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WASTE WISE CITIES TOOL

Step by Step Guide to Assess a City's Municipal Solid Waste Management Performance through SDG indicator 11.6.1 Monitoring

Urban Pathways

GPML Global Partnership on Marine Litter

WASTE WISE CITIES

AFRICAN CLEAN CITIES PLATFORM
PLATE-FORME AFRICAINE DES VILLES PROPRES

Foreword

In our rapidly urbanizing world, the crisis in waste management and plastic pollution is a reflection of our unsustainable lifestyles. We are consuming and producing at a rate that boggles the mind.

With 2 billion people lacking access to solid waste collection and 3 billion people without access to controlled solid waste disposal facilities, urban dwellers, especially in low to middle income countries, are exposed to severe threats to public health due to the mismanagement of solid waste. However, if our waste is managed appropriately and effectively, it will be a resource for a prosperous circular economy, creating green jobs and enhancing the livelihood and income for the urban poor. At the same time, we can reduce the use of natural resources and protecting our environment.

Knowing the risks of mismanaging solid waste and the potential of sustainable waste management, many cities are eager to find solutions for the ever-increasing mountains of waste. That is why I launched the Waste Wise Cities programme on World Habitat day 2018 together with His Excellency, President Uhuru Kenyatta of Kenya, with a call to action to address the global waste management challenges and strive towards the Sustainable Development Goals (SDGs). In the past two years more than 170 cities have taken up the call and dedicated themselves to sustainable waste management.

However, without basic data on municipal solid waste generation and management, many cities and countries are not able to make evidence-based decisions. I recall that when I was Mayor of Seberang Perai in Malaysia, about 40% of the municipal revenues were going towards waste management. This meant that we could not allocate funds for parks, road works, healthcare, or public transport. Once we were able to map and understand better where waste was generated and how it was managed, we were able to reduce the overall cost of waste management. Eventually, we managed to reduce the share of the city's budget to 20% as the rate of recycling increased from 15% to 56%. Data is key to allow cities to identify effective policy interventions and allocate limited resources to build the right kind of infrastructure. In Nairobi, Kenya, the host city of UN-Habitat headquarters, we have worked with Nairobi City County Government in applying the Waste Wise Cities Tool – which led to the development of the Nairobi City County Sustainable Waste Management Action Plan 2020-2022.

The 2030 Agenda and the SDGs highlight waste management with different targets and indicators measuring the waste management performance both at municipal and national level (SDGs 11.6, 12.3, 12.4, 12.5 and 14.1). Measuring SDG Indicator 11.6.1, "Proportion of municipal solid waste collected and managed in controlled facilities out of total municipal solid waste generated, by the city", provides critical information and parameters to establish better waste and resource management strategies that will help cities to create business, employment and livelihood opportunities, and transition towards a circular economy.

UN-Habitat is mandated to develop the monitoring methodology for SDG indicator 11.6.1 and has worked closely with relevant UN agencies such as UN Statistics Division and UN Environment, as well as prominent waste management experts and environmental statisticians from all over the world. These common efforts have led to the development of the Waste Wise Cities Tool, a diagnostic tool that cities apply to assess their municipal solid waste management performance and use as basis for sustainable solid waste management planning.

This publication will be valuable for policy makers, municipal engineers, independent service providers, planners, consultants, researchers and other professionals engaged in designing solid waste management systems in cities lacking up-to-date data.

It is my hope that fact-based data on municipal solid waste assessed with this tool will guide evidence-based planning and lead to effective and efficient solid waste collection systems, enhanced local resource recovery and controlled waste disposal, thereby improving the quality of life for urban residents and eventually achieve the New Urban Agenda as well as the SDGs in the waste sector.

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Executive Director, UN-Habitat

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This publication is dedicated to the memory of Manus Coffey, a thinker, designer, creator and innovator in municipal solid waste management. Manus was principal author of the UN-Habitat 2010 publication Collection of Municipal Solid Waste in Developing Countries, which remains to this day essential reading for practitioners working towards the Sustainable Development Goals.

Contents

List of Acronyms

BRS	Basel, Rotterdam and Stockholm Convention
CBOs	Community-based organisations
DCA	Data Collection Application
DCM	Data Collection Manual
EHS	Environment, Health and Safety
FAO	Food and Agriculture Organization of the United Nations
GHG	Greenhouse Gases
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
HDPE	High-Density Polyethylene
HH	Household
LDPE	Low-Density Polyethylene
MBT	Mechanical Biological Treatment
MRF	Material Recovery Facility
MSW	Municipal Solid Waste
MSWM	Municipal Solid Waste Management
NGO	Non-Governmental Organisation
OECD	Organisation for Economic Co-operation and Development
PET	Polyethylene Terephthalate
PP	Polypropylene
PPE	Personal Protective Equipment
PVC	Polyvinyl chloride
SDGs	Sustainable Development Goals
UN DESA	United Nations Department of Economic and Social Affairs
UNEP	United Nations Environment Programme
UN-Habitat	United Nations Human Settlements Programme
UNSD	United Nations Statistics Division
WACS	Waste Amounts and Composition Survey
WaCT	Waste Wise Cities Tool
WEEE	Waste Electric and Electronic Equipment
WFD	Waste Flow Diagram
WHO	World Health Organization

Summary

Waste Wise Cities Tool (WaCT) guides readers through 7 steps to collect data on municipal solid waste (MSW) generated, collected, and managed in controlled facilities. The tool provides a household survey guide for total MSW generation, a questionnaire to identify the MSW recovery chain and criteria to check the environmental control level of waste management facilities in a city.

Chapter 1 introduces the global challenge of waste management touching upon the necessity of standardized methodology to assess municipal solid waste management performance and increasing capacity development needs in data collection at the municipal level especially in the low and middle-income countries. It also introduces what can be achieved through the application of Waste Wise Cities Tool, showing the case study in Mombasa, Kenya.

