Melaka, Malaysia

City Waste Management Profile

URBAN OCEAN

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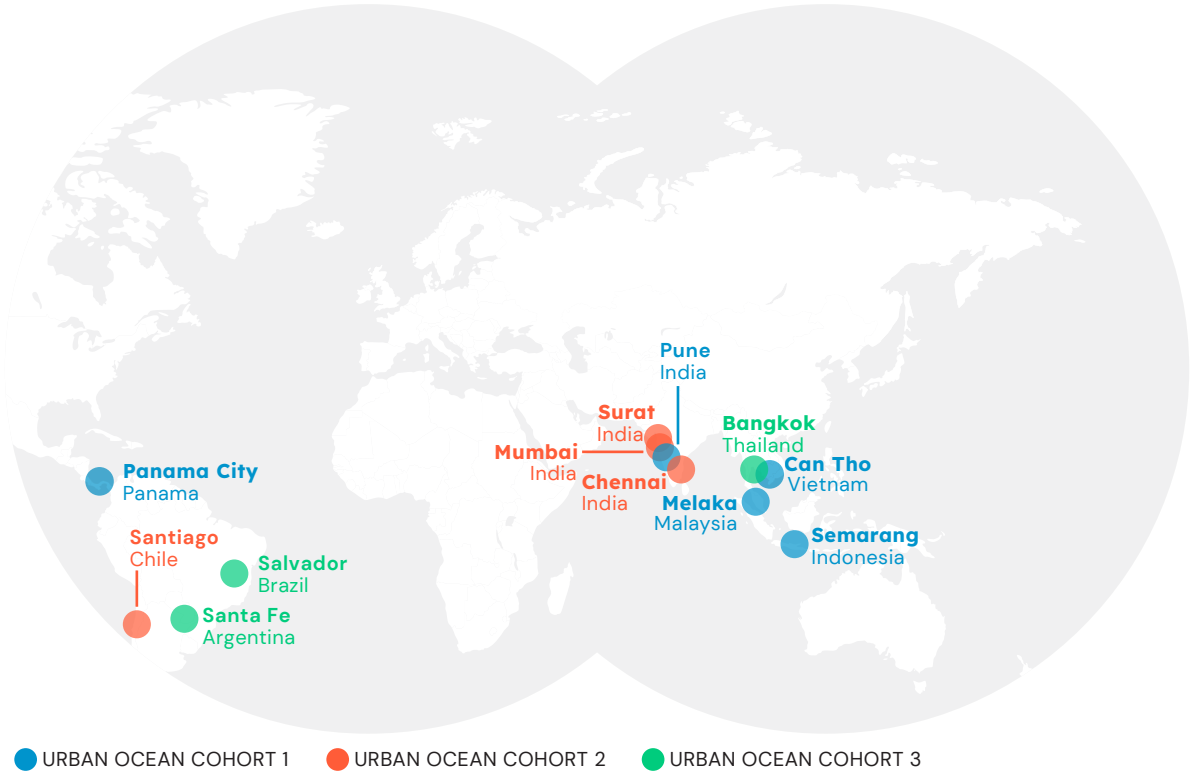
1. Introduction to Urban Ocean

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 leverages city leaders to bring new ideas, partners, and resources together and solve interrelated resilience challenges related to waste management; plastic leakage; and protecting water bodies and the ocean. The program 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 demonstrate thematic leadership and share knowledge and experience across the Resilient Cities Network (R-Cities) community and beyond. The program is jointly led by R-Cities, Ocean Conservancy (OC), and The Circulate Initiative (TCI).

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 global greenhouse gas (GHG) emissions (IPCC, 2021). No climate nor social target will be met without a deep transformation of urban centers towards a more inclusive, sustainable, and resilient path. Approaching urban waste management systems through a resilience lens reveals complex, interrelated ramifications for social, economic, and environmental indicators. In 2018, the International Labor Organization estimated that the waste management sector alone has the potential to create 45 million jobs globally by 2030 while reducing GHG emissions by 15 to 20%. Additionally, circular economies offer a USD 4.5 trillion economic opportunity by reducing waste, stimulating innovation, and creating employment by 2030 (WRI, 2021). Currently, plastic usage is growing and continues to be a threat to public and environmental health in the ocean and in cities. A huge opportunity exists for city governments 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.

Program objective

The Urban Ocean program aims to collaborate with urban leaders to gather new ideas, partners, and resources to address interconnected challenges related to resilience in waste management, reduce plastic leakage and protect water bodies and the ocean. Urban Ocean provides a platform for ocean advocates and urban leaders to join forces in developing comprehensive solutions that meet the needs and priorities of governments, cities, communities, and other stakeholders to create real and lasting impacts.

Cohorts 1 and 2

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

The work further expanded to four additional cities in Cohort 2 – Chennai, Surat and Mumbai (all India) and Santiago (Chile) – to expand the geographic scope of the program, expand the waste management, circular economy and resilience ecosystem, increase collaboration with local governments and establish effective waste management systems that generate environmental, social and economic co-benefits to cities.

