URBAN
OCEAN

Semarang City

The Adaptive Waste Management Models and Inclusive Waste Governance

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Introduction

● **URBAN OCEAN MENTOR CITIES**

● **URBAN OCEAN LEARNING CITIES**

* Chennai was welcomed as an additional city to the first cohort in August 2021 and it is working through an accelerated program order

Vejle Denmark

Rotterdam The Netherlands

Milan Italy

Toyama Japan

Chennai* India

Pune India

Can Tho Viet Nam

Panama City Panama

Melaka Malaysia

Semarang Indonesia

Christchurch New Zealand

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[1]. The Covid-19 pandemic could push between 71 and 100 million people into extreme poverty, of which 30 percent will reside in urban centers[2]. No climate nor social target 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 the complex, interrelated ramifications for social, economic, and environmental indicators. It is estimated that the waste management sector alone has the potential to create 45 million jobs globally and reduce GHG emissions by 15 to 20 percent[3]. At the same time, the circular economy offers a $4.5 trillion economic opportunity by reducing waste, stimulating innovation, and creating employment by 2030[4]. Adding a layer of complexity by including the marine plastic debris challenge can push cities towards rethinking their relationship with the ocean. So, 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 the path towards a more resilient urban-ocean relationship.

Program Objective

The Urban Ocean program aims to work with city leaders to bring new ideas, partners and resources together to solve interrelated resilience challenges related to waste management, to reduce plastic leakage and to protect water bodies and the ocean. Urban Ocean provides the platform for ocean advocates and city leaders to join forces with other allies to develop comprehensive solutions that meet the needs and priorities of governments, cities, communities and other actors, to create real and lasting impact. The program demonstrates how actions to improve waste management and recycling can provide resilient and sustainable solutions that reduce ocean plastic pollution and address 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 experiences across the Resilient Cities Network community and beyond.
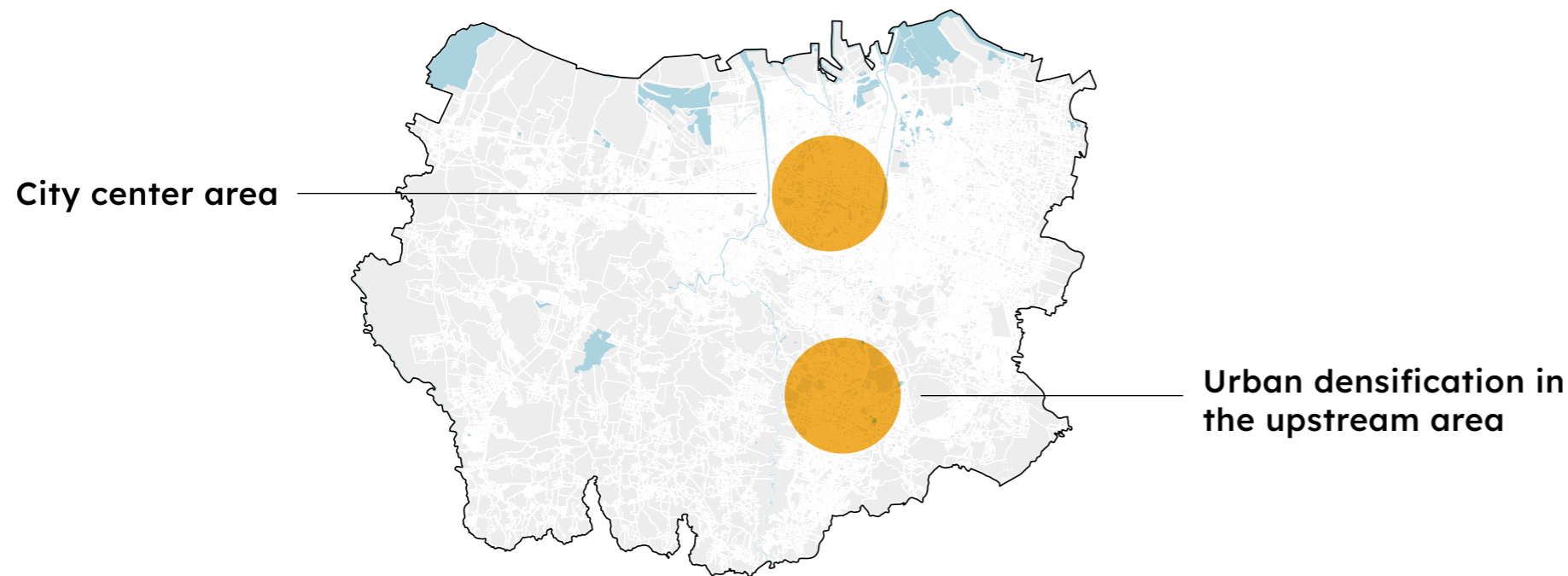
Project Statement

This Project Statement is the result of two years of work and dedication by the City of Semarang and trusted partners to develop specific actions the city can take to advance solutions that address plastic waste challenges. It is based on a rigorous gap assessment process and several capacity-building sessions that helped the city pinpoint the best opportunities for impact and formulate data-driven, multipronged approaches to implement locally. It outlines the context and the needs of the city on which the project builds. It provides the vision and an outline of the impact the city is trying to achieve.

Context

The City

Semarang City, Central Java, Indonesia

City center area

Urban densification in the upstream area

1.6 million
population in 2021

annual growth rate of approximately
**2.5%**

4,432 people
per square kilometre[5]

The growth of Semarang City has spread to the outskirts, particularly to the southern part of Semarang, which features urban densification.
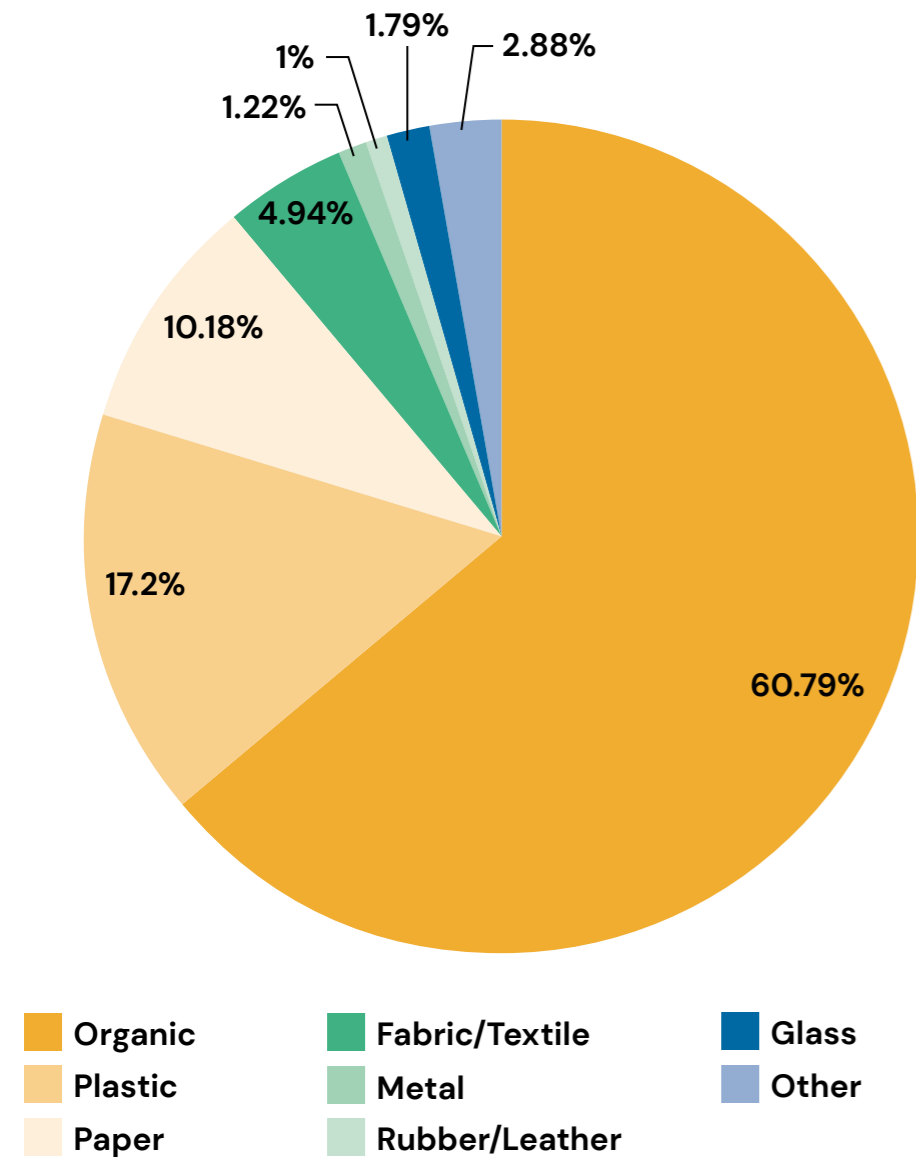
Semarang has a unique topography (see map on the left), consisting of lowland areas and hilly uplands. The lowland in the northern region along the coast is called Semarang bawah (lower Semarang) where the city's old center and the center of the provincial government and trade are located. The hilly, southern region is called Semarang atas (upper Semarang), where Waduk Jatibarang (reservoir) and the Tempat Pembuangan Akhir /TPA Jatibarang (landfill) are located.