Chapter 2 provides definitions of key terminologies and new concepts used for the calculation of the SDG indicator 11.6.1. It also provides the 'ladder of control level' of waste management facilities, which will be a guideline for operational improvements of different waste management facilities. The 'ladder of waste collection services' introduced here also is a new concept to measure population with 'access to waste collection services' an important indicator in relation to poverty eradication.

Chapter 3 takes readers through the parameters and formulas for MSWM assessment for SDG indicator 11.6.1. The chapter explains the conceptual model behind the methodology and it also outlines the necessary data points with formulas.

Chapter 4 takes the readers through the 7 steps of the Waste Wise Cities Tool: preparation; household MSW generation and composition; non-household MSW; MSW received by recovery facilities and control level of recovery facilities; MSW received by disposal facilities and control level of disposal facilities; waste composition at disposal facilities; calculating food waste, recycling, and plastic leakage..

Data forms and tools are available to support each step. Collected data can be entered into an automated WaCT Data Collection Application (DCA) workbook and submitted to UN-Habitat's Waste Wise Cities Programme.

Introduction

2 Billion Tonnes
of municipal solid waste were generated in 2015

number is expected to grow to
3.5 Billion Tonnes
by 2050

the waste sector
is predicted to account
8-10%
of global anthropogenic GHG emissions by 2025 under business as usual scenario

8 Million Tonnes
of plastic find its way into the world's oceans every year

THE PROBLEM

The global scale of urbanization and economic growth are creating a potential "time-bomb" regarding the waste we generate in the world. If not addressed now, the significant negative impact on human health and the environment will be felt by nations at all levels of development. An estimated 2 billion tonnes of municipal solid waste (MSW) are being generated annually, and this number is expected to grow to 3.4 billion tonnes by 2050 under a business-as-usual scenario (World Bank, 2018). Uncontrolled disposal sites are already a major source of Greenhouse Gases (GHG), and if we continue on the current path the waste sector, particularly food waste, is predicted to account for 8-10% of global anthropogenic GHG emissions by 2025. Additionally, every year at least 8 million tonnes of plastic find its way into the world's oceans (Jambeck et al., 2015).

The quantity of waste generated grows with socio-economic development, and as the population in cities become denser, acute public health and environmental problems become more commonplace. Poor waste management results in agglomeration of uncollected waste, the build-up of rodent and insect populations, open waste burning with concomitant impacts on public health and pollution of air, soil and water. Furthermore, unmanaged and mismanaged waste is the main source of marine plastic pollution.

On the other hand, waste management offers great opportunities: resource recovery lessens the dependency on resource imports and reduces natural resource extraction; it enhances livelihoods and income for the urban poor through new business models; and improves quality of life for urban citizens.

WASTE WISE CITIES – SUPPORTING CITIES TO ACHIEVE SDGS RELATED TO WASTE

UN-Habitat launched Waste Wise Cities on World Habitat Day in 2018 with a call to action to tackle the global challenge of waste management. Waste Wise Cities has four key action areas namely: 1) knowledge and best practice sharing; 2) waste data and monitoring; 3) education and advocacy and 4) finance and bankability support. Waste Wise Cities aims to support cities and local governments in achieving the Sustainable Development Goals related to waste and as well as in implementing the New Urban Agenda.

THE SUSTAINABLE DEVELOPMENT GOALS AND WASTE MANAGEMENT

The 2030 Agenda for Sustainable Development and its 17 Sustainable Development Goals (SDGs) were adopted by the United Nations in September 2015. Several targets were set out to address waste management, material efficiency and the impact of waste on the environment.

Many SDGs directly relate to waste management. These include: access to basic services (Target 1.4), eliminate dumping to improve water quality (Target 6.3.), municipal solid waste management (Target 11.6), food waste (Target 12.3), chemicals and hazardous waste, including e-waste (Target 12.4), recycling (Target 12.5), and marine litter (14.1). In addition, two closely related targets look at domestic material consumption and material footprint (8.4 and 12.2). Consequently, a sustainable waste management can contribute to the achievement of a number of SDGs.

A variety of indicators exist to monitor progress towards achieving each SDG target. Each indicator was assigned a so-called custodian agency, as well as partner agencies. Custodian agencies are United Nations bodies (and in some cases, other international organizations) responsible for compiling and verifying country data and metadata, and for submitting the data, along with regional and global aggregates, to the United Nations Statistics Division (UNSD). UN-Habitat is for example the custodian agency of SDG Indicator 11.6.1 *"Proportion of municipal solid waste collected and managed in controlled facilities out of total municipal solid waste generated, by the city"*. UN-Habitat has worked on the development of the monitoring methodology for this indicator coherent with other waste statistics systems in the world. This has crystalized into the current "***Waste Wise Cities Tool***" (WaCT).

WASTE WISE CITIES TOOL AND THE SDG INDICATOR 11.6.1

Assessing and monitoring SDG indicator 11.6.1 ***"Proportion of municipal solid waste collected and managed in controlled facilities out of total municipal solid waste generated, by the city"***, provides critical information for cities and countries to establish better waste and resource management strategies. So far, reliable data and information on municipal solid waste generation and management is lacking globally, especially in low- and middle-income country cities. Where data exists, it is often generated based on international comparisons, without having been validated in the local context.

A global data collection and publication system through the UNSD/UNEP Questionnaire on Environment Statistics has collected data on MSW collection and treatment for about 20 years. Data has been received from about 160 to 170 countries, covering both national and city levels. However, the response rate for the UNSD/UNEP questionnaire is hovering around 50% and data completeness and quality remain a challenge, especially for developing countries. This indicates that it is critical to improve the availability and accessibility of waste statistics and increase training for collection of data and capacity development on the ground.

This paucity of evidence-based data hinders the development of waste management strategies and constrains investment decision-making in infrastructure and service expansion, leading in many countries to insufficient or absent MSW management services. Poor MSW collection and management trigger severe threats to public health and pollute air and water. Furthermore, uncollected, and mismanaged waste is the main source of marine plastic pollution.