Methodology

This report summarizes the information collected to develop a resilience-oriented analysis of the urban waste management system in Melaka. The profile was conducted in collaboration with the Melaka Historic City Council and Universiti Kebangsaan Malaysia, R-Cities, Ocean Conservancy (OC) and The Circulate Initiative (TCI). The analysis involved desk research, a collaborative workshop with city stakeholders, and interviews. The following table presents the key stakeholders who were consulted as part of the program.

TABLE 1
Interviewed stakeholders

Government/ public sector agencies

Department of Environment Melaka (JAS)

Melaka Green Technology Corporation (PTHM)

Perbadanan Sungai dan Pantai Melaka (PPSPM)

Duyong state assemblyman

Klebang state assemblyman

Pantai Kundur state assemblyman

Sungai Udang state assemblyman

Bukit Katil state assemblyman

Economic Planning Unit of Melaka

MBMB Engineering Department

MBMB Environmental Health Department

Informal recycling aggregators

Solid Waste Corporation Melaka (SWCorp)

SWM Environment, Melaka

Private sector

Holiday Inn Melaka

AEON Mall Bandaraya Melaka

Swiss Garden Hotel Melaka

NGOs

Tzu Chi Foundation

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 ("the Profile") examines major disturbances and stresses prevalent in the city that impact the city's waste management system. It brings together preexisting 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.

The Profile seeks to provide insight for the city to better plan and identify appropriate solutions to increase the resilience of their 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.

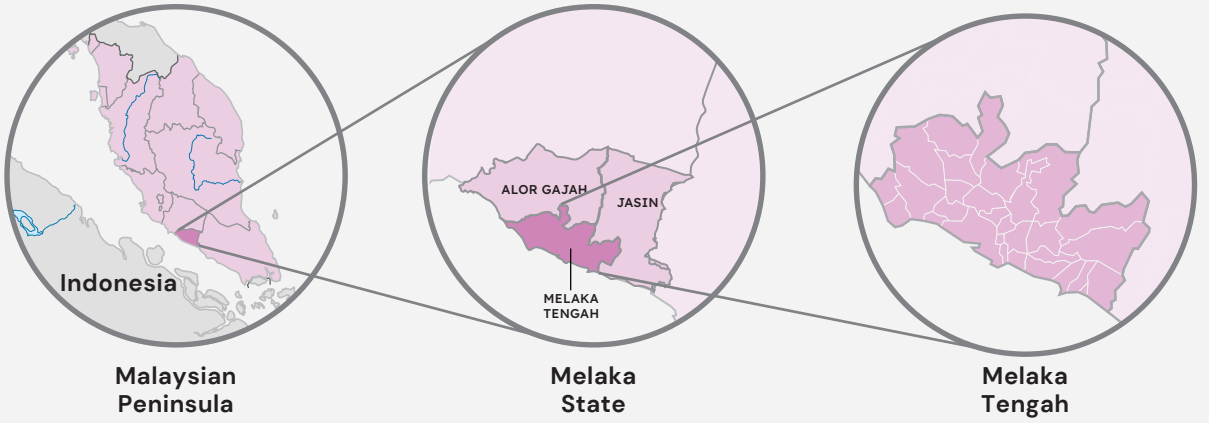
The Profile encourages a more holistic approach to existing challenges and supports cities in the development of individual solutions suited to their specific history, economy, demographics and culture while being aligned with the city's unique institutional, environmental, and financial resources. An added benefit of being part of Urban Ocean is how cities can learn from each other by comparing common elements in their respective Profile.

3. Overview of Melaka and its Resilience Journey

Melaka City is the capital of the state of Melaka, located on the coast in south-western Peninsular Malaysia and opposite the island of Sumatra. Melaka State is subdivided into three districts – Melaka Tengah, Alor Gajah and Jasin – and four municipalities – Melaka Historic City Council, Alor Gajah Municipal Council, Jasin Municipal Council and Hang Tuah Jaya Municipal Council. Melaka City lies approximately 152 km from Malaysia's capital city, Kuala Lumpur. From its historical beginning as a key South-East Asian trading settlement, it has grown into a vibrant, multicultural city. It is expanding in area much more rapidly than it is expanding in population. This urban growth is being driven by land reclamation along the coast and sprawling developments into the city suburbs. It is a major tourist destination within Malaysia, designated as a UNESCO World Heritage Site in 2008 for its unique architecture, culture and townscape.

FIGURE 2

Socio-demographic indicators of Melaka



1,021,000
Population Melaka State

458,123
Population Melaka City

493 km²
Population density

18,5 million
(MYR 83,447,000)
Environmental protection expenditure for the year 2019 for Melaka State out of which USD 6 million (MYR 28,575,000) was for waste management.