The city of Semarang is in a low-lying area, pressured by the rising sea level and a large amount of run-off from the mountainous region. Therefore, the landscape is crisscrossed by a fine network of streams accumulating into rivers that carry the water to the sea. There are four main watersheds containing rivers and streams. The river and surface water are among the main water sources in , but they are threatened by river pollution due to both domestic and non-domestic waste.

The biggest water channel is the Semarang Canal, constructed during the Dutch colonial occupation. The two biggest canals are the Banjir Kanal Timur (East Flood Canal) and Banjir Kanal Barat (West Flood Canal). In addition, there are nine major catchment areas within the municipal boundary, which discharge approximately 999 mm/m² of rainfall per year into the Java Sea.
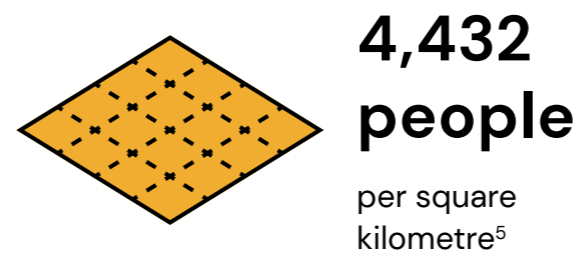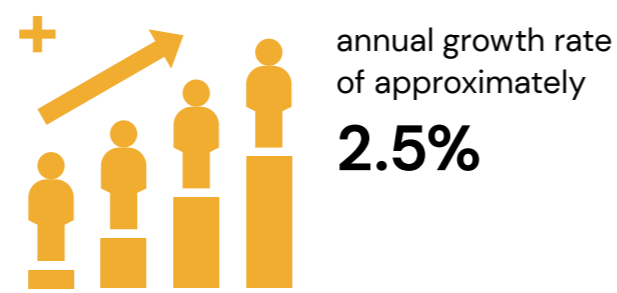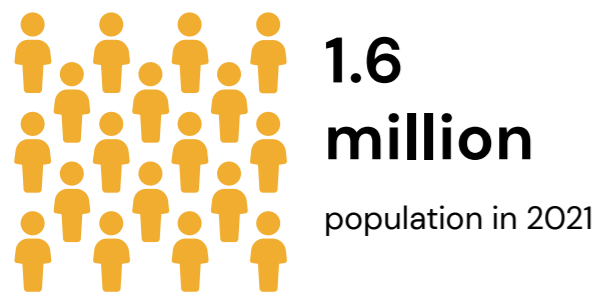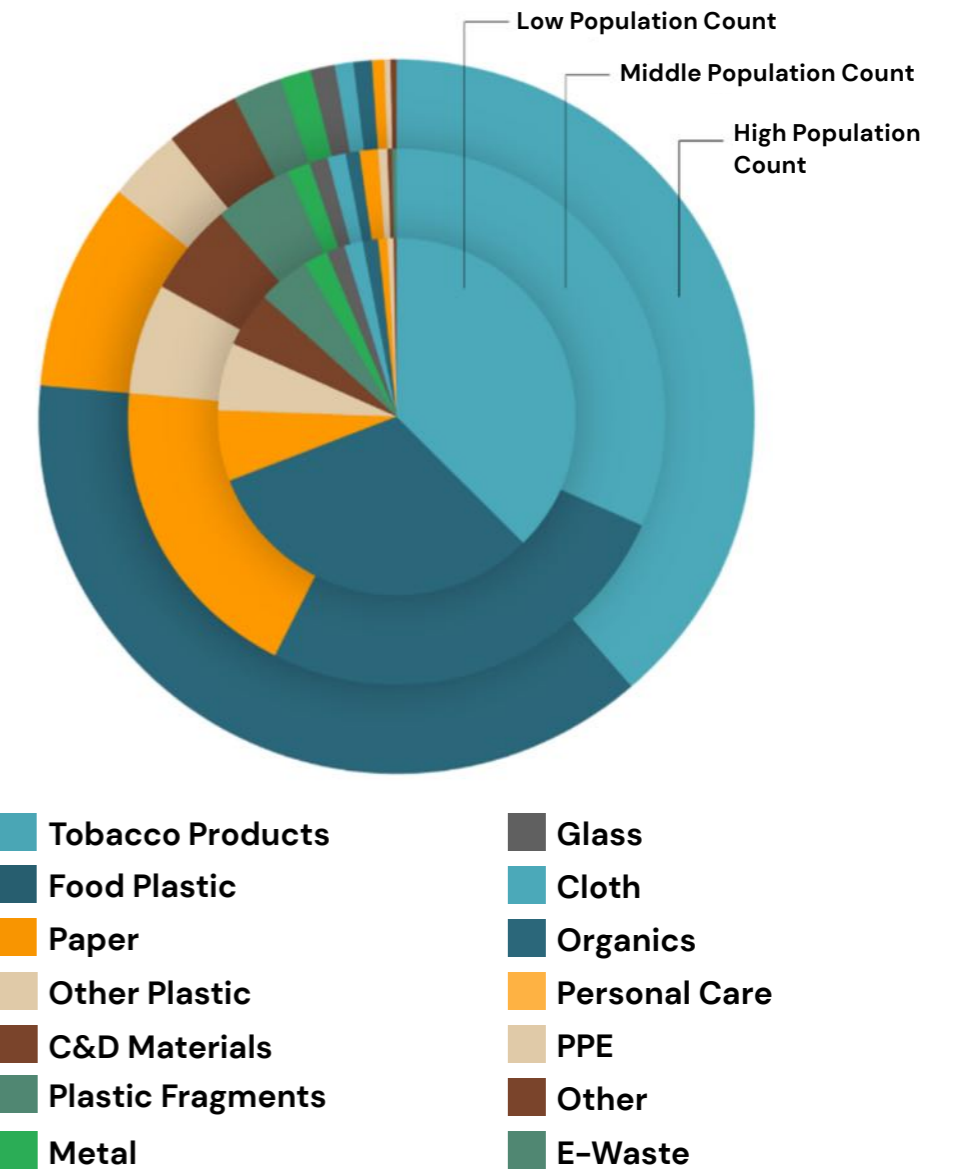
The City´s Waste Management System

Semarang city generates 1,251.7 tons of waste per day, which is equivalent to 456,873.3 tons per year. Several studies, including an assessment of the local waste-to-energy project, indicate that waste in Semarang is mostly composed of organic, household waste. According to the Semarang Environmental Agency, the three most common types of waste (see Figure on the left) are as follows:

- organic waste (60.79%)

- plastics (17,2%)

- paper (10,18%).

Paper's proportion is projected to increase in line with the waste generation in Semarang by 2020 (Andarani, 2018).

The Circularity Assessment Protocol (CAP), as part of the Urban Ocean program, saw a survey conducted over 27 transect areas and provided a more detailed breakdown of waste types in Semarang (Figure on the right). The largest percentage by category of litter items was tobacco products, followed by food plastic. It is applied for every population count sampled in CAP. Organics, paper, and plastic fragments comprised between 4 and 8 percent, respectively, and C&D materials, glass, and metal formed 2% or less of the total litter count.

Semarang City does not have the capacity to provide waste management services for the whole population. A study conducted in preparation of the installation of a waste-to-energy plant in 2019 estimated that around 5 percent of waste in Semarang goes uncollected. The Semarang waste management masterplan states only 87 percent coverage, while the CAP report found 61 percent coverage. Most Semarang waste is disposed of in Jatibarang, the main municipal landfil (TPA). However, the Jatibarang landfill is nearly at capacity and is estimated to be full by the end of 2021.