→ ***SDG indicator 11.6.1*** quantifies parameters that will help cities and countries to better manage resources, mitigate and prevent environmental pollution, create business, employment and livelihood opportunities, and shift towards a circular economy. The methodology to monitor SDG indicator 11.6.1 provides guidelines for ladders for MSW collection services and control level of waste management facilities, and aims to bring standardized definitions, nomenclature and techniques to MSW data collection.

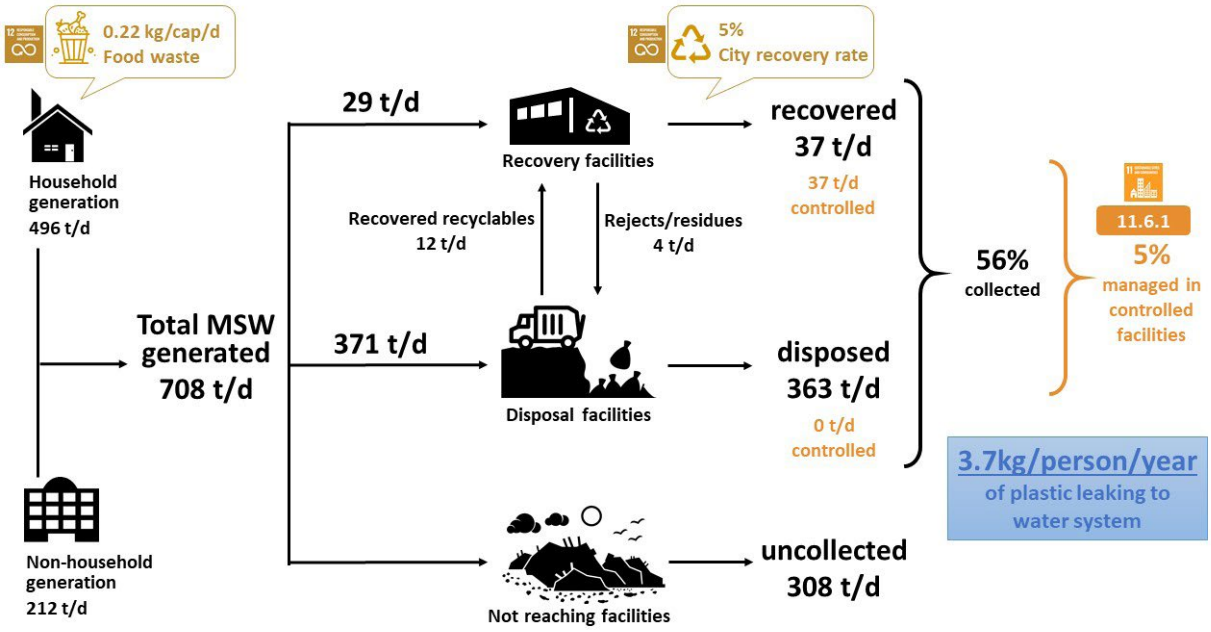
→ ***Waste Wise Cities Tool - Step by Step Guide to Assess a City's MSWM Performance through SDG indicator 11.6.1 Monitoring*** guides readers through the steps to assess the environmental performance of a municipal solid waste management (MSWM) system (SDG 11.6.1), food waste generation (SDG 12.3.1) and resource recovery systems (SDG 12.5.1) in cities.

The Waste Wise Cities Tool (WaCT) consists of seven steps to guide cities on how to collect data on MSW generated, collected, and managed in controlled facilities. The tool provides a household survey guide for estimating total MSW generation, a questionnaire to investigate the MSW recovery chain and criteria to check the environmental control level of waste management facilities in the city. In the last step onward linkages to other SDG indicators are elaborated and an assessment using a Waste Flow Diagram (WFD) is introduced. The WFD is a separate but complementary methodology to the Waste Wise Cities Tool. It uses rapid and observation-based assessment for mapping waste flows and quantifying plastic leakage from MSW management systems (GIZ et al., 2020).

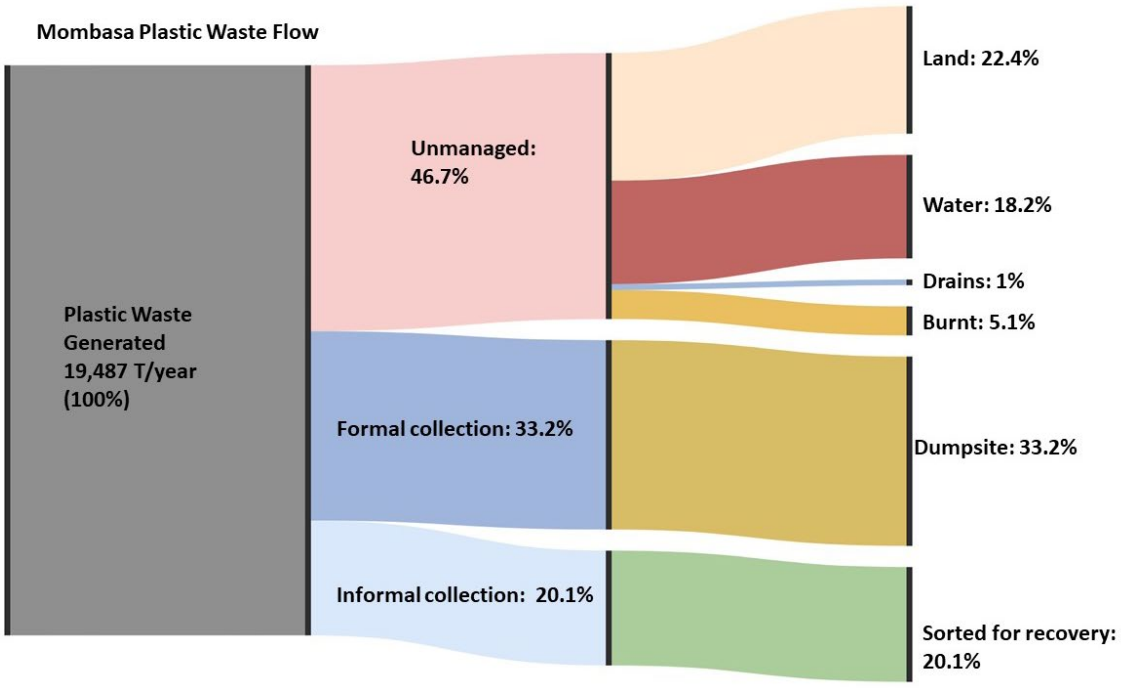
WHAT THE WASTE WISE CITIES TOOL CAN ACHIEVE:

The *Waste Wise Cities Tool* has been field-tested in Nairobi (Kenya), Mombasa (Kenya) and Mahé Island (Seychelles). It has been developed in parallel with the Waste Flow Diagram, a tool which enables estimation of plastic waste emissions to the environment.

