Rotterdam’s Residential Waste Solutions

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This case study has been developed as part of Urban Ocean, one of Resilient Cities Network’s multi-city programs, co-designed and delivered with our partners Ocean Conservancy and The Circulate Initiative. Urban Ocean supports cities in assessing their risks and vulnerabilities as well as gaps in their waste management systems that lead to plastic leakage into the environment and the ocean. It helps cities to identify actions, design better projects and innovative solutions, leverage partnerships, and finally connects cities and their projects to potential funding sources.

Urban Ocean is currently being implemented in six cities in Asia and Latin America and supported by five cities in Europe and Asia Pacific that help their peers to develop projects that allow them to address current and future challenges. The program has a strong emphasis on peer-to-peer learning and knowledge exchange.

The case study series aims to highlight good examples in resilient urban waste management from across the world, and were selected with the following guiding criteria in mind:

- The initiative addresses multiple shocks and stresses
- The initiative exhibits multiple qualities of resilience
- The initiative yields multiple benefits, as it contributes to the overall resilience of both the waste management system and the city as a whole

CASE STUDY TAGS
- SUSTAINABLE AND CIRCULAR SOLUTIONS
- PROSPEROUS AND ENGAGED COMMUNITIES

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Rotterdam is a dense urban environment with households producing a significant amount of waste. The City took on the challenge of addressing multiple concerns with municipal waste, including: inefficient collections, unsanitary conditions, garbage occupying valuable public space, and waste worker safety. Through partner efforts with the public the city optimized waste collection and recycling, launched initiatives to reduce both household waste, as well as waste from material value chains. By 2050, the City aspires to be fully circular.

### Shocks and stresses
- **Disease Outbreaks**
  - Public health risk of pests and diseases
- **Working Conditions**
  - for waste workers
- **Lack of Public Space**
  - Impacting quality of life

### Qualities of resilience
- **Inclusive**
  - Residents are involved in the maintenance of the containers, and get a say in the location
- **Integrated**
  - A city-wide approach to waste collection
- **Flexible**
  - Collection frequency and routes are based on live demand
Rotterdammers produce around 270,000 tons of raw materials and residual waste per year.
Rotterdam is the second-largest city in the Netherlands, with a current population of just over 650,000 residents. The city is part of a wider metropolitan area that is home to 2.6 million people. The port of Rotterdam is by far the largest in Europe, and one of the reasons for the international and diverse population of over 170 different nationalities. Altogether, its residents produce around 270,000 tons of raw materials and residual waste per year.

In a dense urban environment where 75% of buildings are stacked or high-rise, collecting waste from households poses challenges. Until the mid-1990s, households in Rotterdam disposed of their residual waste by putting their bin bags on the curbside the evening prior to the collection day. Not only was this an eyesore for communities, taking up valuable public space, it also caused littering due to birds and rats pulling the bags apart - increasing the number of pests which can spread diseases, unsanitary conditions for waste workers picking up the bags and litter, and indoor health issues by having to keep waste indoors until the collection day. On top of this, the collection system lacked efficiency: waste workers had to operate based on standardized routes without a way to assess real-time demand for collection.

1 City of Rotterdam, 2020
2 City of Rotterdam, 2019
3 City of Rotterdam, 2019
To address public health risks, improve working conditions for waste workers, and enhance the quality of public space, in 1996 the Waste Management Department of Rotterdam developed an underground container system serving as a temporary waste storage facility until collection.

Nearly all containers are located on government-owned land throughout neighborhoods and are accessible to residents at all times. Each container for residual waste has capacity for 100 homes, while containers for glass, paper and cardboard, and textiles serve a higher number of households each. Importantly, the underground containers are sealed off completely and not accessible to animals to avoid pests and spreading of diseases. As the temperature is lower underground, it also reduces bad smell.

With waste temporarily stored, the municipal waste service can run their collection services at times more convenient to them. Waste workers no longer need to manually pick-up bin bags, but instead use a fleet of trucks that lift and empty the bin directly into the back of the truck. Initially bins were emptied 2 or 3 times a week, but nowadays the containers are equipped with fill level sensors which measure how full the container is. This information feeds into the collection system to optimize the routes and timing, which also varies seasonally. Technology is more and more embedded in the waste sector and is helping to reduce the mileage of waste vehicles—lowering carbon emissions and extending the lifecycle of collection trucks.

Nowadays the containers are equipped with fill level sensors which measure how full the container is.