1880 km²
Area Melaka State

270 km²
Area Melaka City

0%[1]
Population in informal housing

Source: Department of Statistics, Malaysia, 2020; World Bank, 2019

1 As per World Bank 2019, there are no informal settlements in Melaka, however, issues regarding low-income population and housing affordability need to be further understood. Melaka Enhancing Services and Sustainability (2019). The World Bank. Available at: https://documents1.worldbank.org/curated/zh/376461556617324490/pdf/Supporting-Report-3-Enhancing-Services-and-Housing.pdf

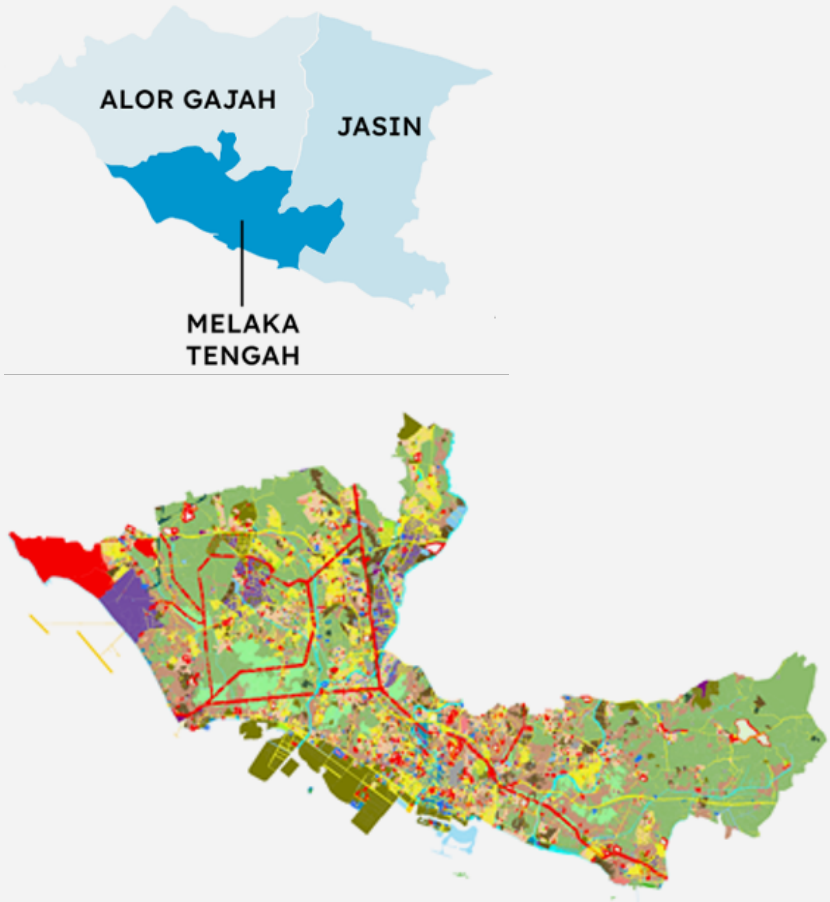
City's connection with the waterbodies

The Melaka River flows from Alor Gajah across central Melaka before joining the Melaka Straits. The latter is one of the busiest shipping routes in the world, in a strategic location connecting China and India. The river is in the UNESCO World Heritage zone, runs through the heart of this historical city, which is a tourist attraction, and is crucial to its economy. The length of the Melaka River is about 40 km; its catchment area is 614 sq.km. Melaka City is located on both sides of the Melaka River near its estuary on the Melaka Straits.

Majlis Bandaraya Melaka Bersejarah (MBMB) or Melaka Historic City Council, is the governing body entrusted with the development, preservation, and administration of the historic city of Melaka, Malaysia. MBMB's mandate is to drive Melaka City towards sustainable growth, resilience, dynamism, smartness, and prosperity, while safeguarding and promoting the unique cultural, historical, and architectural heritage of Melaka.The Melaka State Government together with MBMB has undertaken the initiative of beautification and rehabilitation of its river, considering its immense potential of tourism revenue. Despite this, the Melaka River is categorized as mildly polluted. Littering on the streets, in the river and the illegal disposal of solid waste is still prevalent which leads to blocked drainage channels and increases the risk of diseases spreading or epidemics. The river flows from Alor Gajah (which is upstream) across Central Melaka (which is downstream) before the water flows into the Melaka Straits. The drainage of the city is also discharged into the Straits. Hence changes like sea-level rise have a significant impact on the drainage system and river discharge, further increasing the risk of coastal flooding in Melaka.

Several major river systems flow through highly populated areas into the Straits of Melaka from both Sumatra Island and peninsular Malaysia. They introduce organic pollution (from domestic waste, agriculture, and industries), plastic leakage, and industrial pollution in some areas into the water. The impact of this can also be seen from the high Biological Oxygen Demand (BOD) levels near Malaysian coastal cities such as Penang, Melaka, and Kuala Selangor, indicating lower water quality.[2]

FIGURE 3
Map of Melaka city



2 Zulfigar Yasin, 2019 - https://www.researchgate.net/publication/338577495_The_Ocean_Legacy_of_Malaka_and_Sustainability_in_the_Straits_of_Malacca

Key shocks and stresses impacting the city's waste management systems

As per the Melaka Resilience Strategy, the city is undergoing radical transformation due to urbanization, that will affect its vulnerability to shocks and stresses in the decades to come. Melaka faces various shocks and stresses due to modernization, tourism, urban regeneration, and climate change that impacts the city's waste management system. Cases of food poisoning, tuberculosis and dengue have been increasing in recent years due to poor maintenance of drainage systems, poor hygiene and environmental sanitation. Several factors are contributing to poor water quality in certain areas and the spread of diseases which include illegal dumping or discharge from waste into the drainage channels or river; stagnant water; clogged drains; and litter not being cleaned regularly. A disease outbreak could pose a significant risk and would greatly affect Melaka's reputation as a safe tourist destination, resulting in a loss of income for many small businesses.