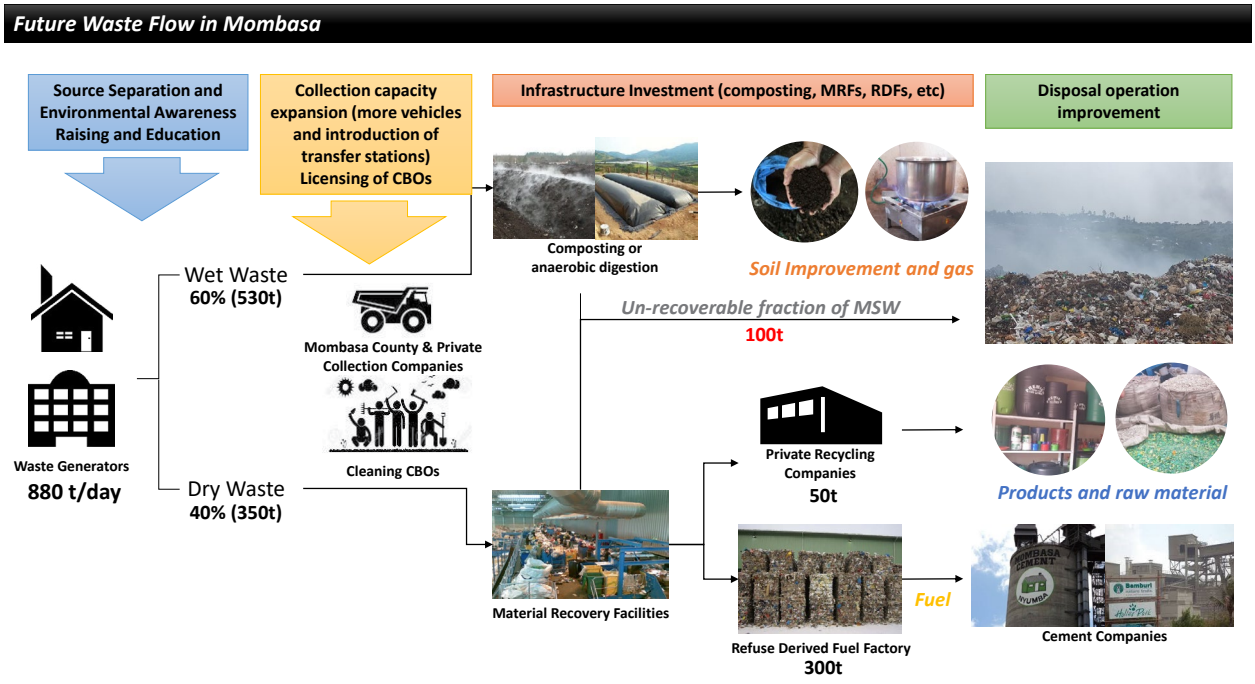
The first figure below depicts the results from the SDG 11.6.1 assessment in Mombasa, a Kenyan coastal city of 1.2 million inhabitants. Results show that about 708 t/day of MSW is generated, of which 56% is collected and 5% is managed in controlled facilities. Around 308 t/day remain uncollected.



Based on this data and using the WFD plastic leakage is estimated to be 3.7 kg per person/year. The second figure below breaks down and categorises the sources and pathways of plastic leakage as identified with the two tools.



The assessment was followed by a local stakeholders workshop, which identified key intervention areas and service/infrastructure investment gaps. Workshop attendees included stakeholders from the waste management chain such as local government officials, environmental regulators, collection service operators, disposal facility managers, formal and informal recyclers, representatives of manufacturers and residents, and many more. The following figure shows the future waste flow envisioned by participants during the workshop in Mombasa.



Key Definitions

MSW

→ **Municipal Solid Waste** includes waste generated from: households, commerce and trade, small businesses, office buildings and institutions (schools, hospitals, government buildings). It also includes bulky waste (e.g. white goods, old furniture, mattresses) and waste from selected municipal services, e.g. waste from park and garden maintenance, waste from street cleaning services (street sweepings, the content of litter containers, market cleansing waste), if managed as waste. The definition excludes waste from municipal sewage network and treatment, municipal construction and demolition waste..

GENERATION

→ **Total MSW Generated** by the City is the total MSW generated by the population and their economic activities within the defined system boundary.

COLLECTION

→ **Total MSW Collected** refers to the amount of MSW generated that is moved from the point of generation, such as specific addresses or designated collection points, to facilities where the waste is recovered or disposed, regardless of collection modality (e.g., by municipal governments, non-state actors or informal sector). The remaining share of MSW generated is considered “uncollected”.

→ **The proportion of Population with Access to Basic MSW Collection Services** is the proportion of the population who receive waste collection services that are either basic, improved or full, defined by the service ladder of MSW collection service. It considers aspects of frequency, regularity and proximity of the collection points (Table 1). This aspect is measured under the SDG indicator 11.6.1 assessment but it is reported through a different indicator, SDG 1.4.1. on access to basic services.

