators

5.4 million
Thai citizens: 5.3 million
Migrant population: circa 100,000

3,500 per km²
Population density (BMA, 2022)

90 billion baht
($2.7 billion USD)
BMA total annual budget

BMA annual waste management: 7.2 billion baht ($216 million USD), i.e. 8% of total.

(Bangkok Metropolitan Administration, 2024)

1,568 km²
(BMA Information Center, 2024)

676,500
Population in informal housing (BMA, 2019)

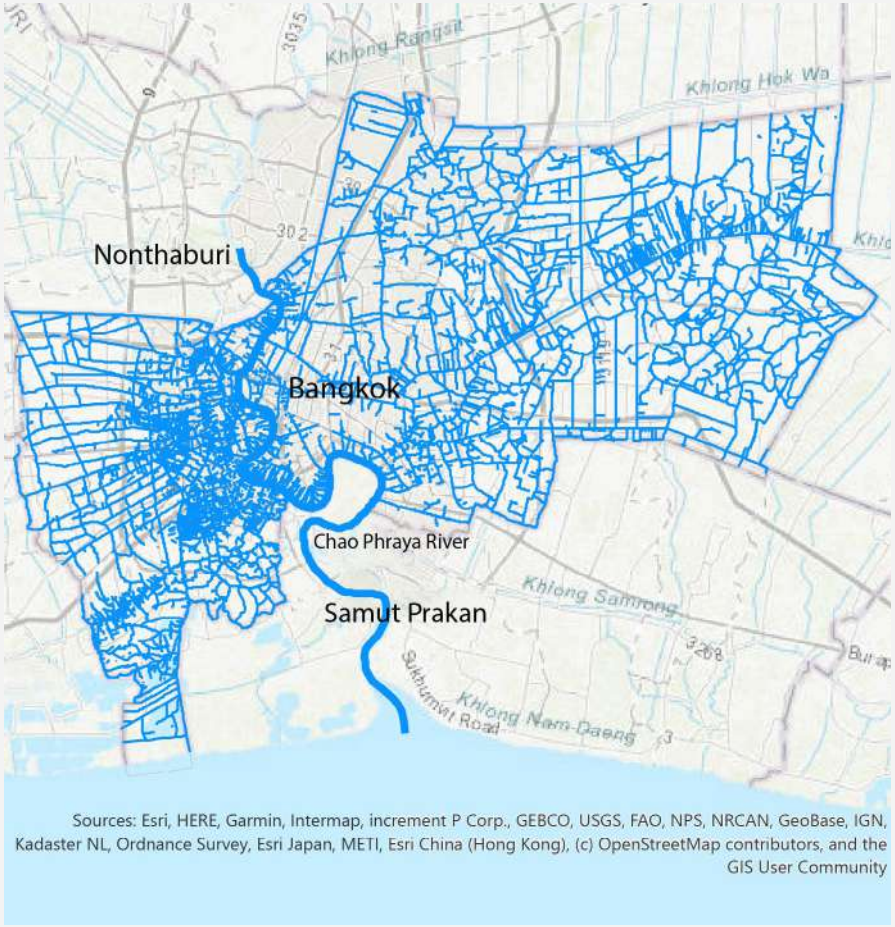
Bangkok has a population of approximately 5.4 million residents across 50 districts, covering an area of 1,568 square kilometers – its population density is about 3,500 people per square kilometer. The city's rapid population growth has increased the built-up area to nearly 16 times its size since 1958, bringing economic, environmental and social challenges. Bangkok is also vulnerable to climate change impacts, including a 1.2-centimeter annual rise in sea levels, compounded by groundwater extraction and construction activities that contribute to land erosion and exacerbate the effects of rising sea levels (Global Covenant of Mayors for Climate and Energy Southeast Asia, 2023). The Bangkok Metropolitan Administration has implemented measures to mitigate flooding and improve drainage. However, these measures address the symptoms, namely flooding, rather than the root cause of subsidence. Continued groundwater extraction remains a significant issue.

Renowned for its lively street scenes, rich cultural heritage, and flavorful cuisine, Bangkok attracted an estimated 22.78 million visitors in 2023. Tourism boosts economic resilience for local communities; however, it also puts pressure on waste management systems, especially in popular tourist areas. The city generates around 16.8 kilotons of mismanaged plastic waste annually in tourist hotspots, some of which leaks into the environment from inadequate disposal facilities and uncollected waste, polluting rivers, scenic spots and roadsides.

Bangkok's Connection with its Waterbodies

Bangkok's relationship with water has shaped its history, culture and urban development. Bangkok has been known as the "Venice of the East" due to its extensive network of canals. Canals serve as primary transportation routes and trade arteries and have influenced the city's urban planning policies and development. Many temples, markets and historical sites are located along its banks, showcasing the cultural heritage of the city.

FIGURE 5
The Chao Phraya River and Extensive Network of Canals in Bangkok



Source: Office of Urban Planning and Development Bangkok
https://cityplangis.bangkok.go.th/BMA_CPUDD/CMPWeb

Chao Phraya river: The Chao Phraya river is the city's lifeline, serving as a crucial source of drinking water and transportation for goods and people. It flows through the city center, linking various districts and providing access to goods and services. As the city has developed, people have settled along both sides of the river and developed an extensive network of canals as their main mode of transport. The river supports numerous economic activities, including fishing, tourism (such as boat tours) and trade. Many waterfront properties often restaurants, hotels and markets that capitalize on the unique heritage, scenic views and accessibility of the river. However, the river is prone to flooding during the monsoon season, presenting a constant challenge for the city. The disruption caused by such severe weather is being intensified by climate change.

Klongs (Canals): Bangkok's klongs are a distinctive feature of the city, adding to its charm and providing a unique way to navigate. Historically, these extensive networks of canals were constructed to serve as transportation routes and irrigation channels. Bangkok was originally built on a network of rivers and marshlands, and during the 19th and early 20th centuries, the city government undertook significant canal construction to improve trade, transportation, and drainage. While some natural waterways exist, many of the canals were created artificially to connect different parts of the city and ease the movement of goods and people. Over time, many of these canals have been filled in or covered as the city has expanded

FIGURE 6
Waste Dumping in Canals

Source: KMUTT

and modernized, but some remain in use today, offering insight into Bangkok's historical water-based infrastructure. However, these canals have suffered from pollution and neglect, leading to a decline in their quality. Many communities along the canals have developed unique lifestyles and practices centered around water, including traditional markets and local fishing.

The canals are crucial for drainage and flood management, especially during the rainy season. However, they also face challenges related to pollution and waste management, as untreated sewage and solid waste often find their way into these waterbodies, impacting water quality and public health.

PROXIMITY TO THE GULF OF THAILAND AND ENVIRONMENTAL IMPLICATIONS

- **Access to marine resources.** Bangkok's location near the Gulf of Thailand provides it with access to marine resources, supporting the fishing industry and seafood markets in the city.
- **Tourism and recreation.** The coastline near Bangkok serves as a recreational area for both locals and tourists, with beaches and water activities that draw visitors to the region.
- **Flooding and climate change.** Bangkok is prone to flooding, exacerbated by climate change and rising sea levels. Improper disposal of waste into the canals eventually finds its way into the drainage system. During the rainy season, heavy rainfall leads to a significant increase in water flow through the city's drainage systems. This rapid flow can push waste, such as bulk items, plastics, food wrappers, and other debris, into the drains blocking the systems which the BMA must regularly remove (Thai PBS, 2022). The interconnectedness of the city's waterways makes effective land waste and flood management essential for urban resilience.
- **Pollution.** Bangkok's rapid development has raised concerns about marine pollution, particularly from plastic waste and other contaminants that can flow into the sea from the city's canals and waterways, affecting marine ecosystems and coastal communities. Industrial waste, wastewater and plastic-waste leakage into the canals and the Chao Phraya river contributes to significant pollution problems, threatening aquatic life and public health. In 2024, the Marine Department of Thailand found higher levels of biological oxygen demand[1] several areas of the Chao Phraya river, indicating pollution from organic matter such as sewage and industrial waste and a decrease in the ability of the river to support aquatic life. Efforts to promote circular economy principles and improve waste management are critical to addressing this issue.
- **Biodiversity.** The rivers and canals support various aquatic species, contributing to the region's biodiversity. Protecting these ecosystems is vital for maintaining ecological balance and ensuring sustainable livelihoods for communities dependent on fishing and tourism.

Bangkok's relationship with its water bodies is multifaceted, encompassing cultural, economic and environmental dimensions. Understanding and addressing the challenges associated with these water bodies are crucial for the city's sustainable development and resilience against climate impacts. Efforts to improve waste management and promote sustainable practices will enhance the health of these vital ecosystems while benefiting the city's communities.

Key Shocks and Stresses Impacting Bangkok's Waste Management Systems

Unprecedented changes and growth over the last decade have led to more people than ever before living in and engaging with Bangkok. To prepare the city and its communities, institutions, businesses and systems to survive, adapt and grow no matter what kind of chronic stresses and acute shocks they experience, the Bangkok resilience strategy was developed under the 100 Resilient Cities Program by The Rockefeller Foundation with the vision of a city that is safe, livable and sustainable for all.