SWM Composition in Semarang.
Source: Environmental Agency, 2021

Legend (right figure):
- Tobacco Products
- Food Plastic
- Paper
- Other Plastic
- C&D Materials
- Plastic Fragments
- Metal
- Glass
- Cloth
- Organics
- Personal Care
- PPE
- Other
- E-Waste

Categories of litter collected in Semarang across all transects by population count
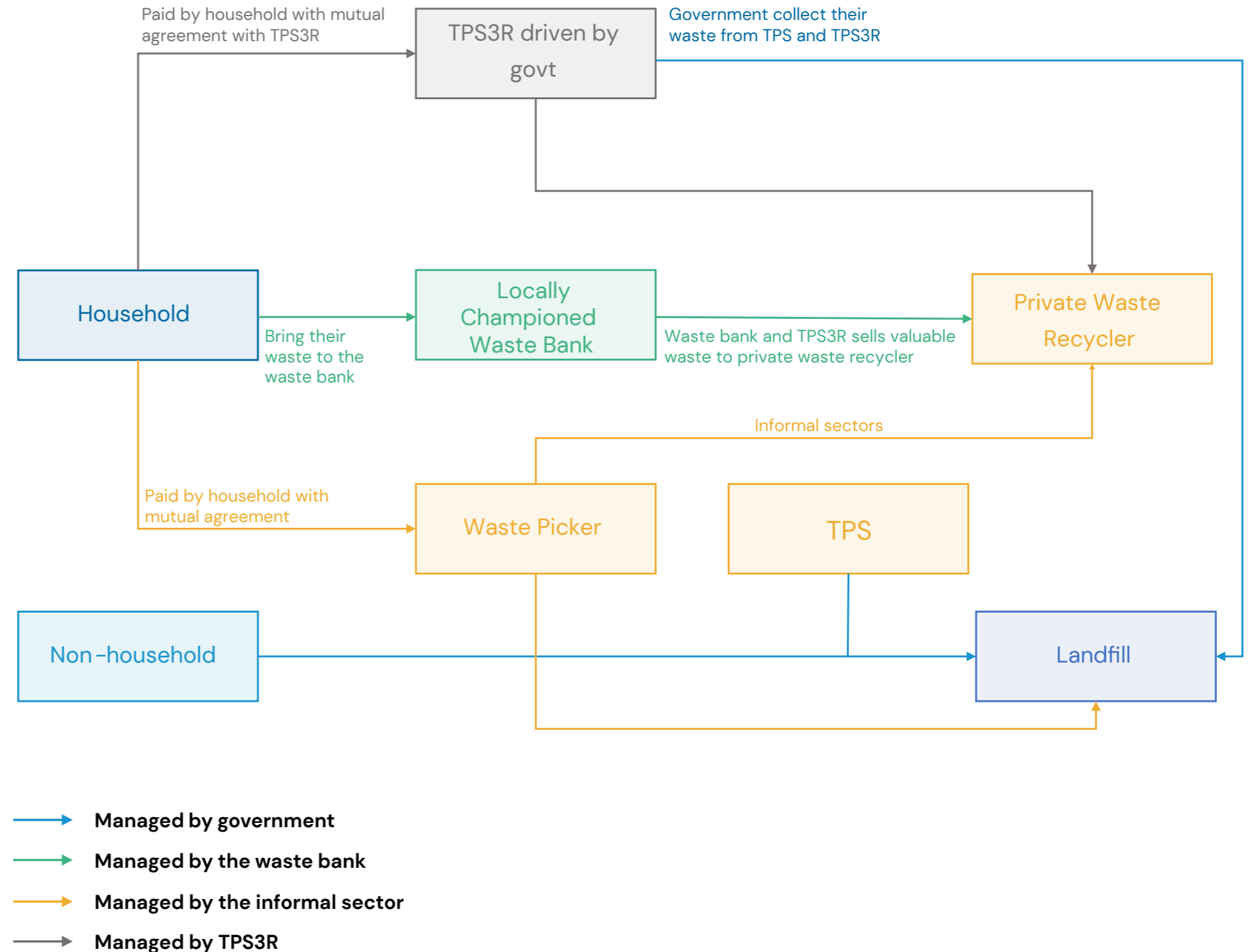
The city government lacks the financial capacity to cover waste collection transportation. The Semarang Environmental Agency manages waste transportation from the transfer station (TPS) or reuse-reduce-recycle transfer station (TPS3R) to the landfill, while citizens have to individually manage waste collection transportation from households to the TPS or TPS3R themselves.

The waste collection cycle depends on the economic status of the households in Semarang:

- Low- to middle-income households do not pay for waste collection; they manage waste disposal individually. (For example, by burning the waste, dumping it in fields, taking it directly to the landfill, or disposing of it in nearby river/water stream). However, some neighborhoods have active local champions and initiatives, such as a waste bank or TPS3R driven by the government (and managed by the community). So, waste collection is well-organized in such neighborhoods.

- Middle to high-income households make payments to waste pickers/third-party vendors to collect and transport their waste to waste banks/TPS3Rs or directly to the landfill.

- TPS3R and waste banks often offer waste collection services to households located close to their site. However, not all households are willing to pay collection fees to the waste banks/TPS3Rs.

There are two types of informal waste pickers in Semarang: those hired to collect waste from households and transport it to the landfill by community groups in neighborhoods (RTs/RWs, respectively smaller and larger areas) where there is no TPS3R nor waste bank; and those who pick up and/or buy waste from households to sell it to a private waste recycler (see Figure on the right).

WASTE FLOW CHART

Paid by household with mutual agreement with TPS3R

Government collect their waste from TPS and TPS3R

TPS3R driven by govt

Household

Bring their waste to the waste bank

Locally Championed Waste Bank

Waste bank and TPS3R sells valuable waste to private waste recycler

Private Waste Recycler

Informal sectors

Paid by household with mutual agreement

Waste Picker

TPS

Non-household

Landfill

→ Managed by government
→ Managed by the waste bank
→ Managed by the informal sector
→ Managed by TPS3R

Project
Justification

By 2030, waste generation in Semarang is projected to increase by 70 percent, with plastic waste generation set to almost double within that timeframe. The 2020 Semarang Waste Management White Book reported that in 2019, 77.64 percent of waste ended up in TPS or TPAs via waste handling, 17.65 percent went to waste banks, TPST/TPS3Rs and recycling and the final 4.71 percent was unmanaged garbage which likely ended up in the environment[6]. So, the flow and management of materials within the community is at a crucial stage. There are opportunities for an integrated waste management system and to continue and expand certain practices that can increase circularity. There are also opportunities for change. With the an ageing landfill

and incomplete waste collection and recycling set-ups, the predicted increase in waste and plastic waste will exacerbate the situation and be difficult to manage. So, both upstream and downstream interventions are critical to get ahead of this trend and keep plastic out of the environment.[7]

The city aims to reach the goal of "getting great Semarang" by 2026. Semarang has determined several targets towards the goal:

• Broaden the scope of waste services in Semarang city by strengthening waste reduction in the upstream and waste recycling at the final landfill.

• Increasing the economic value of waste management, from upstream to downstream.

• Strengthening community capacity in waste management.

Thanks to the Urban Ocean gap assessment process, the city has been able to identify its main challenges and prioritize them to come up with opportunities that may yield multiple benefits. These opportunities have been structured as initiatives with different areas of intervention. The next sections document this process by highlighting the challenges and opportunities identified, and how they have been translated into a project with agreed-upon goals.

Challenges

Rapidly growing Semarang faces multiple challenges in its waste management system.

- It is estimated that the city would require an average of 950,000 m³ of landfill space per year to maintain the current level of waste generation (in "business-as-usual" mode). The city cannot meet this, since its main landfill, Jatibarang, will be at full capacity by 2021.

- The city has set itself the target of reducing its waste generation by 30 percent by 2025. However, even if this target is met, Semarang City's waste generation rate in 2025 is still expected to be greater than 1,000 tons per day. The city government has delivered some interventions in the community and the private sector. However, these measures 'do not work in an integrated manner and are only partially conducted. Besides, citizens lack the awareness to reduce single-use plastics and segregate waste at the source.

- Semarang City has restrictions in place on the use of single use plastic bags. Still, these only apply to a limited number of stores, and many of the small to mid-scale stalls, cafes and mini-markets are still using cheap plastics for packing purposes (wrappers or bags). Introducing restrictions on single-use plastic bags, it is estimated, would annual waste generation in Semarang by 300 tons per year, representing or 0,07 percent of the total.

- Corporates and plastic-producing industries in the city lack knowledge about extended producer responsibility policies, yet all local industries/producers have an active corporate social responsibility (CSR) policy.

- The city government lacks the financial capacity pay for waste collected from households to be transported to the landfill (the "end-of-cycle" stage). It only covers the transport of accumulated waste from transfer areas to landfills. Citizens pay individually for collecte waste to be transported from households to transfer stations by a third-party vendor or community group.