Figure 1: What MSW collected means in SDG 11.6.1

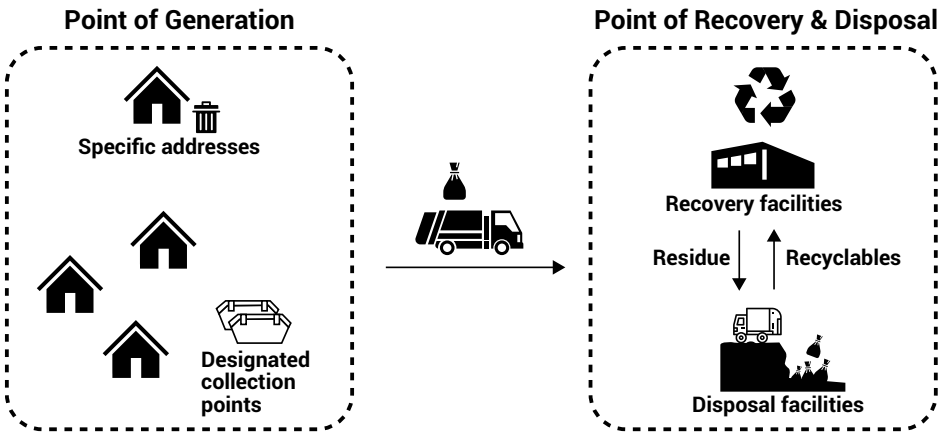


Table 1: The definition of the sub-indicator ladder of service level.

Service Level	Definition	
	Door-to-door	A designated collection point
Full	» Basic frequency and regularity » Without major littering » Separation in three or more fractions	» Within 200m distance » Basic frequency and regularity » Without major littering » Separation in three or more fractions
Improved	» Basic frequency and regularity » Without major littering » Separation in two fractions	» Within 200m distance » Basic frequency and regularity » Without major littering » Separation in two fractions
Basic	» Basic frequency and regularity » Without major littering » No Separation	» Within 200m distance served » Basic frequency and regularity » Without major littering » No Separation
Limited	» Without basic frequency and regularity. » With major littering	» Within 200m distance but no basic frequency and regularity or » Further than 200m distance. » With major littering
No	» Receiving no waste collection service	

RECOVERY

- **Recovery** means any operation the principal result of which is waste serving a useful purpose by replacing other materials which would otherwise have been used to fulfil a particular function, or waste being prepared to fulfil that function, in the facility or in the wider economy

- **Recovery system** is, for the purposes of the WaCT assessment, a grouping of a number of different activities and facilities that are undertaking recovery processes.

- **Point of entry into recovery system** is the first discernible location where a facility within the recovery system receives waste containing potentially recoverable materials. It excludes the transfer of materials between recovery facilities within the system.

- **Recovery facilities** include any facilities with recovery activities defined below including recycling, composting, incineration with energy recovery, materials recovery facilities (MRF), mechanical biological treatment (MBT) facilities, etc.

- **Material Recovery Facility** (MRF; or materials reclamation facility, materials recycling facility, multi re-use facility) is a specialized recovery facility that receives, separates and prepares recyclable materials for marketing to further processors or end-user manufacturers.

- **Mechanical Biological Treatment** (MBT) facilities are a type of recovery facility that combines an MRF with a form of biological treatment such as composting or anaerobic digestion.

- **Incineration** is the controlled combustion of waste with or without energy recovery.

- **Incineration with Energy Recovery** is the controlled combustion of waste with energy recovery.

- **Recycling** is defined under the UNSD/UNEP Questionnaire and further for the purpose of these indicators as “Any reprocessing of waste material in a production process that diverts it from the waste stream, except reuse as fuel. Both reprocessing as the same type of product, and for different purposes should be included. Recycling within industrial plants i.e., at the place of generation should be excluded.” For the purpose of consistency with the Basel Convention reporting and correspondence with EUROSTAT reporting system, Recovery operations R2 to R12 listed in Basel Convention Annex IV, are to be considered as ‘Recycling’ under the UNSD reporting for hazardous waste.

- **Recovery chain** usually involves several steps of the recycling industry which purchase, process and trade materials from the point a recyclable material is extracted from the waste stream until it will be reprocessed into products, materials or substances that have market value. In many low and low-to-middle income countries, this involves waste pickers, intermediate traders, apex traders and end-of-chain recyclers/recoverers.

- **Waste pickers** extract recyclable materials from the waste stream to support their livelihood, selling materials into the recovery system.

- **Intermediate traders** receive materials from both formal and informal recyclable collection systems (including waste pickers), store and prepare these materials for onward trading to apex traders.

- **Apex traders** receive materials from intermediate traders or directly from both formal and informal recyclable collection systems (including waste pickers), store and prepare these materials for onward trading to end-of-chain recyclers/recoverers.

- **End of chain recycler/recoverer** receives materials from apex traders or direct from both formal and informal MSW collection systems and processes them into materials and products that have value in the economy either through recycling, incineration with energy recovery, or other recovery process.

Figure 2: Complexity in the recovery chain (plastic example)

DISPOSAL

→ **Disposal** means any operation whose main purpose is not the recovery of materials or energy even if the operation has as a secondary consequence the reclamation of substances or energy.

→ **Disposal Facilities** refer to sites which are regularly used by the public authorities and private collectors, regardless of their level of control and legality, for the disposal of waste. Such sites may or may not have an official recognition, a permit or a license. Disposal sites may be managed in either a controlled or uncontrolled manner. The definition excludes unrecognized places where waste is deposited occasionally in small amounts which public authorities may clean up from time to time.

→ **Landfill** is the deposit of waste into or onto land. It includes specially engineered landfill sites and temporary storage of over one year on permanent sites. The definition covers both landfills at internal sites, i.e. where a generator of waste is carrying out its own waste disposal at the place of generation, and at external sites.

CONTROL LEVEL OF MSW RECOVERY AND DISPOSAL FACILITIES

→ **MSW Managed in Controlled Facilities** refers to MSW collected and transported to recovery and disposal facilities that are operated under basic, improved or full control according to the Ladder of waste management facilities' control level (Table 2). The Ladder can be used as a checklist for assessing the level of control of a particular recovery or disposal facility. The facility should be classified by going through the decision-making tree attached in Annex 7. Note that the emphasis is on operational control rather than engineering/design. A facility that is constructed to a high standard, but not operated in compliance with Level 3 (or above) standard is not regarded as a controlled facility.