Aging and poorly maintained drainage systems and design flaws in irrigation systems are creating significant flood risk in several locations across Melaka. Shallow drainage pipes cannot hold enough capacity during heavy rain events, often resulting in surface flooding. This can be exacerbated by litter clogging the drainage system, as drains are not always covered. Waste removal services in public spaces, especially in the heritage area, are poor - partly due to the difficulty in accessing narrow roads and properties.

Building resilience through waste management

Through its resilience strategy, Melaka aims to be a vibrant city, where smart governance, collective leadership, sustainable mobility and protective infrastructure supports a thriving, healthy community that is proud of Melaka's outstanding universal values as a world heritage city. The strategy was a result of two years of highly committed and dedicated efforts by city leaders and staff from multiple departments, non-government organizations, experts from institutes and universities in the city, local enterprises, and not least by local communities. Using a resilience lens, the strategy clearly identified the core challenges in health and wellbeing, economy and society, infrastructure and environment, and governance. It also identified immediate and long-term actions that the city can implement in order to meet these challenges.

The Melaka resilience strategy identified losing its world heritage status of vibrant 'living heritage' as one of the shocks, due to increasing property costs pricing out local business owners and displacing residents or families, leaving buildings to become derelict. Many of Melaka's policies and projects are planned at the State level and not administered or developed in close coordination with MBMB. The Sungai Melaka project has been initiated by the State, with the river cruise service (a key source of revenue) managed by the State Corporation Company. However, responsibility of maintaining the infrastructure falls on MBMB. This diffusion of responsibilities across multiple levels of

FIGURE 4
Key shocks and stresses in the city

SHOCKS

- Flood Risk
- Water Shortages
- Disease Outbreaks
- Fire Risk
- Risk of Losing World Heritage Status

STRESSES

- Traffic Congestion
- A Lack of an Integrated Approach to Urban Planning
- Loss of Intangible Heritage
- Multiple Levels of Governance
- Solid Waste Management
- Aging Building & Infrastructure Conditions

government is a cause of stress in the city. Solid waste management practices in Melaka are not sustainable, with only a few material-sorting facilities and most of the waste being sent to the landfill. Despite waste management programs being implemented in the city there is still limited awareness amongst residents, businesses or industries about recycling or waste segregation.

Under the goal of 'A Livable, Vibrant and Efficiently Connected City' the Melaka resilience strategy highlights following actions for waste management with an objective to revive riverside spaces for public activities:

- Transform Krubong Landfill Site into a Public Park
- Establish an Adaptive Heritage Building Control Strategy
- Support New and Growing Industries through the Provision of Business Spaces
- Enhancing Melaka's Watershed Plan for Flood Risk Prevention
- Upgrade Flood Mitigation and Drainage Infrastructure
- Creating a Circular Economy for Solid Waste
- Improving Solid Waste Collection Systems
- Improving Urban Wastewater Governance

Targeted actions towards efficient and sustainable waste management and reduction of waste leakage in the city's river is crucial for the city to build resilience. The city aims at improving its waste management through opportunities to embed circular economy principles in the city's waste management system, to make waste a resource for new products and services, reduce the amount of waste the city generates, promote recycling, and create new local economic opportunities.

To advance these goals and tackle interrelated resilience and waste challenges, Melaka joined the Urban Ocean program in 2020, with an aim to device solutions in sustainable waste management with co-benefits of enhancing tourism and economic activities in the city.

The Urban Ocean program aims to advance the goals aligned with the Melaka resilience strategy based on rigorous research and stakeholder engagement, define opportunity areas in the city and conceptualize pilot ideas ready to implement. The program was jointly led by Resilient Cities Network, Ocean Conservancy and The Circulate Initiative, and implemented by the Melaka Historic City Council and Universiti Kebangsaan Malaysia in the city. For Urban Ocean Gap Assessment, The Circularity Assessment Protocol, a baseline assessment of waste and circularity within the city conducted as part of the Urban Ocean program was deployed. The local team also collaborated with other relevant partners for implementation of specific projects ideas.

The Urban Ocean program was implemented in Melaka as below:

2016–17

Resilience strategy

Melaka identified waste management as a key challenge

2020

Launch of Urban Ocean (Launch of program and Preparation forum)

Melaka joined the Urban Ocean program to address the interrelated resilience challenges related to waste

2020–21

Gap Assessment (Circularity Assessment Protocol -CAP, City Waste Management Profile, Opportunity Assessment Tool - OAT)

The city undertook assessment of risks and vulnerabilities within the waste management systems that lead to plastic leaking into the municipal environment and beyond, identification of opportunities by rethinking waste management through circular economy and resilience principles

2021-22

Design Proposal

Project Statements and Accelerator summit

The city developed specific actions to advance solutions to address plastic waste challenges

Melaka State generates about 1,480 tons of solid waste per day, equal to approximately 0.75 kg of solid waste per capita per day.[3] The rapid population growth and increasing tourism in Melaka have contributed to the rise in the city's waste generation. The City of Melaka also suffers from blocked drainage channels due to plastic waste littering in urban streets and illegal waste disposal in open areas, often clogging drainage channels. In addition to becoming an aesthetic problem, clogged drains fail to function effectively during rain events and lead to localized flooding.[4] Through the gap assessment, the city's capacity to promote good governance schemes and integrated planning has been highlighted as necessary steps towards achieving its circular and resilience goals. For instance, land reclamation projects have largely increased environmental degradation, and river beautification works have not achieved their cleaning targets.