- A limited number of neighborhoods in the city are covered via waste banks[8], TPS3R[9], or TPST[10]. These community-based waste management (recycling, collection, segregation) services could potentially be scaled up to cover all neighborhoods to increase the city's ability to check plastic leakage.

- Currently, informal waste collection exists in the city due to an inherent gap in the collection system. Informal waste collectors make the most of the opportunity to deliver collection services to citizens not covered by the city administration.

- The city of Semarang faces the critical issue of waste segregation at the source, which impacts the 'city's ability to reuse and/or recycle the waste generated. Citizen behavior and lack of awareness are the main causes of this issue; the city has some ongoing community waste management models such as waste banks, TPS3Rs and TPSTs, all of which vary based on the social characteristics of the neighborhood/city district. This implementation of various models in an integrated manner can potentially enhance 'Semarang's waste management cycle.

- The city has comprehensive regulation on upstream waste management, but implementation gaps need to be resolved. In addition, the city has carried out public outreach through its 3R campaign, yet citizen involvement is lacking when it comes to recycling and segregation.

Opportunities
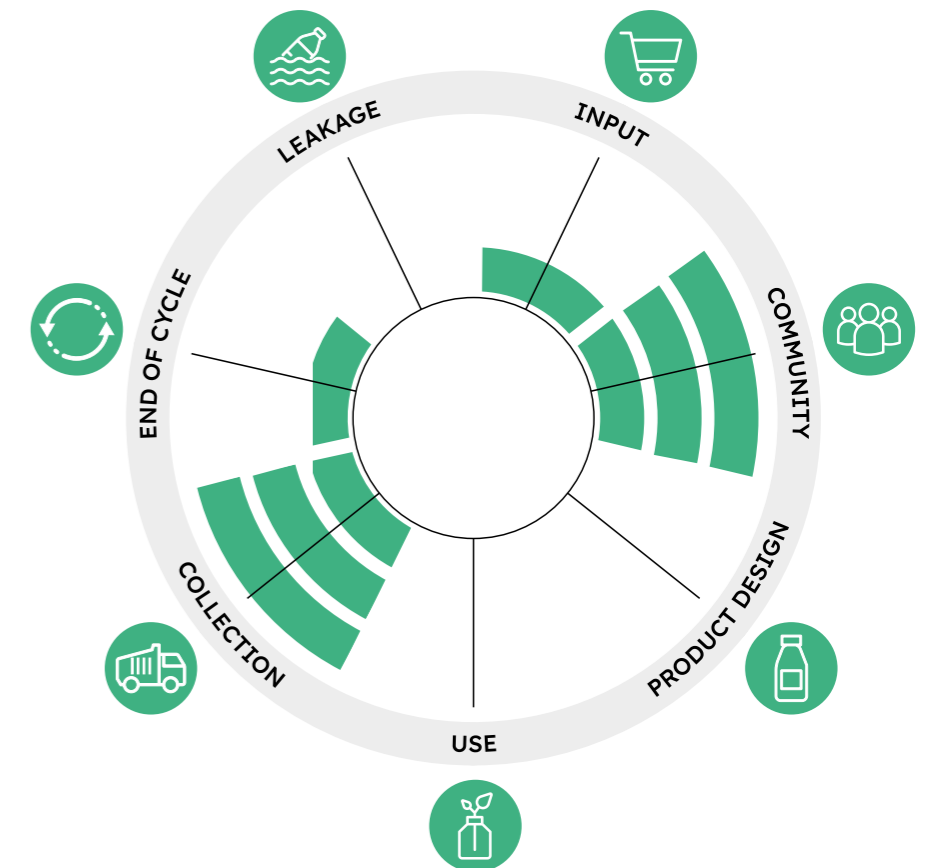
During the Urban Ocean gap assessment phase, the city led participatory workshops to identify the main opportunities for improving the waste management sector in the city, while building more resilient societies and economies. The opportunity areas that were prioritized and explored were:

- Study – Understanding behavioral challenges in citizens.

- Campaign – Raising citizen awareness of waste segregation and 3R opportunities.

- Program – Designing CSR engagement for plastic producers through the Indonesian Packaging Recovery Organization (IPRO).

- Governance – Setting up appropriate waste management governance/model to enforce regulation.

- Projects – Review and upgrade of waste banks and TPS3Rs.

Translating the Opportunities into a Project

The project below has been designed not only to address these identified challenges, but also to make use of the friendly national regulatory environment for circularity and for strengthening the role of municipalities in waste management, particularly in recycling for Semarang City. It considers the existing partnerships with multiple stakeholders, including NGOs, universities and the private sector, with whom the city has been testing different business models and technologies for collecting recyclable waste. These experiences have demonstrated a gap between the collection and treatment of materials, highlighting the need for the city to promote and enforce actions that enable treatment, recycling and recovery of recyclable materials. Therefore, the city recognizes the need to invest in technology and infrastructure to actively transform its recycling industry into a more sustainable, equitable and robust one, while enhancing the enabling regulatory and partnership environment towards building circularity and resilience.

The City Council is already exploring solutions that address the challenges that have been raised into a project, namely the adaptive waste management models and inclusive waste governance. Viewed through a resilience lens, the project is designed to promote environmental, social and economic co-benefits to the city's economies and population.

Goal

This project's goal is to lead a circular economy transformation in Semarang. In line with the Semarang resilient strategy, key impacts expected from the transformation are:
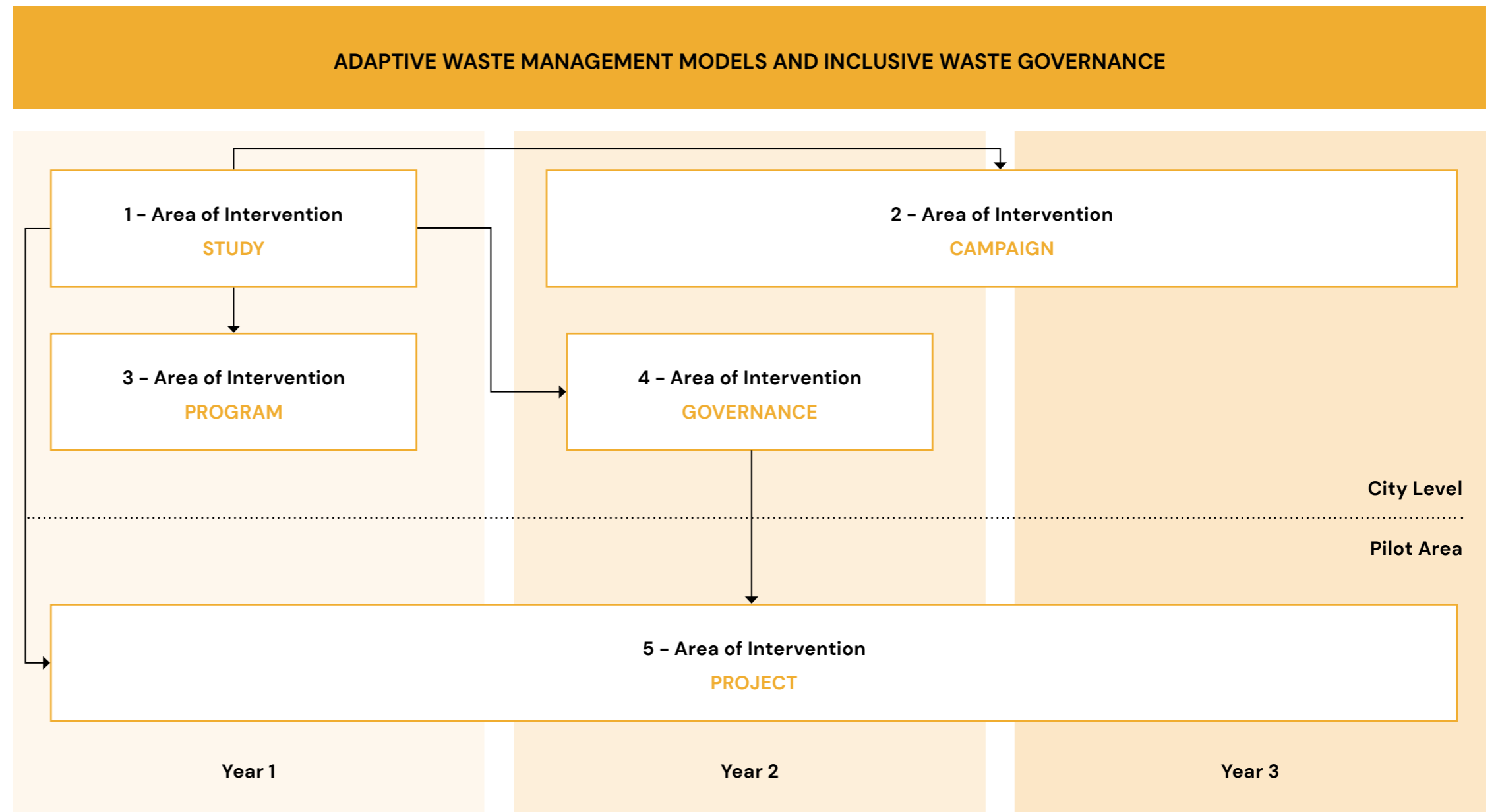
- Waste services coverage (increase to **70 percent** by 2025) – more **than 1.1 million** people to have access to waste collection.