Table 2: Ladder of control level for landfill sites

CONTROL LEVEL	Category	Landfill Site
Full Control	Security	» Physical boundary surrounding the site and supervised access control 24/7
	Water and leachate control	» Site engineering preventing surface and groundwater ingress into the landfill » Functioning leachate containment and management
	Slope stabilization	» Slopes stabilized, including erosion control, to mitigate risk of landslide
	Waste handling, compaction and cover	» Waste deposited in clearly defined operational areas with strict management control » Waste layered and compacted promptly » Daily and intermediate cover applied
	Fire control	» Zero evidence of burning of waste on the surface of the landfill
	Landfill gas management	» Landfill gas controlled with utilization where practicable
	Staffing	» Site staffed full-time with professionally qualified personnel
	Recording	» Functional weighbridge in use with recording waste quantities by waste types
	Environment Health and Safety (EHS)_	» EHS measures implemented in accordance with professional risk assessment and operating plan » Showering and sanitary facilities » Environmental monitoring system in place with annual reporting capability
	Site planning	» Site development and operational filling plan in place » Post closure plan in place
Improved Control	Security	» Physical boundary surrounding the site and supervised access control
	Water and leachate control	» Site engineering preventing surface water ingress into the landfill » Measures taken to prevent seepage of untreated leachate into surface and groundwater
	Slope stabilization	» Slopes stabilized, mitigating risk of landslide
	Waste handling, compaction a nd cover	» Waste deposited in supervised operational area » Waste layered and compacted promptly » Waste periodically covered
	Fire control	» Zero evidence of burning of waste on the surface of the landfill
	Landfill gas management	» Landfill gas controlled, including venting or flaring
	Staffing	» Site staffed with trained personnel
	Recording	» Functional weighbridge in use with data for each delivered waste load recorded in a register
	EHS	» Procedures in place to ensure heath and safety of workers » Toilets and hand washing stations » Environmental monitoring system in place with annual reporting capability
	Site planning	» Operational filling plan in place

Basic Control	Security	» Boundary and access control allowing single point of supervised access
	Water control	» Perimeter drainage maintained around the site
	Slope stabilization	» Slopes stabilized, mitigating risk of landslides
	Waste handling, compaction and cover	» Waste trucks directed to specific operational area of disposal » Heavy mechanical equipment reliably available » Waste layered and compacted within the specific operational area » Some use of cover material
	Fire control	» Zero evidence of burning of waste on the surface of the landfill
	Staffing	» Site staffed during operational hours
	Recording	» Functional weighbridge in use
	EHS	» Basic personal protective equipment in use » Toilets and hand washing stations
	Site planning	» Site drawing showing landfill boundary and filling area in place
Limited Control	Security	» Some access control to limit unauthorised dumping
	Waste handling and compaction	» Heavy mechanical equipment available for minimum levelling and compaction
	Fire control	» Limited evidence of burning of waste on the surface of the landfill
	Staffing	» Staff checking the site regularly
	Recording	» Waste deliveries recorded
	EHS	» Basic personal protective equipment in use
No Control	Security	» No access control
	Waste handling and compaction	» No mechanical equipment » No levelling and compaction
	Fire control	» Site on fire
	Staffing	» No staff
	Recording	» No recording

Table 3: Ladder of control level for incineration

CONTROL LEVEL		Incineration (with or without Energy Recovery)
Full Control	Identity	» Registered and licensed/permitted facility » Clearly marked boundaries
	Security	» Physical boundary surrounding the site and supervised access control 24/7
	Standards	» Engineered facilities with process control » Continuous monitoring and recording of operating parameters and emissions » Flue gas controls compliant with applicable environmental standards » Process controls and instrumentation systems routinely calibrated » Asset management and maintenance plans in place » Evidence of maintenance according to the maintenance plan » Emissions periodically sampled and tested by external laboratories
	Circularity	» Facility has energy recovery and utilization
	Residues	» Effluents are managed in compliance with applicable environmental standards when effluents are generated » De-ashing and flue gas treatment residues managed in compliance with applicable environmental standards
	Fire control	» Fire prevention and control measures in place
	Staffing	» Staffed with professionally qualified personnel
	EHS	» EHS measures implemented in accordance with professional risk assessment and operating plan » Showering and sanitary facilities
	Records	» Incoming and outgoing materials weighed and recorded in a register
Improved Control	Identity	» Registered facilities » Clearly marked boundaries
	Security	» Physical boundary surrounding the site and supervised access control
	Standards	» Facility is engineered with process control » Continuous monitoring of operating parameters and emissions » Facility have flue gas treatment system » Monitoring systems routinely calibrated » Maintenance plan or documented maintenance schedules in place » Evidence that equipment is well maintained
	Circularity	» Facility has energy recovery and utilisation
	Residues	» Effluents are discharged to a permitted discharge point when effluent is generated » Solid residues are disposed at facility designated for incineration residues disposal
	Fire control	» Fire extinguishers available on site
	Staffing	» Site has sufficient number of trained staff for level of operation
	EHS	» EHS measures implemented for all people on site » Toilets and washing stations
	Records	» Incoming and outgoing materials weighed and recorded in a register

Basic Control	Identity	» Registered facilities » Distinguishable boundaries
	Standards	» Facility is engineered with process control » Operating parameters (temperature, smoke etc) are continuously monitored and recorded » Facility has some form of flue gas control » Monitoring systems are occasionally calibrated » Evidence that equipment is well maintained
	Residues	» Effluents are discharged to a permitted discharge point when effluent is generated » Solid residues are disposed at facility designated for incineration residues disposal
	EHS	» Personal protective equipment in use » Water for hand washing
Limited Control	Identity	» Distinguishable boundaries
	Standards	» Operating parameters are logged » Some evidence that equipment is maintained
	EHS	» Personal protective equipment in use » Water for hand washing
No Control	Identity	» Unregistered facilities with no distinguishable boundaries
	Standards	» No operation standards in place » No evidence that equipment is maintained
	EHS	» No EHS measures in place