The strategy identified three action areas, each underpinned by several important goals, which are

1 Biological oxygen demand is the amount of oxygen that micro-organisms use to break down organic matter in water. It is a measure of water quality and is often used to indicate the level of organic pollution in a body of water.

supported by a suite of initiatives and projects. These strategic action areas focus on increasing quality of life, reducing risks, increasing adaptability and driving a strong and competitive economy in Bangkok. Based on the assessment undertaken during the strategy process and on the Urban Ocean gap assessment, some of the key shocks and stresses impacting Bangkok's waste management systems are:

RAPID URBANIZATION AND POPULATION GROWTH

The city's rapid population growth means a significant increase in waste generation, putting pressure on existing waste-management infrastructure and resources. This rapid urbanization has also led to a change in the type and quantity of waste produced. The per capita waste generation is around 1 kg per day, which is higher than the global average of 0.74 kg per capita per day.

CHANGING CONSUMPTION PATTERNS

Rapid growth in the city, coupled with improved lifestyles, convenience-oriented consumption and growing demand for technology and consumer goods has significantly contributed to the growing material diversity in waste generation in Bangkok. The city has witnessed increased consumption of products with diverse materials, such as plastic packaging, single-use materials, electronics with non-recyclable components, and more complex products requiring energy-intensive production.

INFORMAL SETTLEMENTS

Informal settlement communities often lack proper sanitation facilities and waste management infrastructure. Inadequate waste management in these areas contributes to pollution of waterways and the environment, and risks to public health.

TOURISM AND ECONOMIC GROWTH

While tourism brings economic benefits, it also contributes to increased waste generation and litter, particularly from food waste and packaging. The city needs to find ways to manage waste effectively while promoting sustainable tourism practices.

INADEQUATE INFRASTRUCTURE AND LIMITED RESOURCES

While Bangkok has made progress in waste management, its infrastructure struggles to keep up with the population increase and growing volume and complexity of waste. Landfill space is insufficient, leading to challenges with disposal. More than half of the total waste generated in the city is organic waste, exacerbating pressure on landfills, significantly reducing their capacity, and contributing to the production of methane. This is a critical environmental challenge that requires integrated waste-management solutions, such as composting, waste diversion, recovery through composting, and public education. The city also faces a shortage of resources for upgrading and expanding waste-management systems.

POORLY PLANNED GROWTH; CLIMATE CHANGE

Climate change, with its unpredictable weather patterns, has led to increased risks of extreme rainfall and flooding. Bangkok has always received floodwater during the annual five-month monsoon. In the past, fields, canals, irrigation channels and both natural and man-made flood retention areas (known in Thai as Gamling, or "monkey cheeks", because they hold water) acted to reduce flood impacts. The floodwater was even utilized for farming rice, which is tolerant to high-water events. With the trend of urbanization, waterbodies have slowly been replaced by settlements and roads, and Bangkok experienced floods as one of the first recognized urban hazards. Now, complex urban systems, including electricity, transport, communications, drinking water supply, livelihoods and many other elements are more likely to be disturbed as they are concentrated in locations exposed to floods. Additionally, urbanization in Bangkok has also contributed significantly to heat stress, with dense construction of buildings, roads and other infrastructure absorbing and retaining heat, causing an urban heat island effect. This stress impacts health and productivity, especially of vulnerable groups in the context of waste management, particularly outdoor workers who are exposed to high temperatures and challenging conditions.

These shocks and stresses highlight the complex and interconnected nature of waste management for urban resilience in a rapidly growing city like Bangkok. Risks posed by shocks and stresses can be reduced by communities working together to prepare and protect each other from vulnerabilities and to recover quickly. Addressing these challenges requires a multifaceted approach, focusing on infrastructure development, technology, education, public awareness and active and sustained community involvement.

FIGURE 7
Citizens collecting Waste in the Chao Phraya River on World Environment Day 2024

Source: Sira Leepipattanawit

FIGURE 8
Plastic Waste Leakage in Canals from a Community in Talat Phlu Area

Source: Sira Leepipattanawit

Building Resilience through Waste Management

Bangkok is tackling its waste management challenges head-on, employing a variety of strategies to build resilience:

REDUCE, REUSE, RECYCLE APPROACH

- **Public Awareness Campaigns.** The city is implementing public awareness campaigns to educate residents about waste separation, reduction and recycling. This fosters a sense of responsibility for waste management, with an aim of long-term behavioural change.
- **Incentive Programs.** The BMA is introducing programs to reward individuals and communities for their efforts in waste separation, reduction and recycling. For households that separate their waste into organic waste and recyclables, the annual waste management fee is reduced by a factor of four from 960 Thai baht ($28 USD) to 240 Thai baht ($7 USD). This encourages active participation and incentivizes sustainable practices.
- **Waste Fees.** The city is considering implementing "pay-as-you-throw" systems, where households are charged based on the amount of waste they produce. This can encourage residents to reduce their waste.

COMMUNITY ENGAGEMENT

- **Community-based Waste Management.** Bangkok is empowering communities to play a more active role in waste management through community-based programs. This includes promoting waste separation, establishing local waste collection points and encouraging composting and other sustainable practices.
- Behavioural Change through Schools. The Department of Environment Quality Promotion in the Ministry of Natural Resources and Environment (now the Department of Climate Change and Environment) organized a Zero Waste School competition under the Zero Waste Schools Project in Bangkok. The qualifying criteria were as follows:
  - Educating, understanding and participating in waste management activities.
  - Waste management within the school using the 3-R principle (Reduce, Reuse, Recycle).
  - The success and sustainability of waste-free schools.
  - Management of solid waste and the environment according to the Sufficiency Economy Philosophy.

POLICY AND REGULATION

- **Revised Regulations.** The city is reviewing its waste management regulations to ensure they are effective and aligned with best practices.
- **Land Use Planning.** Bangkok is integrating waste management considerations into its land use planning strategies to ensure that new developments are designed with sustainable waste management in mind.

INVESTING IN INFRASTRUCTURE

- **Upgrading Existing Systems.** The city is investing in upgrading its existing drainage and sewerage systems, aiming to improve their efficiency and capacity to handle the increased volume of wastewater.
- **Expanding Recycling Infrastructure.** Bangkok is expanding its recycling infrastructure to promote more efficient waste separation and recycling, further reducing the reliance on landfills.
- **Waste-to-Energy Plants.** Currently, Bangkok operates a waste-to-energy (WTE) plant in Nong Khaem with the capacity to process 500 tons of waste per day. This facility generates electricity used to support the operation of the Nong Khaem plant itself. The Bangkok Metropolitan Administration has plans to invest in two additional WTE plants at On Nut and Sai Mai, each designed to process 1,000 tons of waste daily. These new facilities are expected to be operational by 2027-28. Once the two new plants have been built, Bangkok will have a total WTE capacity of 2,500 tons per day. However, waste-to-energy plants have negative consequences because of associated

GHG emissions and because they have no reuse nor recovery of plastics, or any other materials, for recycling. Urban Ocean partners recognize the need for implementable and circular solutions that hold plastics producers accountable for the full lifecycle of their products, cease the leakage of plastics into the environment and incentivize reuse.

TECHNOLOGICAL INNOVATIONS

- **Smart Waste-Management Systems.** Bangkok is exploring the use of smart waste-management systems to optimize waste collection routes, monitor waste levels and track recycling efforts. This allows for more efficient and data-driven decision making.

COLLABORATION AND NETWORKING

- **Association of Southeast Asian Nations City Network.** Bangkok is participating in this network to share best practices and learn from other cities in the region facing similar waste-management challenges.
- **Partnerships with International Organizations.** The BMA is engaging with international organizations through partnerships and programs like Urban Ocean to access expertise and support for developing innovative solutions. In 2023, the BMA and the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) signed a memorandum of understanding for the Collaborative Action for Single-Use Plastic Prevention in Southeast Asia project, collaborating to sustainably curtail single-use plastic consumption (Thai-German Cooperation, 2023). Moreover, initiatives like the TerraCycle Global Foundation and the Ocean Cleanup work to prevent, collect, and recycle river waste (Royal Thai Consulate-General, Jeddah, 2023). The Environmental Justice Foundation also launched the Bottle Free Seas initiative, installing ten water refill stations throughout Bangkok, which has led to an average of 100,000 fewer plastic bottles being used and discarded per month (Environmental Justice Foundation, 2024).
- **Collaboration with Local Expertise.** Several local experts and partners are actively involved in waste management in Bangkok. These partners come from various sectors, including the private sector, non-governmental organizations, educational institutions and the mass media, depending on the specific projects. Notable educational institutions such as Chulalongkorn University and King Mongkut's University of Technology Thonburi are also engaged and leading in environmental research in Bangkok.
- **Some initiatives focus on separating and managing recyclable waste**, like WasteBuy Delivery, Recycle Day, Trash Lucky, Re-Boon, and Recycoex. Others concentrate on managing organic waste, such as Suan Tong Kao and PakDone. Certain organizations, like YOLO, serve as intermediaries with the private sector to manage low-value plastic waste. Additionally, agencies such as Less Plastic, Chula Zero Waste (under Chulalongkorn University), and Kong Green act as sources of knowledge, encouraging correct waste separation practices. The Thai Health Promotion Foundation supports waste-management efforts by funding data analysis projects, including the development of dashboards with statistical data, to determine effective waste-management strategies (BMA Environment Department, 2022a).