- Amount of waste managed by households/reduced to be transported to landfill (increase to 30% by 2025).

- Waste recycling – 177 TPS3Rs will reduce overall waste generation by 6,152.8 tons/year.
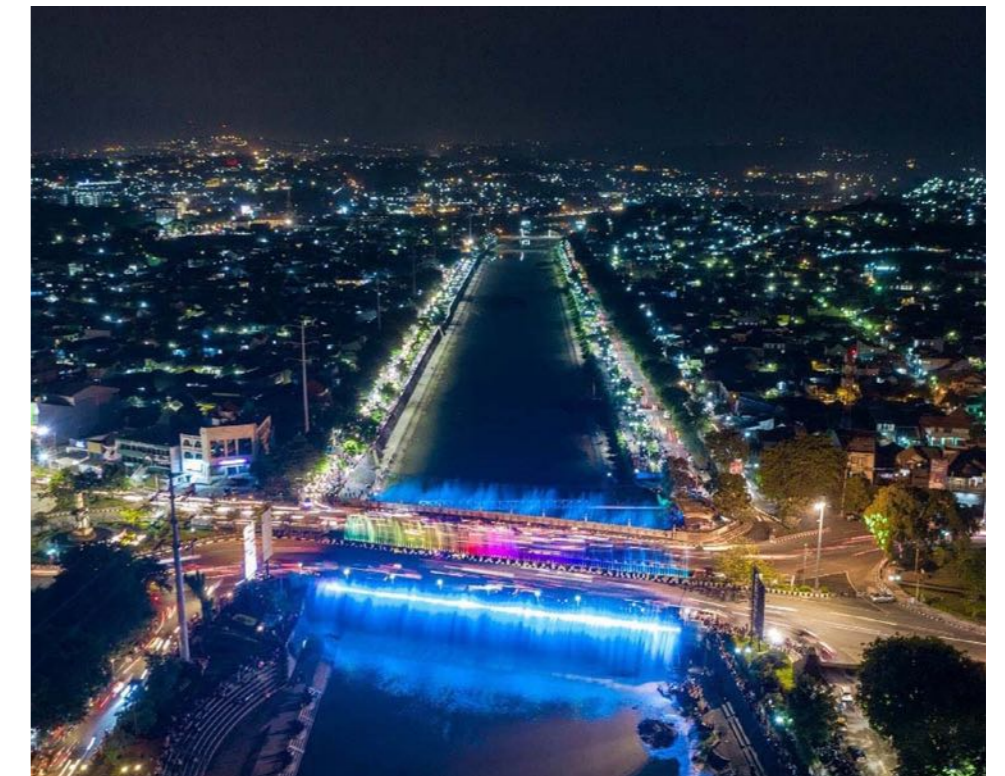
Project
Description

Semarang has various community-level models of waste management, which have been invented as a response to challenges and gaps in the system. These models work. The key opportunity, however, will be to deploy these models in an integrated way under the city government's mandate and/or institutional framework. This intervention will also include studying citizen behavior, including in the informal sector where waste collection activities are performed, to which businesses using plastic packaging are linked and with which the the private sector responsible for producing such packaging materials connects.

Semarang will **promote adaptive waste management models and inclusive waste governance** (see figure on the right) in the city, to be piloted at the micro-level in two neighborhoods. There will be five main activities: Study, Campaign, Program, Governance and Project. The Study and Program activities will be implemented at the city level, while the Campaign, Governance and Project activities will be focused at the micro-/ neighborhood level.

ADAPTIVE WASTE MANAGEMENT MODELS AND INCLUSIVE WASTE GOVERNANCE

1 – Area of Intervention
STUDY

2 – Area of Intervention
CAMPAIGN

3 – Area of Intervention
PROGRAM

4 – Area of Intervention
GOVERNANCE

City Level

Pilot Area

5 – Area of Intervention
PROJECT

Year 1

Year 2

Year 3

1 - Study

OVERVIEW

The study will be conducted to understand interventions to enhance neighborhood waste collection. As Semarang has various typologies of communities, the analysis can enrich the knowledge in future tailored–made waste management interventions to create more adaptive waste management. Hence this study activity aimed at understanding the waste handling in Semarang city.

ENABLING ENVIRONMENT & LOCAL RESOURCES

Existing infrastructure

- Potential collaboration with University of Georgia
- Collaboration with universities in Semarang
- Study by the environmental agency and BAPPEDA

Environmental condition

- Study on optimizing waste retribution for increasing city revenue
- 'Buku Putih Pengelolaan Sampah' (Semarang waste management profile book) [11]

EXPECTED IMPACT

Understanding behavioral challenges in citizens

SDG

Responsible Consumption and Production

Target 12.5
By 2030, substantially reduce waste generation through prevention, reduction, recycling, and reuse

RESILIENCE VALUE

- Reducing waste upstream can reduce the financial burden on the city of Semarang.
- Reducing GHG emissions from Jatibarang landfill.
- The communication and awareness-raising activities must be designed to promote social cohesion, participation and inclusion.
- Strengthening community engagement, especially in waste management through TPS3Rs.
- Increasing awareness of the private sector of environmental conditions in the city.
- Creating job opportunities in community-level waste management.

ACTIVITIES FOR IMPLEMENTATION

Behavior study/mapping on people's awareness —understanding community behavior and the barrier(s) to waste segregation.

Study on waste governance —mapping existing waste management and the governance of waste management at city and community levels.

Study on the various waste handling mechanisms in Semarang's peri-urban area.

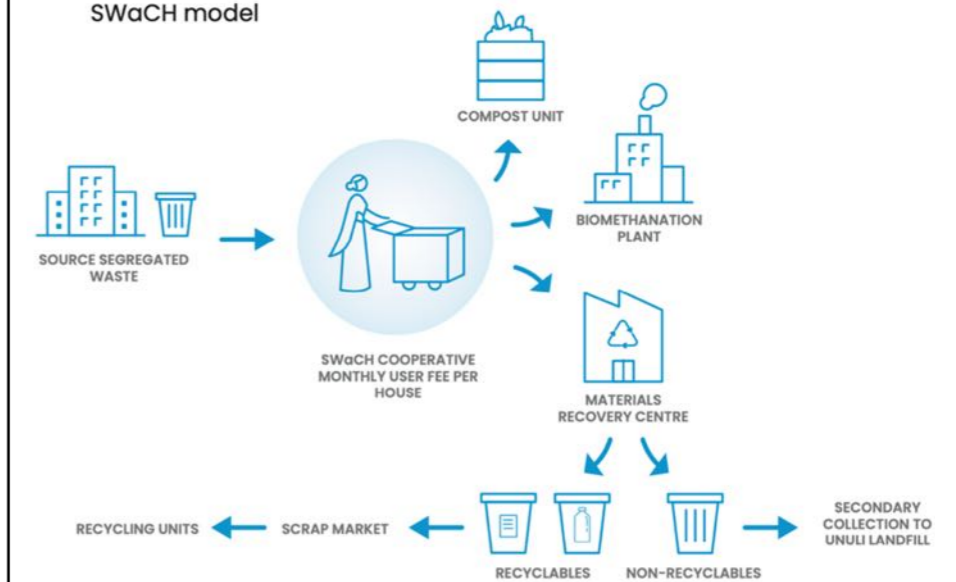Study model for full waste management.

Study on the ability to pay for waste collection.

Study to map the existing waste management infrastructure and its capacity for handling.

INSPIRATION

SWaCH model

Pune, India

In Pune (India), informal waste pickers form a significant part of the waste management system. What is different to other cities is the way they collaborate with the city government through SWaCH, Pune's pro-poor public-private partnership wholly owned by self-employed waste workers. SWaCH bolsters the socio-economic position of waste pickers while creating a more sustainable and efficient solid waste management system. SWaCH has a comprehensive approach to strengthening informal waste pickers' position and integrating them into the cooperative. Involvement of all stakeholders, including the city council, has enabled SWaCH to become the best example to other cities in handling the informality of waste management. A council advocates for workers' rights and liaises with Pune Municipal Council on safety requirements, benefits and contracts. Waste pickers who become part of SWaCH receive an identification card and are provided with access to government schemes for medical insurance and pensions and a waste picker help desk.