Approaching urban waste management systems through a resilience perspective reveals the complex, interrelated ramifications for social, economic, and environmental indicators. Waste management needs to be tackled in an integrated manner with an objective of reducing waste, managing the exiting waste efficiently to reduce waste leakage in water bodies, promoting sustainable innovations as well as impacting livelihoods. Actions towards improve waste management and recycling can provide resilient and sustainable solutions that reduce waste pollution and address key stresses in the city, such as improving public health, supporting unemployment and economic development including tourism, and reducing environmental degradation.

The Melaka's Urban Ocean initiative is changing the relationship between the city and the waste it produces. It envisions to strengthen the recycling industry from a resilience and circularity perspective and incorporates activities to add value to materials, reduce the amount of waste being produced, decrease health and environmental risks associated with inadequate waste disposal, and allow for the economic and social benefits of enlarging the recycling industry.

3 SWCorp (2017)

4 Asian Development Bank, Green City Action Plan: A Framework for Green Actions Melaka - https://www.adb.org/sites/default/files/related/41571/imt-gt-green-city-action-plan-melaka-april-2014.pdf

4. Legal, Policy and Governance

State and local regulations and guidelines

Solid waste management in Melaka State has been taken over by the Federal Government from the local authority as stipulated in Act 672 (Solid Waste Management and Public Cleansing Act 2007). This Act stated that controlled solid waste (domestic waste, commercial waste, institutional, industrial and construction waste) will be managed by a government agency under the Ministry of Housing and Local Government (KPKT), namely Solid Waste and Public Cleansing Management Corporation (SWCorp) effective on 1 September 2008. This move aimed to standardize solid waste management and public cleansing services across all citizens, irrespective of their income levels, including mandatory at-source separation, litter reduction, and fines and imprisonment for illegal dumping. It also aimed to privatize collection and transportation services of household waste, thereby reducing financial pressure on local authorities and governments.

Malaysia's federal government has also developed a National Plastics Sustainability Roadmap 2021–2030 outlining strategies and action plans to achieve greater plastic circularity levels. The roadmap informs all stakeholders about the opportunities and necessary measures to take to unlock the potential value of the plastics industry and support the government and global agenda towards a healthier, cleaner and sustainable Malaysia.

Governance structure

The following authorities are involved and impact the waste management systems in Melaka. Their roles and responsibilities are as below:

National Level
To support implementation of Act 672, the National Solid Waste Management Department (Jabatan Pengurusan Sisa Pepejal Negara—JPSPN) and the SWCorp were established. The roles of each are as follows: **JPSPN:** • Develop policies and regulations to establish a sustainable solid waste management system to safeguard public health, protect and conserve the environment, preserve natural resources, ensure clean surroundings and preserve aesthetic value. • To play its role as the institution responsible in formulating strategies, action plans and laws on solid waste and public cleansing management. • To coordinate cooperation between agencies at the federal, state and local government levels, as well as the private sector and communities, to ensure smooth implementation of solid waste and public cleansing management. **SWCorp:** • Enforcement of the policies and strategies developed by JPSPN and management of Municipal Solid Waste at the local level. • Improve waste management services as well as public awareness and participation

State Level
Implement regulations at the state level that apply to all local jurisdictions, such as the taxes/fees for waste management and public cleaning as per Act 672.
City Level
Act 672 transferred the executive authority on solid waste management and public cleansing from the local authorities to the federal government. The roles of local authorities are limited to powers delegated by the National Government.

Key strategies and plans for waste management

The Twelfth Malaysia Plan (2021–2025) is the government's latest national economic blueprint which provides guiding principles to address current issues and at the same time restart and rejuvenate Malaysia's socioeconomic development for long-term sustainability and prosperity. The themes of the Twelfth Plan are resetting the economy; strengthening security, wellbeing and inclusivity; and advancing sustainability. One of the themes in the plan focusses on 'Embracing the Circular Economy' wherein public and private sectors are encouraged to adopt and integrate the Sustainable Development Goals (SDGs) and environmental, social and corporate governance (ESG) principles in their decision making. Apart from creating green job opportunities and ensuring resource security, adopting circular economy is expected to reduce waste generation, pollution, GHG emissions and dependency on natural resources. The use of recycled materials and recycling of producted waste will be increased, while the responsibility of producers in managing their end-of-life products will be extended.