**Approach**

**Fill level data for a container in Rotterdam**

*source: City of Rotterdam*
Rotterdam Container Map

Mapping pick-up routes live

photo by David Rozing
The new system was first introduced in a neighborhood with known waste collection issues. Key steps included assessing the necessary storage capacity per number of inhabitants. The containers needed to be located only a short walking distance for each household. Another step focused on mapping the underground in collaborating with the engineering department: how much space is available for a container? When the results from the initial pilot came back positive, a large-scale program was rolled out to introduce the underground containers throughout the city over the course of 10 years.
At present there are 6664 underground containers in the Rotterdam\(^4\) that residents can access 24/7. Over 270,000 tons of waste is collected through this system every year. Each new development is now provided with underground containers. Collection frequency and routes are optimized with data from fill sensors, providing waste workers with an efficient as well as safe and sanitary collection system. When the container system was introduced, it was largely ran by the waste management department. Over time, comprehensive guidelines were developed together with the urban planning department to ensure containers are anticipated into the designs.

While citizen engagement was not a key part from the outset, nowadays there are neighborhoods which select their own locations for the containers. If the underground infrastructure allows it, the containers will be placed according to their preference. Furthermore, residents always have the opportunity and right to send in a different view to the municipality’s proposal, and plans will be changed if their suggestion adds more value.

Since 2015, Rotterdammers have also been able to ‘adopt’ the underground containers. Research showed that residents are keen to be involved in keeping their local area clean – and when the municipality opened the volunteering scheme, over 900 container adopters signed up. They are equipped with tools to ensure the space around containers are tidy. Besides keeping an eye on their local container and flag if for example a bag is stuck, their presence discourages fellow residents to litter around the bins, or put their waste next to the container. The City continues to recruit new bin adopters to collectively keep the city clean and create shared ownership.

To optimize the waste management system and accommodate a growing population, Rotterdam is trialing ways to further improve their services. In the borough of IJsselmonde, the municipality has piloted the addition of

\(^4\) City of Rotterdam, not dated
a ‘compactor’ to existing containers. As the name suggest, this packs the waste in the container more compactly, doubling the capacity from 100 to 200 homes per container. This is especially valuable in inner-city areas where space is limited but population density is higher.

In addition, while there is competition for public space above ground, the same goes for space underground. Moving pipes or cables is expensive, and sometimes district heating systems block the potential of placing an underground container. Therefore, Rotterdam will experiment with narrower containers to mitigate these limitations and fit easier into existing underground infrastructure. The City is also looking to automate signaling of defect fill sensors, and further improve data collection efforts by integrating other data sets, such as complaints from residents. Another trial is focused on installing LED indicators on the containers, so residents can see when the container is full.

Rotterdam was the first city in the Netherlands to implement an underground container system, and has inspired many other cities across the country to do the same. Some have opted to use a similar system while keeping the containers above ground or semi-underground, as it is easier and less costly to implement. Although the concept behind the underground container is not complex, for cities considering implementing a similar system, it is worth bearing in mind:

**SPACE AVAILABILITY**
The availability of space and public or private land ownership to accommodate the locations of containers

**LONG-TERM CAPACITY**
Ensuring there is long-term human- and financial capacity to maintain the system

**WIDER RECYCLING SYSTEM**
Considering how the system interacts with the wider recycling system and what is possible depending on the type of housing (how many bins need to be provided for each type of waste for example, and the difference between high-rise and low-rise housing)

5 City of Rotterdam, 2019
While the City has several plans in place to optimize waste collection and recycling, the overall objective remains to reduce the amount of waste per inhabitant. When less waste is generated, pressures on waste collection are also alleviated. The short-term target is to decrease the residual waste by 47kg per inhabitant: from 296kg in 2018 to 249kg in 2022 per inhabitant per year. Furthermore, Rotterdam also works on prevention measures in the front end of the material value chain. Rotterdam has clear yet ambitious objectives: by 2030, the City wants circularity to become common practice in all sectors, aiming to reduce primary resource use by 50% and creating 3,500 to 7,000 jobs that contribute directly to the circular economy. By 2050, the City aspires to be fully circular, making waste an obsolete concept. Read more in the Circular Rotterdam report. 

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6 Metabolic and Circle Economy, 2018
Further Reading

City of Rotterdam (2020) Databank


City of Rotterdam (not dated) Map of containers

City of Rotterdam (not dated) Waste Guide


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