By focusing on a multipronged approach that combines infrastructure investment, sustainable practices, community engagement, policy reforms, technological innovations and collaborations, Bangkok is demonstrating a strong commitment to building resilience through waste management and paving the way for a cleaner, greener and more sustainable city for its residents.

4. Legal, Policy and Governance

Governance Structure

TABLE 2
Roles and Responsibilities of Departments related to Waste Management

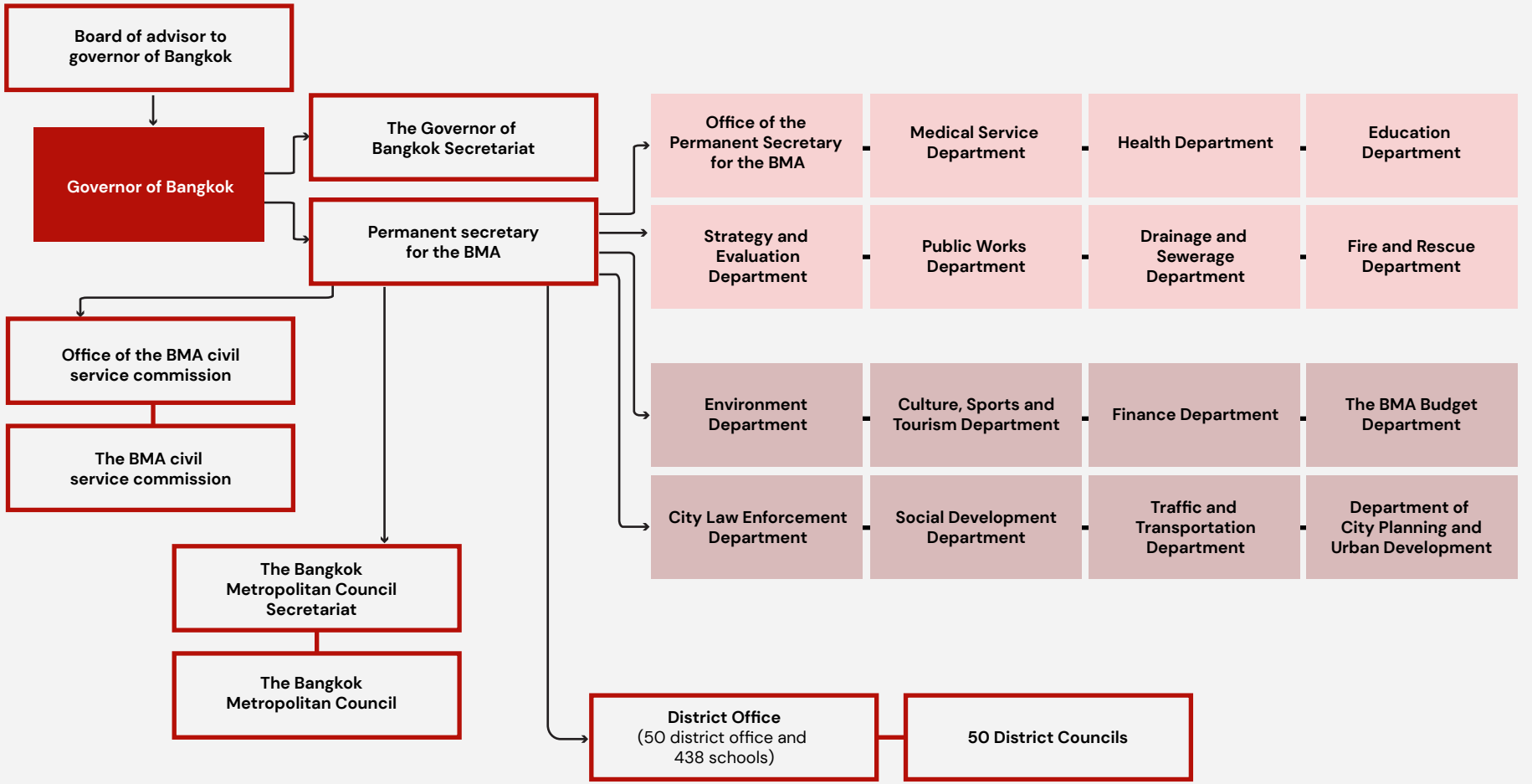
NATIONAL LEVEL – THE MINISTRY OF NATURAL RESOURCES AND ENVIRONMENT

DEPARTMENT	ROLES AND RESPONSIBILITIES:
Pollution Control Department	• Provide technical inputs on policies and plans to promote and maintain national environmental quality in terms of pollution control. • Make recommendations for setting environmental quality standards and pollution control standards. • Develop an environmental quality management plan for pollution management and measures to control, prevent and solve issues caused by pollution. • Evaluate environmental quality monitoring results and prepare a pollution situation report. • Coordinate to carry out restoration and prevention of potential hazards from pollution in contaminated areas. • Redress pollution complaints. • Act in accordance with the law on promotion and maintenance of national environmental quality in terms of pollution control.
Department of Climate Change and Environment	• Propose policies and plans on climate change management, including the implementation of international obligations. • Develop and provide knowledge and information services on climate change and the environment. • Communicate about, create awareness of and increase the potential of the public to be ready to adapt to climate and environmental changes. • Create a network of cooperation and promote the participation of all sectors in action on climate change and the environment. • Study, research and develop technologies and innovations on climate change and the environment.

CITY LEVEL - BANGKOK METROPOLITAN ADMINISTRATION

DEPARTMENT	ROLES AND RESPONSIBILITIES:
Solid Waste and Sewage Management Office	• Study and develop the waste management system of Bangkok • Create an action plan • Develop cooperation among all sectors to reduce and separate waste • Develop a waste collection and transportation system • Provide trash cans and waste collection trucks to support waste collection for 50 district offices.
Policy and Planning Division	• Create policies and plans for waste management in the Bangkok development plan, the annual operational plan of Bangkok, and the annual operational plan of the Environmental Office • Set targets and indicators to drive waste management work in Bangkok as a whole • Monitor the results of operations, and evaluating them annually.
Solid Waste Disposal Division	• Supervise and control waste disposal to ensure efficiency, value for money, and hygiene according to academic principles and laws, regulations, and other related rules, including considering engineering operations related to cleanliness and the environment.

FIGURE 9
Administrative Structure of Bangkok



Source: Bangkok Resilience Strategy, 2016. Updated based on information received by BMA, 2024

National and Local Regulations and Guidelines

In Thailand, waste management regulations and guidelines are established at both the national and local levels. These regulations are designed to promote sustainable waste-management practices, protect public health and ensure environmental conservation. Table 3 and Table 4 give an overview of the key national and local regulations and guidelines relevant to waste management in Thailand and Bangkok.

TABLE 3
National Regulations and Guidelines

	Act, regulation or guideline	Overview	Key provisions
1	**Waste Management Act (1992)**	This is the primary legislation governing waste management in Thailand. It provides a framework for the management of municipal solid waste, hazardous waste, and other types of waste.	• Establishes responsibilities for waste generators, local authorities and waste-management operators. • Requires waste segregation, collection, transportation, treatment and disposal. • Promotes recycling and the reduction of waste generation.
2	**National Environmental Quality Act (1992, revised in 2019)**	This act aims to maintain and improve environmental quality and includes provisions related to waste management.	• Mandates the preparation of environmental-impact assessments for waste management projects. • Sets standards for waste treatment and disposal.
3	**Hazardous Substances Act (1992)**	This act regulates the management of hazardous waste and substances to protect public health and the environment.	• Establishes guidelines for the classification, handling, treatment and disposal of hazardous waste. • Requires licensing for facilities that manage hazardous waste.
4	**National Policy on Solid Waste Management (2016)**	This policy outlines the national strategy for solid waste management in Thailand.	• Promotes waste reduction, recycling and the circular economy. • Encourages public participation and collaboration among stakeholders in waste management efforts.
5	**Regulations on Plastic Waste Management (2019)**	These regulations aim to reduce plastic waste and promote sustainable alternatives.	• Implements a ban on specific single-use plastics and establish targets for plastic waste reduction. • Encourages recycling and the use of environmentally friendly packaging materials.