At the local level, The Melaka Green City Action Plan (2017–2030) was formed in 2014 in partnership with the Asian Development Bank as a guideline and strategy in creating a sustainable city. This plan includes measures to improve solid waste management, local industry development, energy efficiency and transport. One of the focus areas under this plan is to advance Melaka on the path to becoming 'zero-waste' and reducing waste-related GHG emissions. The expected 'zero-waste' outcomes are:

→ The amount of solid waste per capita decreases

→ Composting of organic waste increases

→ Opportunity for energy generation from waste increases

→ Disposal of hazardous waste is better managed

→ Rate of recycling increases

Existing projects for waste management

The existing projects for waste management focus on raising awareness and changing behavior amongst citizens to advance sustainable waste management in the city. Some key projects are as below:

Towards Zero-Waste:

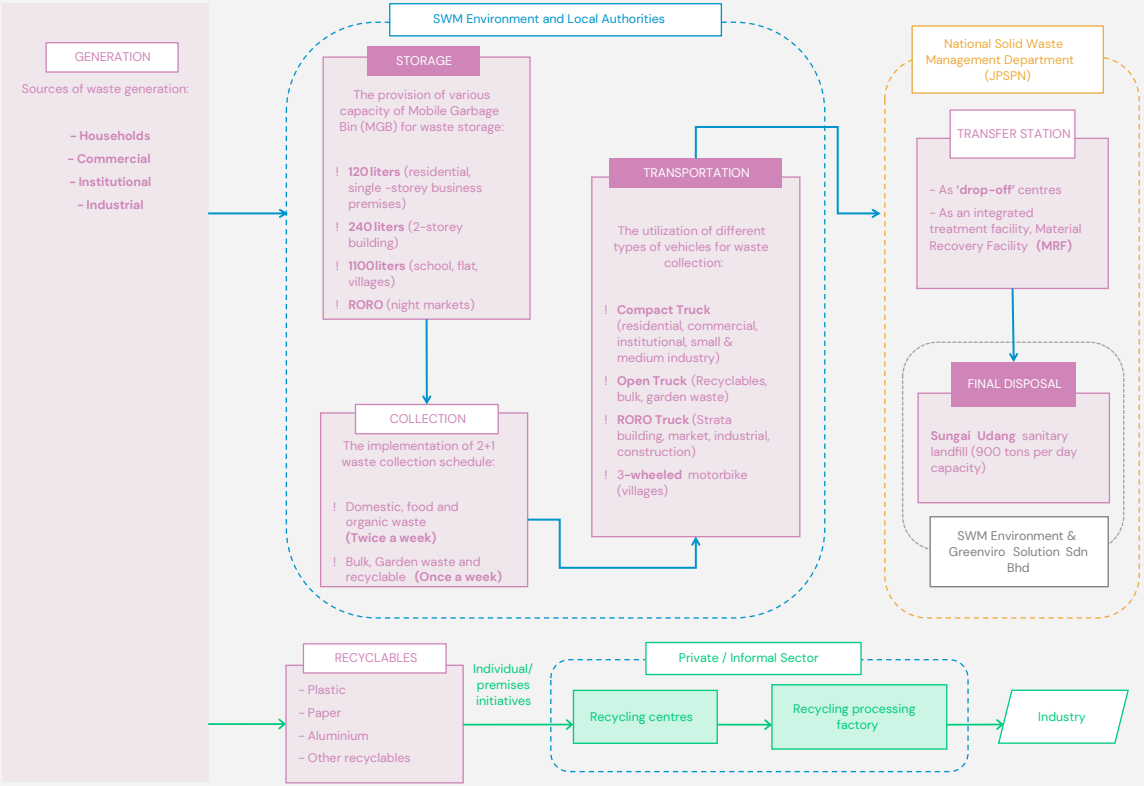
- **Separation at source. Started 01 September 2015, in which all premises are required to separate solid waste at source.**
- **Sungai Udang Landfill.** Opened 01 April 2015.
- **Waste Eco-Park.** Development of a park that can demonstrate and promote waste recycling, recovery and treatment activities by industry and provide a sustainable solution to the waste management problem.
- **Don't mess with Melaka campaign.** Consumers were advised to bring their shopping bags, and all premises were asked to change to compostable plastic bags and compostable food containers. Strict limitations were put on plastic bag use from 01 January 2016 and on polystyrene usage starting 01 September 2015.

5. Waste Management in the City

Overview of Melaka's waste management system

The rapid population growth and increasing tourism in Melaka have contributed to the rise in the city's waste generation. The city generates about 1,480 tons of solid waste per day comprising 670–1000 tons of waste from households and 400–700 tons of waste from commercial and industrial premises. There is limited data on collection efficiency, though it is estimated that more than 70% of the generated waste in Malaysia is collected using both curbside and communal centers.[5] During the gap assessment, an average of six bins per sq. km was identified, with two of the nine transect areas having no public bins. In addition, even though 70–80% of the waste disposed in the landfill could potentially be recycled/treated, it is estimated that only around 10% of the waste collected is in fact recycled and treated with most ending in the landfill in Sungai Udang, Melaka.[6]

FIGURE 5
The city's waste management value chain



5 Anwar Johari et. al., 2014. Municipal Solid Waste Management and Potential Revenue from Recycling in Malaysia. https://www.researchgate.net/publication/269672136_Municipal_Solid_Waste_Management_and_Potential_Revenue_from_Recycling_in_Malaysia

6 Malaka Historic City Council, 2020

Waste generation and characterization

Rapid population growth, modernization, tourism activities, economic development, and improved lifestyles are increasing the generation of solid waste in the city. Even though increased tourist activity has led to increased littering rates, the municipality has one of the lowest plastic waste leakage rates in the state.[7]

Waste characterization

35% of the waste in Melaka is organic food waste followed by plastics which account for 21% of the household solid waste stream. This is followed by diapers/napkins at 12% and paper/cardboard at 10%.