2 - Campaign

OVERVIEW

Awareness will be raised locally based on the study of community behavior (action 1). This co created intervention will include community groups in the pilot area as the 'campaign's main target. Semarang City will work with a local NGO to conduct this campaign.

ENABLING ENVIRONMENT & LOCAL RESOURCES

Existing infrastructure

- GIZ PILAH[12]
- USAID CCBO[13]
- Potential collaboration through GEF[14]

Environmental condition

- One of the GIZ PILAH project locations in Kaligawe subdistrict to increase people's awareness of waste segregation
- Waste handling campaign[15] conducted by the Semarang Environmental Agency

EXPECTED IMPACT

Raising citizen awareness of waste segregation and 3R opportunities

SDG

Responsible Consumption and Production

Target 12.5
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RESILIENCE VALUE

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- Increasing awareness of the private sector of environmental conditions in the city.
- Creating job opportunities in community–level waste management.

ACTIVITIES FOR IMPLEMENTATION

Design the campaign model to raise city awareness.

Develop a partnership with an NGO to engage local community groups.

Training and dissemination on waste management and segregation aspects in the pilot area.

3 - Program

OVERVIEW

The city has an opportunity to connect with the IPRO in Semarang and it can start an initiative with the IPRO to create a CSR engagement platform for local plastic producers and industry partners on plastic waste reduction, recycling and introducing better packaging alternatives policies/initiatives.

ENABLING ENVIRONMENT & LOCAL RESOURCES

The current CSR program from private sectors in Semarang

EXPECTED IMPACT

Designing CSR engagement for plastic producers through the IPRO

SDG

Sustainable Cities and Communities
Target 11.3

By 2030, enhance inclusive and sustainable urbanization and capacity for participatory, integrated, and sustainable human settlements planning and management in all countries

RESILIENCE VALUE

- Reducing waste upstream can reduce the financial burden on the city of Semarang.
- Reducing GHG emissions from Jatibarang landfill.
- The communication and awareness-raising activities must be designed to promote social cohesion, participation and inclusion.
- Strengthening community engagement, especially in waste management through TPS3Rs.
- Increasing awareness of the private sector of environmental conditions in the city.
- Creating job opportunities in community-level waste management.

ACTIVITIES FOR IMPLEMENTATION

Survey on private sectors interest/capacity. to ensure relevant engagement.

Develop communication and coordination with the private sector in connection with IPRO

Develop partnerships with local/regional NGOs that have connections to IPRO.

Platform development for the CSR/private sector hub in plastic waste management.

4 - Governance

OVERVIEW

Semarang city has adopted relevant regulation; however, its implementation lacks enforcement. The city will test the appropriate waste management mechanisms for both community and private sectors in the two pilot locations based on the study conducted (action 1).

EXPECTED IMPACT

Setting up appropriate waste management governance/model to enforce regulation

SDG

11 **Sustainable Cities and Communities**
Target 11.3

By 2030, enhance inclusive and sustainable urbanization and capacity for participatory, integrated, and sustainable human settlements planning and management in all countries

ACTIVITIES FOR IMPLEMENTATION

Mapping of existing waste collectors in pilot areas

Designing the governance structure.

Develop a partnership with local NGOs and university to formulate the enforcement mechanism and testing.

Draft policy on waste management to enforce the circular economy.

ENABLING ENVIRONMENT & LOCAL RESOURCES

Existing infrastructure

• GIZ PILAH

• USAID CCBO

• Potential collaboration through GEF

Environmental condition

• Both Ngaliyan and Kaligawe subdistricts have TPS3Rs and already have community groups active in waste management.

• Waste segregation managed by the TPS3R

• Waste pickers hired by their neighborhood

RESILIENCE VALUE

• Reducing waste upstream can reduce the financial burden on the city of Semarang.

• Reducing GHG emissions from Jatibarang landfill.

• The communication and awareness-raising activities must be designed to promote social cohesion, participation and inclusion.

• Strengthening community engagement, especially in waste management through TPS3Rs.

• Increasing awareness of the private sector of environmental conditions in the city.

• Creating job opportunities in community-level waste management.

5 - Project
Review and Upgrade of Waste Banks and TPS3Rs

OVERVIEW

TPS3Rs and waste banks are the two most promising initiatives to enhance the city's waste collection, stop leakage and, ultimately, enhance the entire waste management cycle. In this action, the city will review the active TPS3R and waste-bank approaches, upgrade the waste segregation and sorting facilities at selected TPS3Rs and increase the staff capacity to manage the intervention. Currently, some upgrading interventions for the TPS3Rs and waste banks are being carried out by a local NGO (Bintari) in collaboration with GIZ; DLH (environmental agency) is the implementing authority from the local government.
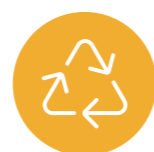
ENABLING ENVIRONMENT & LOCAL RESOURCES

Existing infrastructure

- GIZ PILAH
- USAID CCBO

Environmental condition

- Some upgrades in Kaligawe have been made

EXPECTED IMPACT

Review and upgrade of waste banks and TPS3Rs

SDG

Responsible Consumption and Production

Target 12.5
By 2030, substantially reduce waste generation through prevention, reduction, recycling, and reuse

RESILIENCE VALUE

- Reducing waste upstream can reduce the financial burden on the city of Semarang.
- Strengthening community engagement, especially in waste management through TPS3Rs.
- Creating job opportunities in community-level waste management.

ACTIVITIES FOR IMPLEMENTATION

Reviewing current TPS3Rs and waste banks and their financing mechanisms.

Working with local NGOs and the private sector to upgrade the TPS3Rs.

Engaging potential collaboration with the current development of waste marketplace application developed by Bintari to be tested in the two pilot locations.
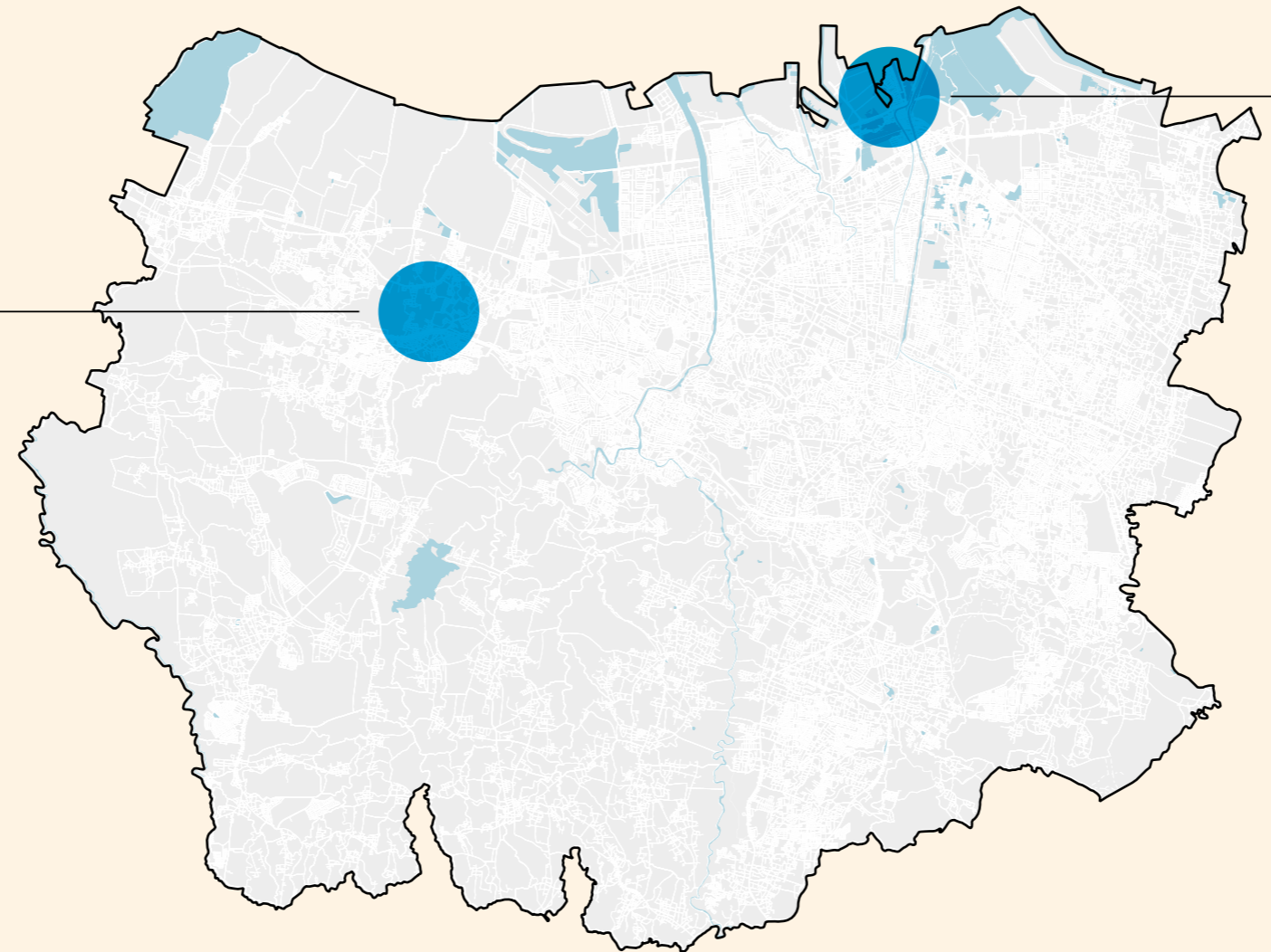
Designing the upgrade plan and potentially scale-up the approach to all neighborhoods in the city.