TABLE 4
Local Regulations and Guidelines (Bangkok Metropolitan Administration)

	Act, regulation or guideline	Overview	Key provisions
1	**Waste Management Ordinance (2000)**	This ordinance establishes the framework for waste management within Bangkok, outlining the roles and responsibilities of the local authorities.	• Mandates waste collection, transportation and disposal services. • Encourages recycling initiatives and public education on waste management. • Establishes penalties for illegal dumping and littering.
2	**Bangkok Solid Waste Management Plan (2021-2025)**	This plan outlines strategies and actions for improving solid-waste management in Bangkok over a five-year period.	• Focuses on reducing waste generation, improving waste segregation and recycling rates, and enhancing waste treatment facilities. • Promotes public participation in waste management initiatives.
3	**Bangkok Plastic Waste Reduction Strategy (2020)**	The strategy aims to reduce plastic waste in Bangkok.	• Encourages businesses to reduce plastic use and adopt sustainable practices. • Promotes public awareness campaigns on plastic pollution and waste reduction.
4	**Local Environmental Quality Standards**	The BMA establishes specific local environmental quality standards related to waste treatment and disposal.	• Sets guidelines for emissions from waste management facilities. • Regulates the operation of waste treatment plants and landfill sites to minimize environmental impacts.
5	**Community Engagement Guidelines**	The BMA promotes community involvement in waste management through various initiatives.	• Encourages local communities to participate in waste reduction and recycling programs. • Supports community-led waste management initiatives and education campaigns.

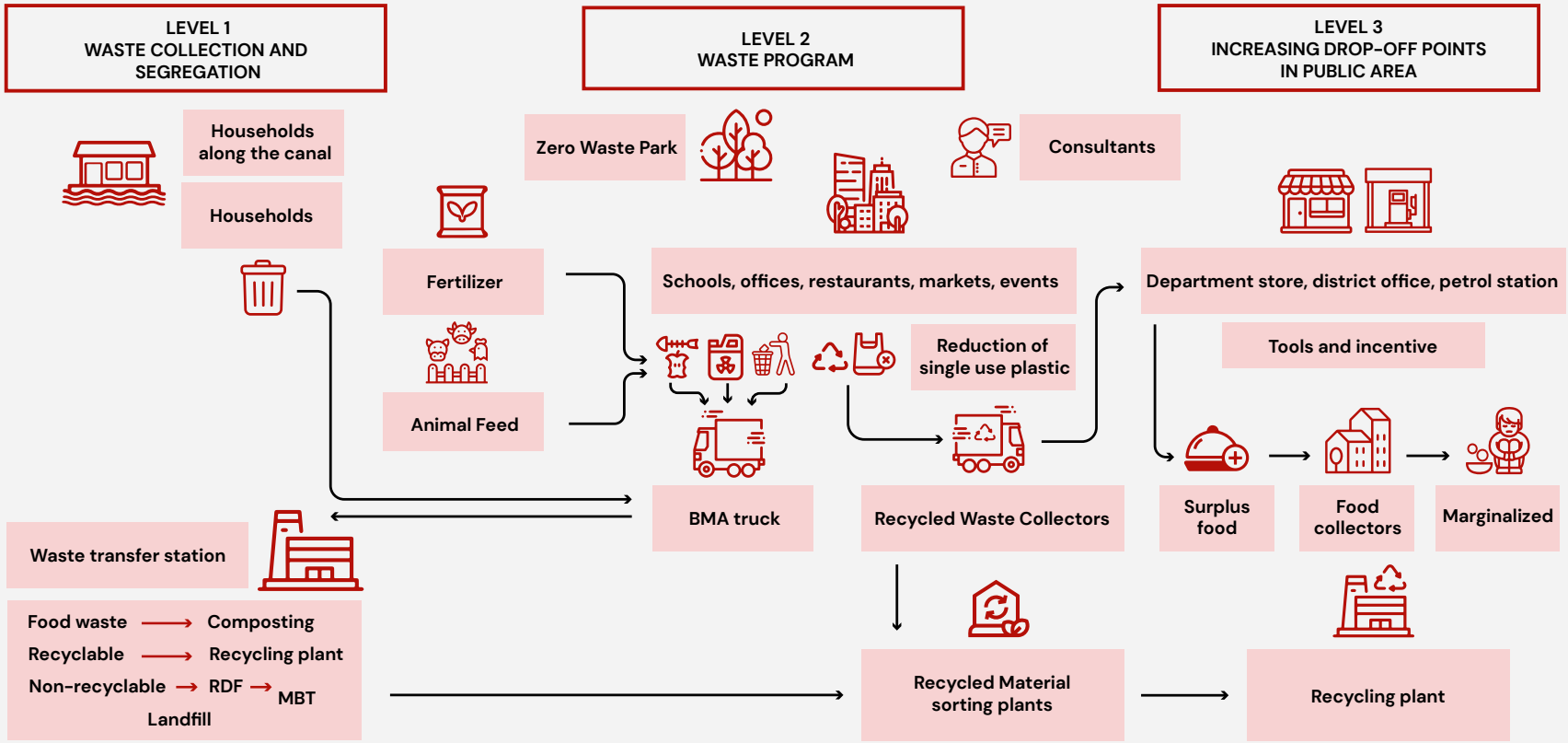
The regulatory framework for waste management in Thailand and Bangkok is designed to promote sustainable practices, protect public health and ensure environmental quality. Bangkok has been seeking cooperation from the private sector to support the reduction of plastic waste by establishing a system for returning plastic waste to the manufacturers of these products, although the current volume of waste being returned is relatively small. However, the proposed increase in waste collection fees may impact the production and management of waste after it has been used. By establishing clear roles and responsibilities, encouraging recycling and reducing waste generation, these regulations aim to enhance the resilience of the waste-management system in Bangkok and address the growing challenges of waste management in dense and growing urban environments.

Key City Strategies and Plans for Waste Management

The BMA has focused in recent years on creating a sustainable, circular waste-management system that prioritizes waste reduction, recycling and resource recovery. The city aims to integrate circular economy principles to reduce the waste being sent to landfills, improve public health and mitigate environmental impacts. Key goals include enhancing public awareness, expanding recycling programs, implementing waste-to-energy processes and using composting to transform organic waste into valuable resources and reduce the volume of waste being sent to landfills and WTE plants.

The pilot Zero Waste district is one of the key strategies for waste management in Bangkok.

FIGURE 10
Pilot Zero-Waste District by BMA



Source: Bangkok Metropolitan Administration, 2024

Bangkok focuses on separating waste at source as below:

1. Organize a waste collection system to separate waste types by starting the Zero Food Waste project in three pilot districts: Phaya Thai, Pathum Wan, and Nong Khaem. This will expand to cover all 50 districts of Bangkok, communicating through public media in the district and on social media, including advertisements on free-to-view television.
2. Encourage waste-generating sources such as households, schools, industrial sites and hospitals to join the Bangkok Zero Waste program, which started in 2021 with 22 sources among educational institutions, businesses, communities, hotels, markets, department stores, religious sites, hospitals and so on. Program participants are supported to separate four types of waste: food waste, recyclable waste, general waste and hazardous waste. In 2022, the program was expanded to 84 sources in four districts. In addition, there is a contest for complete waste-management models for various types of solid waste sources, such as those from restaurants, fresh markets, hotels, office buildings, banks, government flats, schools, minimarts and so on.
3. Increase waste collection points for recyclable materials and surplus food in public areas, with the following projects:

   The Bangkok Magic Hands Project: initiated by the Environment Department in collaboration with various partners including Less Plastic Thailand, the Thailand Environment Institute, the Public–Private Partnership for Sustainable Plastics and Waste Management group, the WON project, the Institute for Packaging and Recycling Management for the Envir1onment, YOUturn by PTTGC, Z-Safe Group, YOLO, Trash Lucky, and the Kidkid company, this project collects recycled plastic materials for repurposing. In its first phase, the project focused on creating reflective work suits from plastic fibres for street sweepers in Bangkok. This initiative helps improve the quality of life for street sweepers, as well as those in the cleaning and park maintenance departments and district offices, by reducing accident risks and enhancing safety for on-duty workers.

   The project was piloted in 50 districts, producing 1,200 suits, and involved a satisfaction survey among street sweepers and the public. A majority reported increased safety from the suits (66.8 percent satisfaction). However, there were suggestions for improvement; the suits' waterproof coating made them uncomfortably hot, and their bright colours attracted dirt more than the previous solid-coloured uniforms. As a result, the project will test the production of reflective vests to be worn over the old solid-coloured work suits. Currently, design and sewing are in progress for a test batch of 3,600 vests, which will be distributed to district offices for further evaluation once completed.

   The Bangkok Food Bank project is a solution to the problem of surplus food (which eventually becomes food waste) by organizing a system to collect good, clean, safe food unsold from stores to be provided to vulnerable recipients. This is a collaboration between Bangkok and its network partners to create a mechanism to sustainably help those in need.

FIGURE 11
The Bangkok Magic Hands Project

Source: BMA, 2024

Various organizations in Bangkok, such as **WasteBuy Delivery**, **Wake Up Waste**, and **Recycoex**, facilitate the collection of recycled materials. These organizations offer convenient services, allowing residents to schedule pick-ups of separated waste via mobile applications or phone calls from their homes. Additionally, public areas have been equipped with waste separation points.