Waste collection and transportation

Source separation of household solid waste in Malaysia was made mandatory under Act 672, which is currently enforced in the states and Federal Territories of Kuala Lumpur, Putrajaya, Johor, Melaka, Negeri Sembilan, Pahang, Kedah and Perlis.[8]

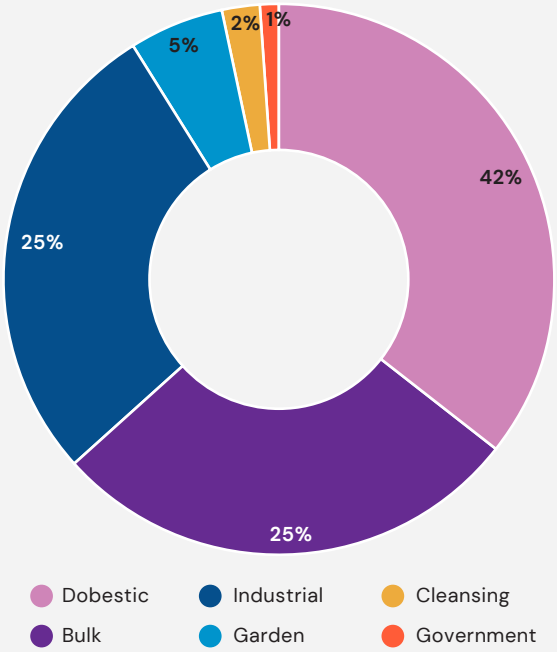
System: As of 2015, waste in Melaka is collected on a '2+1' collection frequency schedule, where household residual waste is collected twice a week while the recyclable waste and bulky waste is collected once a week. Residual waste includes kitchen waste, food waste, contaminated materials, and disposable diapers. Recyclables that must be segregated include paper, plastic, bulky waste, and garden waste. Separated waste must be neatly packed inside suitable plastic bags/containers and placed next to the trash bin on collection day. Waste collection services in public spaces are poor; partly due to difficulty accessing narrow roads and properties, especially in the heritage area.

Agencies/Stakeholders: Solid waste management in Melaka State is managed by the Federal Government as stipulated in Act 672. This Act states that controlled solid waste (domestic waste, commercial waste, institutional, industrial and construction waste) and public cleansing management will be managed by SWCorp, effective on 1 September 2008.
SWCorp has appointed 'SWM Environment Sdn Bhd' as the main concessionaries for waste management in Melaka . There are regulations at the state level that apply to all local jurisdictions, such as the taxes/fees for waste management and public cleaning.

Service provision to low-income households: In Melaka State, waste management and public cleansing services taxes/fees are not based on high, middle or lower-income categories. Waste collection and public cleansing services are delivered based on the appointed concessionaires or local authority's jurisdiction area. All citizens have the same access to waste management services with different approaches by the appointed agencies and local authorities.

FIGURE 6

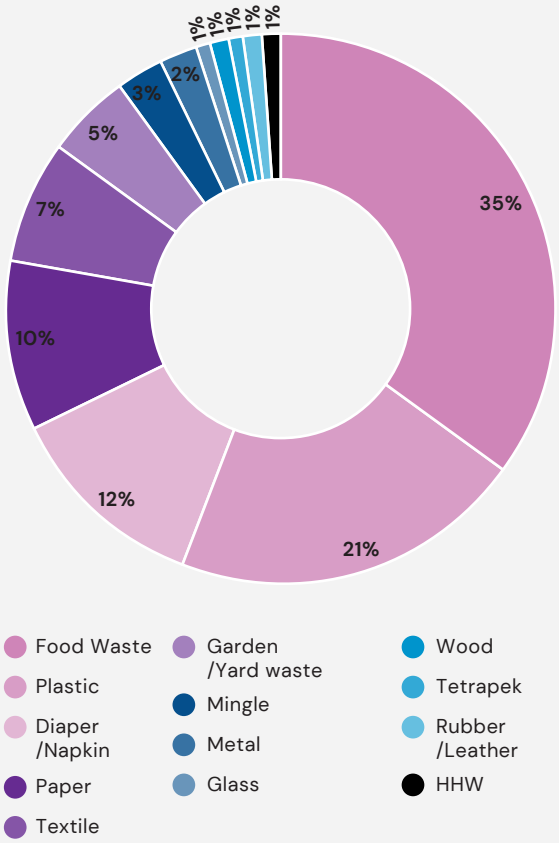
The main sources of waste in the city



7 Circularity Informatics Lab, August 2021. Circularity Assessment: Melaka, Malaysia. University of Georgia, Athens, GA, USA. - https://resilientcitiesnetwork.org/downloadable_resources/UR/UO/Melaka-Report-2021-08-31-reduced.pdf