The project will be piloted in two subdistricts with different characteristics: Ngaliyan and Kaligawe.

Pilot site
Ngaliyan Subdistricts

Pilot site
Kaligawe Subdistricts

NGALIYAN

TPS3R in Ngaliyan

Ngaliyan subdistrict is located in the western part of Semarang. It is a fast-growing subdistrict consisting of 87 RTs and 12 RWs, with a population of about 13,468 in 2019.

Ngaliyan is form of mixed settlement types, including housing complexes, kampong (village) and Kawasan Industri Candi (an industrial zone). The neighborhood lacks waste collection from households to the TPS and lacks waste segregation at the household level. In addition, commercial activities are increasing in the area, causing more waste to be generated..

There is a TPS3R located in the neighborhood, close to the TPS. The TPS3R operator partially serves as a transport and sorting officer for the TPS. The waste transportation operations cover 2 RWs, or about 208 families. The waste collection by TPS3R operator is scheduled for every two days, while third parties serve other RW areas that are not covered by the TPS/TPS3R. Each household has to pay IDR15,000 for the service, which is managed by each RT.

The TPS3R previously had fertilizer processing activity. Laboratory tests revealed the fertilizer to be the second best in the city of Semarang. However, this activity has been shut down due to a lack of marketing or operation strategy. On the other hand, the non-organic waste sorting activities have not been optimal and are constrained by the scale of plastic waste that is not properly sold.

KALIGAWE

TPS3R Mandiri in Kaligawe

Kaligawe subdistrict is located by the coast, in the northern part of Semarang, adjacent to the industrial zone. Its population in 2019 was 10,562, with 76 RTs and 10 RWs. The settlement consists of a low- to medium-income housing complex and flats, and itis prone to tidal inundation and flooding.

Currently, the waste management system in Kaligawe is under the responsibility of the community group Kelompok Swadaya Masyarakat Mandiri, which is under the auspices of the community institution Badan Keswadayaan Masyarakat. The group consists of 16 waste collection officers who serve seven RWs and three officers responsible for waste sorting before it enters the transfer station container.

There are two TPSs and in addition, the community group has initiated community waste management through TPS3R development with the support of the Semarang Environmental Agency in 2018. However, the capacity of their collection is still limited.

The TPS3R activities range from transportation to sorting. At the beginning of its operation, the facility was equipped with a fertilizer processor, which struggled to survive due to its high operational and marketing costs.

Further understanding
the resilience value

This initiative has been designed under the premise of being a resilient project. Not only will it transform the recycling industry into a more robust and innovative one that can be adapted to the needs of the city, but it will also develop more interconnected systems, so Panama City is more prepared to survive and thrive from the shocks and stresses it faces. Conceptually, this means thinking about this project from three perspectives:

- How the project itself demonstrates qualities of resilience, so that it is in a better position to handle external shocks and stresses.

- How the project contributes to the resilience of the city, considering its direct and indirect impacts.

- How the operation of the project is influenced by the resilience of the city environment in general (positively or negatively).

Beyond the immediate objectives to be achieved, the transformation sought will include and maximize all the "co-benefits" generated by the project that contribute to the structural, community and/or individual resilience of the citizens of Semarang City. For this, the link between the recycling industry and the city, the region and even the nation will be considered, including the interdependencies between the existing social, environmental, economic and institutional systems.

The City Resilience Framework identifies seven qualities of resilience that any urban system must incorporate so that it can resist, respond and adapt more quickly to the shocks and stresses it faces. So, this initiative – understood as a system integrated into the city – is designed considering the following qualities of resilience:

REFLECTIVE	Systems that have mechanisms to continuously evolve and will modify standards or norms based on emerging evidence, learning from past experiences.	Under the circularity program, municipal capacity will be created to monitor, track and evaluate results from all components of the project.
ROBUST	Systems that include well-conceived, constructed and managed physical assets so they can withstand the impacts of shocks and stresses.	The design of TPS3R will investigate the possibility of designing for building efficiency as well as including social programs for training the workforce, etc.
REDUNDANT	Systems that create spare capacity purposely to accommodate disruption, extreme pressure and surges in demand.	The project is designed to strengthen the recycling sector in the city; therefore, more recycling businesses will be created.
FLEXIBLE	Systems that can change, evolve and adapt in response to changing circumstances.	The location being defined for the recyclables sorting and treatment facility takes into consideration the possibility of expansion depending on necessity, including if other districts decide to use it as well.
RESOURCEFUL	Systems that can rapidly find different ways to achieve their goals or meet their needs during a shock or under stress.	The project is structured to create job opportunities in community-level waste management.
INCLUSIVE	Systems that emphasize the need for a broad consultation and engagement of communities.	• The project has a multistakeholder approach, working with the private sector, univerisities, communities and NGOs. • The project will strengthen community engagement. • The project will increase awareness, especially among the private sector, of environmental conditions in the city.
INTEGRATED	Systems that promote consistency in decision-making and ensure that all investments are mutually supportive to a common objective.	• The project is completely connected: by reducing waste upstream, it is expected to reduce the financial burden on the city. • The project has the potential to improve various urban systems, including by reducing GHG emissions.

Roadmap for implementation

Institutional Arrangements

Several actors are involved in in Semarang waste management, including local government, the private sector, universities and local NGOs. Bappeda (the Planning and Development Board), the Environmental Agency (DLH) and the Housing and Settlement Areas Agency serve as regulators, while Landfill UPTD[16] (Unit Pelaksana Teknis Dinas – Technical Implementation Unit) and Regional UPTD (Regions I–IV) serve as operators.

ACTIONS	PLANNING	MONITORING AND EVALUATION	IMPLEMENTATION
Study	• Bappeda • DLH	• Bappeda • DLH	• Universities [17] • NGOs[18] • Research groups
Campaign	• Bappeda • DLH	• DLH	• DLH • Universities • Research groups • Community groups • Private sector companies[19]
Program	• Bappeda	• Bappeda	• IPRO • NGOs • Private sector companies
Governance	• Bappeda • DLH	• Bappeda • DLH	• DLH • Universities • NGOs • Community groups in Kaligawe and Ngaliyan subdistricts • Housing and Settlement Agency • Public Works • Spatial Planning Agency
Project	• Bappeda • DLH	• Bappeda • DLH	• NGOs • Community groups in Kaligawe and Ngaliyan subdistricts • Housing and Settlement Agency • Public Works