To further improve waste management, public waste disposal points have been upgraded to use wire cages. A **pilot program** has been launched by the BMA **across 21 districts**, with 162 locations featuring a total of 229 wire cages. This initiative has proven successful, with residents reporting that the wire cages are durable, lightweight and suitable for placement on the street. Moreover, they provide a clean, transparent view of the waste inside, enhancing safety and encouraging proper waste disposal.

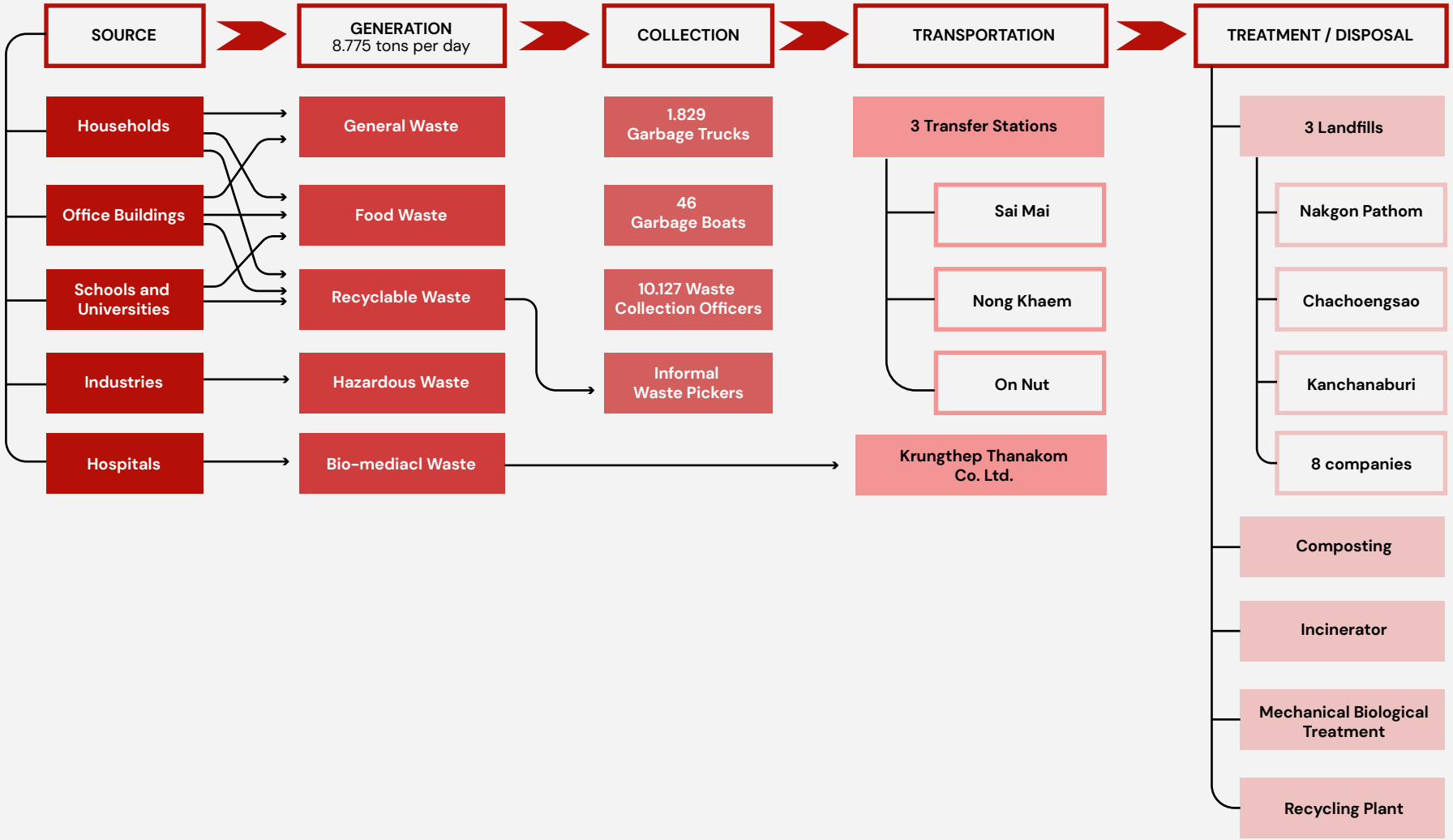
5. Waste Management in Bangkok

Overview of Bangkok's Waste-Management System

Thailand is among the top five countries contributing the most plastic-waste pollution into the world's oceans (UNESCAP, 2019). Solid-waste management in Thailand is formally governed by policies, regulations and standards set by the central government and implemented by local authorities, such as the BMA. Bangkok's municipal waste-management system is complex and ever-evolving as it seeks to address the growing challenges of waste and sustainability in a large urban environment. According to estimates by the BMA published in 2024, the city generates more than 8,500 tons of waste per day (BMA Environment Department, 2024). The per capita waste generation is around 1 kg per day, which is higher than the global average of 0.74 kg per capita per day (World Bank Group, 2018). Population growth, economic development and shifts towards single-use and shorter-lifespan products are among the major causes of the increasing waste generation in Bangkok. The BMA's Environment Department has primary responsibility for the city's waste management and works closely with its 50 district offices. Figure 11 shows an overview of Bangkok's municipal waste-management system from source to disposal:

FIGURE 12

Waste Management System in Bangkok

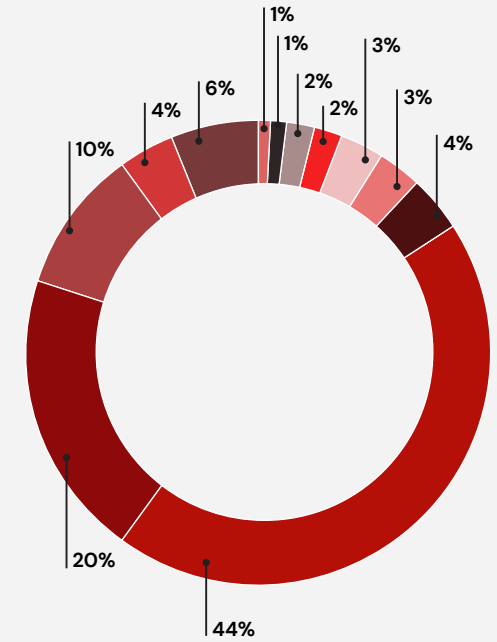


Waste Composition

Bangkok generates a significant amount of waste, with food waste consistently making up a large proportion (42-52 percent) of the total. Recycled waste represents only 10-12 percent, whereas more than 30 percent of waste is still not recycled, indicating significant opportunities for increased recycling in the city.

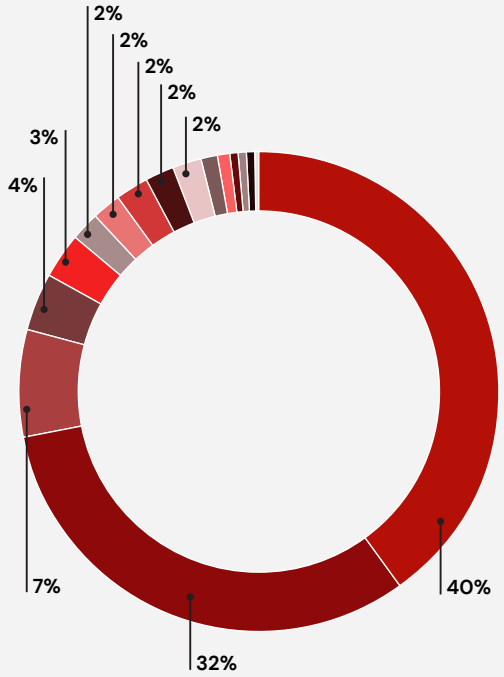
According to the Circularity Assessment Protocol findings for Bangkok by the University of Georgia under the Urban Ocean program, the litter documented was primarily of two categories: 40 percent food-related plastic packaging and 32 percent tobacco products. Both types of waste have only limited recycling potential, if any. Some stakeholders interviewed and consulted for the protocol indicated a potential lack of community concern for food-related plastic packaging, which may explain the high proportion of this waste type found in Bangkok litter.

FIGURE 13
Waste Composition in Bangkok



Source: UNESCAP, 2019

FIGURE 14
Material Breakdown for Litter Items in Bangkok



Source: Bangkok Circularity Assessment Protocol, 2024

Figure 14 shows the most common litter items. Plastic cigar/cigarillo tips were found to be the most common – this is similar to the Urban Ocean Cohort 1 cities,[2] where three out of the five cities had cigarettes as the top litter item. Straws were the second most common litter item and plastic grocery bags were the fifth most common. Both these items have been banned in Thailand since 2022 as part of the second phase of reducing single-use plastic products outlined in Thailand's Roadmap on Plastic Waste Management 2018-2030. Plastic food wrappers were the third most frequently found litter item and have limited recycling capabilities. Despite polyethylene terephthalate (better known as PET) plastic bottles being high-value recyclables in the informal sector, they are still the fourth most common litter item, indicating potential to increase recycling efforts and coordination with the informal sector. Incorporating the informal sector into Bangkok's waste management would allow these items to be collected at higher volumes.