8 SWCorp, 2020

FIGURE 8
Waste composition in the city



Treatment and disposal

Approximately 99% of municipal waste is disposed through landfilling, whereas incineration is used on a very small scale for clinical waste disposal at Bukit Rambai, Melaka. Only 10% of the waste collected is estimated to be recycled and treated for the entire state of Melaka (SWCorp, 2020) The Krubong landfill commissioned since the 1980s has reached maximum capacity with almost a billion tonnes of accumulated solid waste and the local authorities have identified a new landfill in Sungai Udang, Melaka, in April 2015. This is the main 64-acre landfill presently servicing the city of Melaka, owned and operated by SWCorp.

Recycling of waste

The 2+1 program is the first step toward recovering recyclables from waste. The program encourages waste segregation at source by collecting recyclables one day a week and food and other waste separately two days a week. The non-recyclable waste, including food waste, is dumped in landfills due to the lack of a composting facility. There are also plans for the state to ultimately transfer the full waste management cost to consumers rather than subsidize them. This change is likely to promote reduced waste production and encourage a culture of recycling.

City government, NGOs, and volunteers, through several campaigns, have already tried to raise awareness on reuse and recycling as well as collection of recyclables if there is a request from the communities. However, despite these programs, there is still limited awareness amongst people, businesses or industries on importance of recycling or waste segregation. Littering on the streets, in the river and the illegal disposal of solid waste is still prevalent in the city.

FIGURE 7
Sungai Udang Lanfill

6. Key Findings and Opportunities

	Key challenges	Potential opportunities
Urbanization and governance	• Melaka is a major tourist destination within Malaysia, designated as a UNESCO World Heritage Site in 2008 for its unique architecture, culture and townscape. This resulted in increased tourism and an economic boom, along with environmental preservation challenges. • Many of Melaka's policies and projects are decided at the state level and are not administered or developed in close coordination with MBMB. The various agencies, service providers and local authority bodies do not always communicate between themselves or share data effectively.	• The touristic nature of the city can be leveraged to improve the quality of the natural and built environment and foster economic development in the city. • The city can explore higher engagement within authorities with clear roles and responsibilities and a participatory approach in the planning processes, which will improve accountability and improve administrative systems in the city.
Resilience	• The city has old and poorly maintained drainage systems, creating significant flood risk in several locations across Melaka. Litter clogging the drainage system has also been an issue as drains are not always covered. • The city's river is polluted due to upstream tributaries, agricultural activities, sewage and the discharge of untreated wastewater and solid waste.	• Even though increased tourist activity has led to increased littering rates, the municipality has one of the lowest plastic waste leakage rates in the state. This can be promoted amongst the citizens and tourists as a good practice to imprint the message of cleanliness with an aim to reduce waste clogging in the water bodies and drains.
Existing waste management systems	• Despite programs in place, there is still limited awareness amongst residents, businesses or industries about recycling or waste segregation. • Waste collection in the city is not integrated due to a gap in management, given the involvement of multiple agencies. • Most of the waste is sent to the landfill site in Sungai Udang, which will soon be at capacity. • Waste collection services in public spaces are poor, especially in the heritage area, partly due to the difficulty in accessing narrow roads and properties.	• Existing laws and policies involving waste segregation and reduction in illegal dumping should be fully implemented and enforced.

7. Glossary of Terms

Act 672: The Malaysian Solid Waste and Public Cleansing Management Act No. 672 of 2007 aims to establish regulations and guidelines for the management of controlled solid waste and public cleansing. Its primary objective is to ensure adequate sanitation and address related matters as necessary. The Act grants executive authority to the Federal Government, giving the Director General the duty of implementation and requiring their approval for designated solid waste management facilities.

BOD: Biological Oxygen Demand - Higher BOD indicates more oxygen is required, which leaves less for oxygen-demanding species to feed on, and signifies lower water quality. Inversely, low BOD means less oxygen is being removed from water, so water is generally purer.

CAP: Circularity Assessment Protocol. Assessment protocol developed by the University of Georgia to identify and analyze waste streams, particularly plastics.

GHG: Greenhouse Gases

IPCC: Intergovernmental Panel on Climate Change

JPSPN: National Solid Waste Management Department

KPKT: Ministry of Housing and Local Government of Government of Malaysia

LIP: Local Implementation Partner

MBMB: Melaka Historic City Council

MSW: Municipal Solid Waste. Waste that is generated in households and establishments in the city such as commercial establishments, hotels, educational institutions etc.

OC: Ocean Conservancy

R-Cities: Resilient Cities Network

MYR: Malaysian Ringgit. Local Malaysian Currency.

SWCorp: Solid Waste and Public Cleansing Management Corporation established under the Federal Government of Malaysia to enforce solid waste management in cities.

TCI: The Circulate Initiative

UNESCO: United Nations Educational, Scientific and Cultural Organization

USD: United States Dollar

WRI: World Resources Institute

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