Implementation Timeline

PROJECT ACTIVITY	Year 1				Year 2				Year 3				BUDGET ESTIMATION (USD)
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	
1. STUDY – Understanding behavioral challenges in citizens													50,000
Behavior study/mapping on people's awareness	■												
Study on waste governance		■											
Study on the various waste handling mechanisms in Semarang's peri–urban area		■	■										
Study model for full waste management		■	■										
Study on the ability to pay for waste collection	■												
Study to map the existing waste management infrastructure and its capacity for handling	■	■											
2. CAMPAIGN – Raising citizen awareness of waste segregation and 3R opportunities													20,000
Designing the campaign model to raise city awareness					■	■							
Develop a partnership with an NGO to engage local community groups						■	■	■					
Training and dissemination on waste management and segregation aspects in the pilot area									■	■	■	■	
3. PROGRAM – Designing CSR engagement for plastic producers through IPRO													20,000
Survey on the private sectors' interest/capacity	■												
Develop communication and coordination with the private sector in connection with IPRO		■											
Develop partnerships with local/regional NGOs that have connections to IPRO		■	■										
Platform development for the CSR/private sector hub in plastic waste management			■	■									
4. GOVERNANCE – Setting up appropriate waste management governance/model to enforce regulation													30,000
Mapping of existing waste collectors in pilot areas					■								
Designing the governance structure						■							
Develop a partnerships with local NGOs and university to formulate the enforcement mechanism and testing							■	■					
Draft policy on waste management to enforce the circularity							■	■					
5. PROJECT: Review and Upgradation of waste bank and TPS3R													200,000 (100,000 for each pilot)
Reviewing current TPS3Rs and waste banks and their financing mechanism	■	■											
Develop a partnership with local NGOs and the private sector for upgrading the TPS3R	■	■	■	■	■	■	■						
Engaging potential collaboration with the current development of waste marketplace application developed by Bintari to be tested in the two pilot locations	■	■	■	■									
Designing the upgrade plan and potentially scale up the approach to all neighborhoods in the city									■	■	■	■	

Annex

OPPORTUNITIES	REGULATION
STUDY – Understanding behavioral challenges in citizens	• National law number 18, 2008 — waste management and waste handling in Indonesia • National law number 32, 2009 — Environmental Protection and Management • National law number 23, 2014 — Regional Government • Government Regulation Number 81, 2012 — Management of Household Waste and Similar Household Waste • Government Regulation Number 21, 2021 — Implementation of Spatial Planning • Presidential Regulation Number 97, 2017 — National Policies and Strategies for the Management of Household Waste and Similar Household Waste • Semarang City Regulation Number 14, 2011 — Spatial Planning of Semarang City of 2011–2031 • Semarang City Regulation Number 5, 2021 — Amendment to Regional Regulation Number 14 of 2011 concerning Spatial Planning of Semarang City 2011–2031 • Semarang City Regulation Number 2, 2012 — Public Service Retribution in Semarang City • Semarang City Regulation Number 6, 2012 — Waste Management. • Mayor Regulation Number 37, 2015 — Implementation Guidelines\Regional Regulations of the City of Semarang Number 6, 2012 concerning Waste Management • Mayor Regulation Number 18, 2018 — Changes in Tariffs for Retribution for Waste/Cleaning Services and Retribution for the Provision and/or Vacuuming of Toilets • Mayor Regulation Number 52, 2018 — Instructions for Implementing Retribution for Waste management Services and Retribution for the Provision and/or Vacuuming of Toilets in the City of Semarang • Mayor Regulation Number 79, 2018 — Regional Policies and Strategies in the Management of Household Waste and Waste Similar to Household Waste as amended by Mayor Regulation Number 34, 2019 concerning Amendments to the Mayor Regulation Number 79, 2018 concerning Policies and Strategies Regions in the management of household waste and similar household waste
CAMPAIGN – Raising citizen awareness of waste segregation and 3R opportunities	• Mayor Regulation Number 37, 2015 — Implementation Guidelines\Regional Regulations of the City of Semarang Number 6, 2012 concerning Waste Management • Mayor Regulation Number 18, 2018 — Changes in Tariffs for Retribution for Waste/Cleaning Services and Retribution for the Provision and/or Vacuuming of Toilets • Mayor Regulation Number 52, 2018 — Instructions for Implementing Retribution for Waste management Services and Retribution for the Provision and/or Vacuuming of Toilets in the City of Semarang • Mayor Regulation Number 79, 2018 — Regional Policies and Strategies in the Management of Household Waste and Waste Similar to Household Waste as amended by Mayor Regulation Number 34, 2019 concerning Amendments to the Mayor Regulation Number 79, 2018 concerning Policies and Strategies Regions in the management of household waste and similar household waste
PROGRAM – Designing CSR engagement for plastic producers through IPRO	• Mayor Regulation Number 37, 20151 — Implementation Guidelines\Regional Regulations of the City of Semarang Number 6, 2012 concerning Waste Management
GOVERNANCE – Setting up appropriate waste management governance/ model to enforce regulations	• Semarang City Regulation Number 6, 2012 — Waste Management. • Mayor Regulation Number 37, 2015 — Implementation Guidelines\Regional Regulations of the City of Semarang Number 6, 2012 concerning Waste Management • Mayor Regulation Number 18, 2018 — Changes in Tariffs for Retribution for Waste Management Services and Retribution for the Provision and/or Vacuuming of Toilets • Mayor Regulation Number 52, 2018 — Instructions for Implementing Retribution for Waste management Services and Retribution for the Provision and/or Vacuuming of Toilets in the City of Semarang • Mayor Regulation Number 79, 2018 — Regional Policies and Strategies in the Management of Household Waste and Waste Similar to Household Waste as amended by Mayor Regulation Number 34, 2019 concerning Amendments to the Mayor Regulation Number 79, 2018 concerning Policies and Strategies Regions in the management of household waste and similar household waste
PROJECT: Review and upgrade of waste bank and TPS3R	• Mayor Regulation Number 37, 2015 — Implementation Guidelines\Regional Regulations of the City of Semarang Number 6, 2012 concerning Waste Management • Mayor Regulation Number 18, 2018 — Changes in Tariffs for Retribution for Waste Management Services and Retribution for the Provision and/or Vacuuming of Toilets • Mayor Regulation Number 52, 2018 — Instructions for Implementing Retribution for Waste management Services and Retribution for the Provision and/or Vacuuming of Toilets in the City of Semarang • Mayor Regulation Number 79, 2018 — Regional Policies and Strategies in the Management of Household Waste and Waste Similar to Household Waste as amended by Mayor Regulation Number 34, 2019 concerning Amendments to the Mayor Regulation Number 79, 2018 concerning Policies and Strategies Regions in the management of household waste and similar household waste

Endnotes

[1] Intergovernmental Panel on Climate Change (2021). Report on Climate Change 2021: the Physical Science Basis. Link: www.ipcc. ch/report/sixth-assessment-report-working-group-i

[2] World Bank (2020). Link: https://blogs.worldbank.org/ developmenttalk/new-poor-are-different-whothey-are-and-why-it-matters

[3] International Labour Organization (2018). World Employment Social Outlook; Eunomia (2015). The potential Contribution of Waste Management to a Low Carbon Economy. www.eunomia. co.uk/reports-tools/the-potential-contribution-of-waste-management-to-a-low-carbon-economy

[4] WRI (2021). 5 Opportunities of a Circular Economy. Link: https:// www.wri.org/insights/5-opportunities-circular-economy

[5] Semarang City CBS (2022).

[6] Adipradana (2020).

[7] Resilient Cities Network (2021). Circularity Assessment Protocol – Semaragan, Indonesia. https://resilientcitiesnetwork.org/ downloadable_resources/UR/UO/Semarang-Report-2021-09-03-reduced.pdf

[8] **Waste banks** operate at the community level on various scales, using similar principles to monetary banking. However, instead of depositing money, people deposit waste that can be recycled.

[9] **TPS3Rs** (transfer stations with reduce-reuse-recycle principles) cover at least 400 households.

[10] **TPSTs** are integrated waste management transfer stations with bigger capacity than TPS3Rs and have their own waste processing facilities.

[11] Bappeda Kota Semarang (2020). Buku Putih Semarang Kelola Sampah. https://bappeda.semarangkota.go.id/kategori/1/buku-putih-semarang-kelola-sampah

[12] GIZ PILAH is a program proposed by the GIZ which focused on reducing waste leakage in Semarang.

[13] USAID Clean Cities Blue Ocean (CCBO) is a program agreed between the Government of the Republic of Indonesia, through the Ministry of National Development Planning/Bappenas, and the United States Government through USAID Indonesia.

[14] The Global Environment Facility (GEF) and the World Bank provide support for the Sustainable Cities Impact Project (SCIP) in Indonesia; the project aims to build cityies' capacity to incorporate biodiversity and climate-smart management designs, in addition to infrastructure and nature-based solutions, in sub-projects across sectors (waste management, urban biodiversity, transport, energy efficiency, etc.)

[15] Pemerintah Kota Semarang (2021). DLH Terus Sosialisasikan Pilah Sampah https://semarangkota.go.id/p/2834/dlh_terus_sosialisasikan_pilah_sampah

[16] UPTD is a unit under the Environmental Agency.

[17] Universities include Diponegoro University, Semarang State University, UNIKA.

[18] NGOs include Bintari, IKUPI, Kota Kita.

[19] Private sector companies include PT. Indofood, Marimas, Coca-Cola, Phapros.