SOURCE SEPARATION OF WASTE

To minimize waste generation and waste being sent to landfills, the BMA is promoting waste separation and reduce–reuse–recycle campaigns for households, communities, schools and institutions and has also initiated activities for community-based waste management.

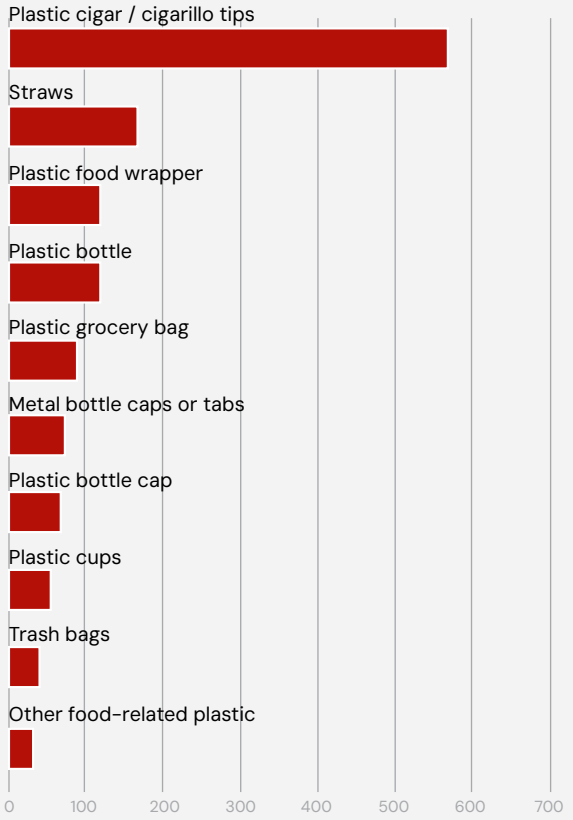
A plan for sorting waste at the household level has been launched, which foresees waste being separated into four types, as follows.

FOOD WASTE

In 2018, the generation of food waste in Bangkok was around 3.9 million tons. The COVID-19 pandemic temporarily reduced dry waste generation, but the increase in online food delivery led to a rise in non-recyclable plastic and paper waste. Food waste stems from various sources including food distribution (hypermarkets, supermarkets, markets), food services (restaurants, hotels), and households (Thailand Environment Institute, 2021). The food distribution system in Bangkok is complex, with a mix of modern trade (supermarkets, convenience stores) and traditional fresh markets. Transportation, storage, and product quality issues contribute to food waste. The non-refrigerated nature of many markets leads to increased spoilage. Households generate a considerable amount of food waste as well.

Bangkok's food waste management system includes composting, animal feed, incineration, and landfilling. However, the system struggles to efficiently handle the volume of food waste, and a lack of systematic segregation at the source hampers effective management. There's limited public awareness and participation in waste segregation.

FIGURE 15
Most Common Litter Items (by count) in Bangkok



2 Pune (India), Can Tho (Vietnam), Panama City (Panama), Semarang (Indonesia) and Melaka (Malaysia).

In 2023, the BMA launched the No Mixing campaign to promote food waste separation. Currently, the city's waste-management program operates across 184 markets, with support from 50 district offices, successfully diverting up to 75 tons of food scraps per day. The waste is managed through various methods: direct delivery to farmers (36.6 tons/day, 49 percent), processing by district offices for fertilizer (22.3 tons/day, 30 percent), on-site fertilizer production (5.6 tons/day, 7 percent), animal feed programs (5.1 tons/day, 7 percent), and other methods (4.9 tons/day, 7 percent).

The BMA regulation is that food waste should be collected in green, clear or opaque white plastic bags to allow for visibility of the contents. Black or opaque bags are to be labelled as "food waste".

RECYCLABLE WASTE

Recyclable waste is largely handled by the private and informal sectors and groups of people who perceive it to be valuable and collect, wash, separate and sell the waste. Some groups also often separate recyclable waste to donate to the homeless or the unemployed so that they can earn a living.

Since 2022, Unilever and Zero Waste YOLO have worked together on the Magic Hands project to produce steel gratings as return points for low-value recyclable plastics, including items like foam boxes, plastic utensils and coffee capsules. A total of 52 steel gratings were created for installation at 50 district offices and two at the Bangkok City Hall (Unilever, 2022).

GENERAL WASTE

General waste is mixed waste including non-recyclable plastic contaminated with food/other products, foam, packaging, rubber, textiles, paper or surplus vegetable waste. Residents place them in designated areas, such as in front of their houses or at community trash disposal points. For houses and shops along the road, there is a time limit for waste to be placed outside after 10 p.m. so as not to obstruct traffic.

HAZARDOUS WASTE

Hazardous waste comprises batteries, light bulbs, spray cans and chemical bottles. These are to be separated in orange bags.

The Environment Department of the BMA promotes separation as follows:

1. **At source:** Focusing on campaigns promoting waste separation at the source, i.e. at the household level.
2. **Through separate collection vehicles:** Focusing on the waste-collection system which is tailored to fit the specific needs of different areas, with district offices taking the lead. This includes the introduction of specialized waste collection vehicles to encourage residents to separate their waste properly and to ensure it is disposed of in accordance with vehicle types and scheduled collection dates.
3. **Through dedicated collection points:** The 'Dispose at a Dedicated Space, Collect on Time' initiative establishes designated disposal locations along main and secondary roads, as well as within communities and along canals. Clear signs are installed to indicate disposal times and collection schedules, along with efforts to educate the public on appropriate waste disposal practices. Additionally, large items such as furniture and mattresses are collected from residences on a scheduled basis, with cleaning departments across all 50 districts coordinating specific collection times to enhance organization and minimize improper waste disposal (BMA Environment Department, 2022).

Waste Collection and Transportation

Waste collection and transportation in Bangkok is via door-to-door services through the Bangkok Metropolitan Administration. Waste collection begins daily between 6 p.m. and 3 a.m., concluding around 5:30 a.m. Collection schedules vary depending on waste type and location. Household waste is collected daily or 2-3 times per week; organic waste from markets is collected daily; bulky waste and recyclables are collected on Sundays or by appointment; household hazardous and infectious waste are collected on Sundays or by appointment; and yard, demolition and construction waste are collected by appointment. Collection in communities, on minor roads, and in alleys is adjusted as needed.

In addition, waste disposal points on footpaths on main and secondary roads public areas have been improved to be wire cages, with a pilot trial in 21 districts with 162 collection points totalling 229 wire cages. People felt that wire cages were a durable form of trash cans and were easy to fold, lightweight and suitable for placing on the road; that they looked clean; that people could see the waste inside; and that they were safe for the person discarding waste in them. However, concerns remain over people dumping waste without putting it in a wire cage. The system is now changed to a one-hour disposal time limit by communicating with the owners or occupants of buildings along the sidewalks in commercial areas such as Sukhumvit Road to put waste in bags, tie the bags tightly, and place them on the sidewalk at the garbage disposal point without a mesh cage. The district office must collect it within one hour. After that, garbage bags are prohibited from being placed at the garbage disposal point on the sidewalk. If such bags are found, a fine of 2,000 baht ($60 USD) is issued. This operation has led to cleaner streets, with no garbage piling up on the sidewalk. In 2025, this strategy will be expanded to 50 districts on one road per district.

For household waste collection, a fee of 20 baht ($0.5 USD) per month is levied. The BMA plans to increase this collection fee to 60 baht ($1.75 USD) per month for households who do not separate their waste. Households that already separate their waste will continue to pay 20 baht per month as an incentive to continue the practice of waste separation at source.

Bangkok's waste-management infrastructure consists of 1,829 garbage trucks, 46 garbage boats and various types, sizes and colours of waste bins distributed throughout the 50 districts, managed by 10,127 waste collection officers. Garbage trucks include compression trucks, hydraulic trucks and road sweeper trucks, each suited for different situations and areas. The boats include patrol boats and weed and garbage collection boats, designed for the varying accessibility of canals and rivers. Some vehicles are rented from private companies.

In about 30 districts of Bangkok, some households are situated along canals, necessitating the use of boats for waste collection, as garbage trucks cannot access these areas. These are generally along canals that are sufficiently wide for safe passage of the boats. These boats then drop off the waste at designated collection points where the waste is picked up by trucks and then sent to disposal stations. The BMA also deploys large boats daily from 8 a.m. to 4 p.m. to collect floating garbage in the Chao Phraya river. The BMA collects approximately 2-3 tons of waste from the river each day.

FIGURE 16
Waste Collection Bins

Source: KMUTT

FIGURE 17
Waste Collection Trucks

Source: KMUTT

FIGURE 18
Waste Collection Boats

Source: R-Cities

For waste collection in alleys that are narrow and are not accessible by the collection vehicles, the workers manually carry the waste from these areas on small handcarts, or community leaders hire local help to collect the waste and drop it off at collection points along the roads which can then be collected by the BMA staff.