Table 4: Ladder of control level for other recovery facilities

CONTROL LEVEL		Other Recovery Facilities
Full Control	Identity	» Registered/licensed facility » Clearly marked boundaries
	Security	» Physical boundary surrounding the site and supervised access control 24/7
	Standards	» Engineered facilities with process control » Environmental pollution control compliant to applicable environmental standards
	Circularity	» Extracted materials delivered into recycling/recovery markets » Nutrient value of biologically treated materials utilized in agriculture/ horticulture when organic waste is processed
	Residues	» Residues managed in accordance with applicable environmental standards
	Fire control	» Fire prevention and control measures in place
	Staffing	» Staffed with professionally qualified personnel
	EHS	» EHS measures implemented in accordance with professional risk assessment and operating plan » Showering and sanitary facilities
	Records	» Incoming and outgoing materials weighed and recorded in a register

Improved Control	Identity	» Registered facilities
	Security	» Clearly marked boundaries » Physical boundary surrounding the site and supervised access control
	Standards	» Engineered facilities with process control » Some measures taken to control environmental pollution
	Circularity	» Extracted materials delivered into recycling/recovery markets
	Residues	» Residues disposed of into the city MSW system
	Fire control	» Fire extinguishers available on site
	Staffing	» Staffed with trained personnel
	EHS	» EHS measures implemented for all people on site » Toilets and washing stations
	Records	» Incoming and outgoing materials weighed and recorded in a register
Basic Control	Identity	» Registered facilities » Distinguishable boundaries
	EHS	» Personal protective equipment in use » Water for hand washing
Limited Control	Identity	» Distinguishable boundaries
	EHS	» Personal protective equipment in use
No Control		» Unregistered facilities with no distinguishable boundaries » No EHS measures in place

FORMALITY OF MSWM

The Formality of MSWM activities is an important aspect to take into consideration when conducting the SDG 11.6.1 assessment. MSWM activities are carried out by formal and informal economic units, both public and private, and by generators for the purpose of the prevention, collection, transportation, recovery and disposal of waste.

- **Formal waste management** relates to waste management activities undertaken by units working within the context of the formal governmental or non-state actors regulating and operating waste management; that is, organisations or individuals registered as economic units with government authorities and assumed to generally abide by local laws and regulations related to wastes and their management.

- **Informal waste management** refers to individuals or enterprises who are involved in private sector recycling and waste management activities which are not sponsored, financed, recognised, supported, organised or acknowledged by the formal solid waste authorities, or which operate in violation of or in competition with formal authorities (Scheinberg et al., 2010). Informal units are assumed to abide by local waste-related laws and regulations when it is in their interests to do so.

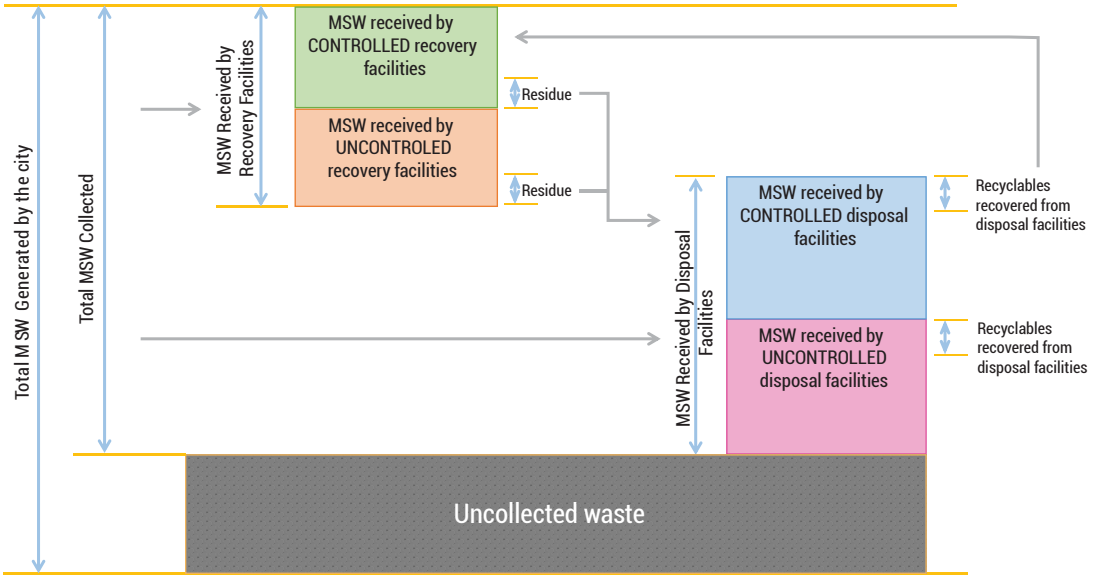
Parameters for MSWM Assessment for SDG indicator 11.6.1

CONCEPT MODEL

Figure 3 summarizes the elements measured by SDG indicator 11.6.1. The MSW generated by the city is either collected or uncollected, and the collected MSW is delivered to recovery or disposal facilities. Recovery facilities generate residues that are sent to disposal facilities. In many cities, recyclables are also recovered from disposal facilities and brought back into the recycling value chain.

Recovery or disposal facilities can be categorized as either 'controlled' or 'uncontrolled' depending on the operational measures put in place to minimize the environmental, health and safety impacts from the facilities. When both recovery and disposal occur within the same facility, it is necessary to evaluate the control level of the recovery and disposal operations independently of each other.