Additionally, in 2024 the Ocean Cleanup from the Netherlands, in collaboration with the BMA, has deployed an Interceptor boat to clean the Chao Phraya river. The aim is to bring increased awareness and visibility to the issue of plastic pollution for Bangkok's residents and inspire the community to find solutions to the problem through research and technology in collaboration with public and academic partners.

For low-income households:

- → Households living in the same building as rental rooms will pay a monthly waste management fee to the building owner to pay the fee to the BMA.
- → Communities with houses next to each other in the city will pay a fee of 20 baht per house per month. Households or tenants who do not want to pay the waste management fee will take one plastic bag of their waste out to throw away every day, such as throwing it in a public waste bin or someone else's waste bin to avoid the burden of this expense.

FIGURE 19
Interceptor 019 by the Ocean Cleanup in Chao Phraya River

Source: The Ocean Cleanup, 2024

Infractions such as littering, improper garbage disposal and unpaid fees are common. For individuals and households, the BMA struggles to enforce legal penalties because many violations stem from circumstances beyond their control. For example, households might improperly dispose of waste, or residents may be unavailable for fee collection. This makes systematic record-keeping and enforcement difficult; current solutions are limited to warnings and informal neighborhood-level interventions. Further complicating fee collection is the BMA's outdated and complex city planning system. Garbage often accumulates at vacant properties, making it impossible to assign fee responsibility.

Treatment and Disposal

After it is collected, municipal solid waste is transported to three large transfer centers in Bangkok: Sai Mai, On Nut and Nong Khaem as described below.

TABLE 5
Transfer Centres in Bangkok

Transfer centre	Sai Mai	On Nut	Nong Khaem
Sources	18 districts 4 organizations (government agencies, universities, military)	25 districts 35 organizations	25 districts
Waste transfer contractor	Wasaduphan Thurakit Ltd (private)	Phairot Sompong Phanit Co. Ltd (private)	Klum 79 Ltd (private)
Solid waste transferred (tonnes/day)	2,000-2,300	2,600	3,600
Landfill site location	Kamphaeng Saen District, Nakhon Pathom Province	Phanom Sarakham District, Chachoengsao Province (sanitary landfill)	Kamphaeng Saen District, Nakhon Pathom Province
Other waste disposal measures		Euro West Engineering Ltd. Contracted by BMA to renovate On Nut transfer station and establish a waste composting processor to compost 1,200 tonnes/day	BMA contracted a private company to buid and operate an incinerator at Nong Khaem, incinerationg 300 tonnes/day and generating 5 MW of electricity

Principal districts covered	Bangkhen, Bangsue, Bungkhum, Donmuang, Dusit, Jatujak, Khannayao, Khlongsamwa, Ladphrao, Laksi, Phyathai, Rajathewi, Saimai and Wangthonglang	Nong Chok, Min Buri, Lat Krabang, Prawet, Saphan Sung, Bang Kapi, Suan Luang, Phra Khanong, Bang Na, Khlong Toei, Watthana, Huai Khuang, Din Daeng, Pom Prap Sattru Phai and Samphanthawong	Thawi Wattana, Bang Khae, Nong Khaem, Bang Bon, Bang Khuntien, Thung Kru, Chom Thong, Phasi Charoen, Taling Chan, Bang Phlat, Bangkok Noi, Bangkok Yai, Thon Buri, Bang Kho Laem, Yan Nawa, Sathon, Bang Rak, Khlong San, Pra Nakhon, Rat Burana, Pathum Wan, Ratchathewi and Dusit

Source: UNESCAP, 2019

NONG KHAEM WASTE TRANSFER STATION:

PROCESSES

- Landfill: About 2,690 tons per day are disposed of through landfilling in Nakhon Pathom province.
- Waste-to-energy: Roughly 460 tons are processed via WTE technology to produce electricity.
- Mechanical biological treatment (MBT): A smaller portion, around 15 tons, undergoes MBT for material recovery.

CHALLENGES

- The high dependency on landfilling at Nong Khaem highlights the need for improved waste segregation at the source to maximize recyclable recovery and reduce landfill usage.

ON NUT WASTE TRANSFER STATION:

PROCESSES

- Composting: A significant portion, about 1,690 tons per day, is directed towards composting, focusing on organic waste.
- MBT: Approximately 60 tons per day undergo MBT, which supports material recovery and reduces waste destined for landfills.
- Landfill: Around 500 tons per day are directed to landfill in Chachoengsao province.

CHALLENGES

- The high dependency on landfilling at Nong Khaem highlights the need for improved waste segregation at the source to maximize recyclable recovery and reduce landfill usage.

SAI MAI WASTE TRANSFER STATION:

PROCESSES

- Mixed systems: Around 1,200 tons per day are processed through a newer mixed waste treatment system in Kanchanaburi province.
- Landfill: Sai Mai handles approximately 1,630 tons per day through traditional landfill methods at Nakhon Pathom province and Kanchanaburi province.

CHALLENGES

- Sai Mai's reliance on landfilling and mixed systems emphasizes the need for further infrastructure investment to increase recycling and composting capacities..

LANDFILLS:

The remaining solid waste is disposed of at landfill sites located outside of the Bangkok metropolitan area. Currently, Bangkok manages waste disposal through three landfills:

- Waste from Sai Mai and Nong Khaem transfer stations is taken to a landfill site in Kamphaeng Saen district in Nakhon Pathom province.
- Waste from Sai Mai is also taken to Huai Krachao district in Kanchanaburi province.
- Waste from On Nut transfer station is taken to a landfill site in Phanom Sarakham district in Chachoengsao province.

SERVICE PROVIDERS:

Collection and transportation of waste in Bangkok is undertaken by the BMA through its staff and fleet of vehicles. The 50 district offices primarily collect general waste, food waste and hazardous waste from households, office buildings, commercial establishments, schools and universities, as well as public areas. However, biomedical waste from hospitals is collected by the Krungthep Thanakom company.

The treatment and disposal of general waste is contracted to eight companies. They receive waste from three waste transfer stations and manage it at landfills located in Chachoengsao, Nakhon Pathom and Kanchanaburi provinces.

Recycling of Waste

- **Government Initiatives:** The BMA plays a role in recycling by encouraging waste segregation at source and providing separate bins for recyclables and non-recyclables. At the district level, waste drop-off points are designated in collaboration with non-governmental organizations or the private sector to encourage waste separation and recycling.
- **Community Programs:** Local communities often participate in recycling programs. Education campaigns are conducted by local non-governmental organizations and civic groups to raise awareness about the importance of recycling and how residents can properly segregate their waste.
- **Private Sector and Informal Workers:** More than 3,000 private recycling companies and informal waste collectors, known as Saleng in Thai, are significant contributors to the recycling process. They collect recyclables like plastics, paper and metals from households or businesses and sell them to recycling facilities.
- **Waste Drop-off Points:** Drop-off points are available at the district level to encourage residents, businesses and visitors to participate in the city's recycling efforts. In collaboration with the private sector and local non-governmental organizations, these points encourage public engagement and expand the city's recycling infrastructure to make recycling more accessible and convenient.
- **Material Recovery Facility (MRF):** Thailand's first MRF is being built in Bangkok as part of the Smart Recycling Hub project. The Smart Recycling Hub is a public–private partnership initiated by the Alliance to End Plastic Waste, the Thailand Institute of Scientific and Technological Research, the Bangkok Metropolitan Administration, the Eastern Economic Corridor and the Public–Private Partnership for Sustainable Plastics and Waste Management to establish a plastic circularity ecosystem in Thailand. The MRF will be a pilot facility that aims to recover at least 50,000 tons of plastic waste annually. MRFs are specialized plants that receive, separate and prepare dry recyclable materials for reuse in the manufacturing process. In the initial stage, a feasibility study and engineering design development for the MRF will be carried out in Bangkok and the Eastern Economic Corridor area covering Chonburi, Rayong and Chachengsao under the project. The findings from the feasibility study will be used for the planning and construction of the MRF.

The Informal Sector in Recycling

The recycling sector in Bangkok is largely informal and plays a significant, albeit often overlooked, role in Bangkok's waste recycling system. It is primarily composed of waste pickers and municipal waste collection crews, and it contributes to recycling by separating recyclables from waste streams. Recycling and waste separation occur throughout the waste's journey until it reaches a waste transfer station. This

activity increases overall recycling rates and provides supplemental income for those involved.

Informal recyclers likely manage a large percentage of the city's recyclable waste, particularly materials that the formal system may not efficiently collect or process. This includes materials that may be difficult to sort, have low market value or are scattered across diverse locations. Informal recycling often operates at a lower cost than formal systems due to its labour-intensive nature and the relative absence of regulatory and infrastructure overheads. Informal workers can reach areas where formal collection systems are inadequate or non-existent, expanding the reach of recycling efforts to a wider range of waste sources. The informal recycling sector provides employment for a substantial number of individuals, often those from low-income backgrounds.

In Thailand, *Saleng* are informal waste traders who play a crucial role in the country's waste-collection and recycling system. These individuals, often working independently or in small groups, collect recyclable materials such as plastics, metals and paper from households, streets and businesses. They typically use tricycles or motorcycles with small carts to transport the collected materials to recycling centers or markets.

FIGURE 20
Informal Waste Trader (Saleng) in Thailand

Source: Thairath Online, December 2022.
https://www.thairath.co.th/news/local/2573898

Saleng contribute significantly to waste management by reducing the amount of waste sent to landfills, while generating income from the sale of recyclables. They often operate outside formal waste-collection systems and are known for their resourcefulness and knowledge of local recycling practices. Their efforts not only support environmental sustainability but also provide economic opportunities in the communities they serve.

The major stakeholders in the informal recycling sector are as follows.

- **Municipal Waste-collection Crew:** These are formal BMA employees who supplement their income by separating recyclables during their regular collection routes.
- **Waste Pickers:** These people collect recyclables from the waste bin at each household, retail shops, grocery stores, public spaces and so on. Some of them are otherwise unemployed or homeless and take on this activity to earn some income. Housekeepers in office buildings, hospitals, schools, housing complexes and department stores are also involved in waste picking.
- **Saleng:** These informal workers purchase recyclable materials directly from households, businesses, waste pickers and retail shops. They often work independently or in small groups.
- **Waste Traders/ Dealers/ Aggregators:** These actors collect waste materials from waste pickers and Saleng, then sell them to manufacturers or export them for processing elsewhere.

The Bangkok Metropolitan Administration does not formally recognize or fully integrate the informal recycling sector into its formal waste-management system. However, there is growing recognition of the significant contribution and vital role played by the informal sector, and some efforts through public and private initiatives are underway to improve the working conditions, safety, and integration with the formal system. These initiatives center around:

- **Improved Working Conditions and Safety:** Some initiatives aim to improve the working conditions and safety of waste pickers by providing training, access to better equipment and health benefits.
- **Increased Transparency and Regulation:** Efforts to improve transparency and regulate informal recycling operations are underway, although they face considerable challenges due to the informal and highly dispersed nature of the sector.
- **Collaboration and Partnerships:** Initiatives to collaborate with the informal sector are underway, recognizing the practical knowledge and importance of informal workers, to more effectively manage the city's waste streams.

The informal sector's role is complex and requires a nuanced understanding. While its contribution to recycling is invaluable, challenges regarding working conditions, environmental impact and lack of regulation must be addressed to create a truly sustainable waste-management system that incorporates both formal and informal actors effectively.

6. Key Findings and Opportunities

Key Findings

HIGH WASTE GENERATION	Bangkok generates a substantial amount of waste daily, with food waste consistently comprising a significant portion (42-52 percent) of the total. While the Covid-19 pandemic initially caused a temporary reduction in waste production, the subsequent rise in online food deliveries led to an increase in non-recyclable plastic and paper waste. This high volume of waste, particularly food waste, places a considerable strain on the city's waste management infrastructure and highlights the need for more effective waste reduction and recycling strategies. The composition of waste also includes a considerable number of plastics and other materials, underscoring the need for targeted interventions to address various waste streams.
INADEQUATE INFRASTRUCTURE AND INEFFICIENT WASTE SEPARATION	Bangkok's waste management infrastructure faces challenges in keeping up with the city's rapid population growth and increasing waste volume. Landfill space is limited, and the current system struggles to efficiently handle all waste types. Inefficient waste separation at the source significantly hampers the effectiveness of recycling programs. The lack of consistent and widespread source separation contributes to large amounts of mixed waste, including recyclable materials, ending up in landfills and leaking into the city's important waterways. This issue is further exacerbated by limited public awareness of and participation in proper waste sorting.
THE SIGNIFICANT ROLE OF THE INFORMAL SECTOR	The informal sector plays a crucial but largely unregulated role in Bangkok's waste recycling system. Waste pickers, *Saleng*, and other informal actors collect and process a substantial portion of the city's recyclable materials. While their contributions are vital to the overall recycling rate, they often face challenging working conditions, lack safety protections, and have limited access to resources or support. Formalizing and integrating this sector into the formal waste-management system would enhance recycling efficiency and improve the livelihoods of these workers.
VULNERABILITY TO CLIMATE CHANGE IMPACTS	Bangkok's susceptibility to flooding, intensified by climate change, significantly impacts its waste-management system. Waterbodies, historically used for transportation and waste disposal, are increasingly polluted due to improper waste management. The interconnectedness of the city's waterways necessitates effective flood management strategies and a comprehensive approach to mitigating the environmental effects of waste. Addressing climate change risks is crucial for the long-term sustainability of Bangkok's waste management

Opportunities

INTRODUCING COMMUNITY-LED INITIATIVES FOR A HOLISTIC APPROACH TO WASTE MANAGEMENT

To address the generation and composition of waste in Bangkok, a multifaceted approach is needed. This involves citywide as well as community-level campaigns promoting mindful consumption and reusable alternatives, targeted strategies to reduce waste in various sectors through educational programs and incentives, and focused interventions to minimize plastics and packaging waste leaking into the city's environment and waterways and ending up in landfills. Regulations on single-use plastics and incentivizing sustainable packaging could also be explored. A comprehensive food waste-management program, targeting all sources from distribution centers to households and incorporating composting and improved food storage practices, is also vital.

FORMALIZING AND IMPROVING RECYCLING

To enhance waste management, it is essential to create a standardized waste segregation system across the city, supported by clear labeling and public education campaigns to ensure consistent sorting of waste. This includes providing readily accessible and appropriately sized bins for different waste streams in residential, commercial and public areas, as well as considering incentives for households and businesses that comply with the system. A pilot program should be initiated in select areas before expanding it citywide. Additionally, recycling programs should be expanded by increasing drop-off points, optimizing collection routes and supporting the development of recycling facilities capable of handling various materials to improve efficiency and enhance resource recovery. The BMA, through its Solid Waste Management Plan and Plastic Reduction Strategy, aims to promote recycling as part of the city's efforts to reduce the waste being sent to landfills and mitigate environmental pollution. The city's approach focuses on a combination of community awareness and engagement, infrastructure, and engagement with the private sector and civil groups to encourage both residents and businesses to adopt more sustainable waste-management practices. However, challenges remain, and continued efforts to engage the public, improve waste separation and address plastic waste are essential to achieving the city's recycling goals.

EXPLORING EXTENDED PRODUCER RESPONSIBILITY SCHEMES WITH THE PRIVATE SECTOR

Collaborations with the private sector for extended producer responsibility schemes can be explored between private companies and the government, for common and popular Thai brands. Opportunities for buy-back mechanisms or deposit return schemes can also be explored. Products such as single-use or low-value plastics can be transitioned to alternative materials that can be recycled or reused before end-of-life disposal. Additionally, use of reusable straws, bottles and travel cups, especially by restaurants and street food vendors, can be promoted. However, it is important to note that considerations and guidelines related to extended producer responsibility are under the purview of the Government of Thailand at the national level – these can then be adopted and implemented by the BMA at the city level.

BUILDING RESILIENCE TO CLIMATE CHANGE THROUGH EFFICIENT WASTE MANAGEMENT

Bangkok's vulnerability to climate change impacts demands a focus on climate-resilient waste-management infrastructure, capable of withstanding extreme weather events. It is necessary to integrate strategies to address both pollution and flood risks. These strategies will involve improvements to drainage systems and canal management, along with a reduction in the leakage of waste that blocks these systems. Public awareness campaigns highlighting the impact of climate change on waste management and promoting responsible waste disposal are important for long-term sustainability. These efforts require a collaborative approach involving government agencies, businesses, community groups and the informal sector.

FORMALIZING AND INTEGRATING THE INFORMAL SECTOR

The informal waste sector's contribution to recycling in Bangkok is significant. Formalizing this sector requires providing waste pickers and *Saleng* with training, safety equipment and access to resources, potentially through collaborations with non-governmental organizationsand community groups. Establishing fair and transparent trading systems for recyclable materials will ensure these workers receive fair prices. Addressing health and safety concerns for informal recyclers is also paramount and may involve offering healthcare and improved working conditions.

REDUCING THE VOLUME OF ORGANIC/FOOD WASTE THROUGH COMPOSTING

Given that more than half of the total waste generated in Bangkok is organic waste, reducing this volume through composting can significantly alleviate pressure on landfills, minimize methane emissions and promote more sustainable waste-management practices. This can be done through a multipronged strategy that encourages composting at both the individual and community levels, as well as in businesses and institutions. The city could establish large, industrial-scale composting facilities that handle organic waste collected from various sources, including households, businesses and markets. These facilities can turn large quantities of organic waste into compost on a larger scale. Bangkok's bustling markets produce significant volumes of food waste. Setting up dedicated composting facilities at these markets could help reduce their environmental impact.

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