Figure 3: Concept figure of SDG indicator 11.6.1



FORMULAS

SDG indicator 11.6.1 is calculated as follows:

$$\text{SDG } 11.6.1 = \frac{\text{Total MSW collected and managed in controlled facilities (t/day)}}{\text{Total MSW generated (t/day)}} \text{ X } 100\ (\%)$$

The calculation of SDG indicator 11.6.1. is broken down to two sub-indicators:

$$\text{SDG } 11.6.1.a = \frac{\text{Total MSW collected (t/day)}}{\text{Total MSW generated (t/day)}} \text{ X } 100\ (\%)$$

$$\text{SDG } 11.6.1.b = \frac{\text{Total MSW collected and managed in controlled facilities (t/day)}}{\text{Total MSW generated (t/day)}} \text{ X } 100\ (\%)$$

Data collected for the assessment of SDG indicator 11.6.1 can contribute to estimating SDG indicator 12.3.1.b on Food Waste Index, by providing *household food waste generation per capita,* through the below formula. Further detail is elaborated in Step 7.

$$\text{Per capita household food waste generation} = \text{Per capita MSW generation rate (kg/cap/d) x proportion of food waste}$$

Step 4, which maps the material recovery flow through interviews with recovery facilities, can provide input data for SDG indicator 12.5.1 *National Recycling Rate*, by providing the city's recovery rate.

$$\text{City Recovery Rate} = \frac{\text{Total recovered materials (t/day)}}{\text{Total MSW Generated(t/day)}} \text{ x } 100\ (\%)$$

Data collected for SDG indicator 11.6.1 can also be used to estimate a city's plastic leakage when combined with additional field observations guided by the WFD (GIZ et al., 2020), introduced in Step 7.

$$\text{City Plastic Leakage} = \frac{\text{Total plastic leakage to water systems (kg/year)}}{\text{Total Population}}$$

DATA POINTS

The data points required to calculate SDG indicator 11.6.1 include:

- Total MSW generated by the city
- Total MSW collected
- Total MSW managed in controlled facilities

These data also help cities to identify the proportion of MSW that remains uncollected.

A. Total MSW generated by the city

MSW is waste generated by households, as well as similar waste from non-household sources, such as businesses, schools, offices, supermarkets, restaurants, hotels, hospitals, etc. It also includes bulky waste (e.g. old furniture, mattresses) and wastes from selected municipal services, e.g. park and garden maintenance, and street cleaning services (street sweepings, the content of litter containers, market cleansing waste). MSW does not include waste from municipal sewage networks and wastewater treatment facilities, as well as construction and demolition waste from commercial building contractors.

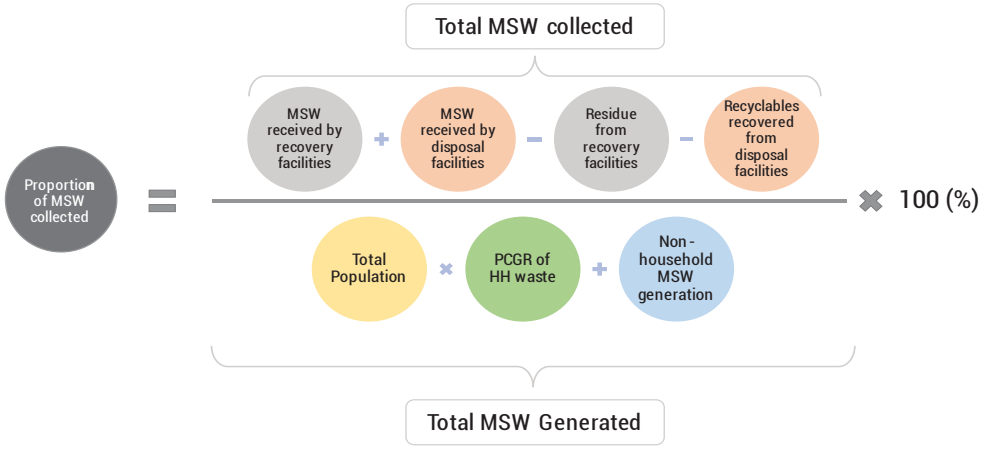
For cities that do not yet have reliable data on MSW generation from households, it can be estimated through the multiplication of the total population by per capita MSW generation from households. Non-household MSW generation also needs to be estimated. The detailed methodology for doing this is provided in Steps 1, 2 and 3.

B. Total MSW collected

Total MSW collected is the amount of MSW generated that is moved from the point of generation, such as specific addresses or designated collection points, to facilities where the waste is recovered or disposed.

When measuring total MSW collected there is a risk of double counting concerning the residue or rejects from recovery facilities, and the amount of waste reclaimed from disposal facilities going to recovery. Therefore, these amounts need to be deducted from the sum of waste received by both recovery and disposal facilities. The residue from recovery facilities is assumed to go to either disposal facilities or other recovery facilities.

Equation 1: Total MSW[1] collected



Steps 4 and 5 provide detailed methodology on how to collect this data.

C. Total MSW managed in controlled facilities

MSW managed in controlled facilities refers to MSW collected and transported to recovery and disposal facilities with basic, improved or full control according to the Ladder of waste management facilities' control level.

The Ladder can be used as a checklist for assessing the level of control of a particular recovery or disposal facility. The facility's control level is the category (full, improved, basic, limited and none) where it checks the most boxes. Note that the emphasis is on operational control rather than engineering/design control. A facility that is engineered and constructed to a high standard, but not operated in compliance with Level 3 (or above) standard is not regarded as a controlled facility.

Steps 4 and 5 provide detailed methodology on how to collect this data.

[1] Note that MSW collected for recovery includes mixed MSW, commingled recyclables or recoverable fractions extracted from MSW

Equation 2: Total MSW managed in controlled facilities

ADDITIONAL DATA POINTS

The SDG 11.6.1 indicator assessment provides three further MSWM data points:

- Per capita MSW generation rate
- MSW composition
- Uncollected waste

Although they are not necessary for the calculation of the SDG indicator values, these figures are of particular importance for the identification of service/infrastructure gaps, and formulation of strategies.

D. Per capita MSW generation rate

A very relevant parameter that can be derived from the previous formula is the "total per capita MSW generation rate". Steps 2 and 3 explain how to calculate this through waste sampling from households for cities, if no reliable or updated data is available.

This is especially recommended for cities where a large amount of MSW remains uncollected. Data on per capita waste generation also enables optimization of collection system performance, an exercise that can potentially generate significant budgetary savings for the city.

E. MSW Composition

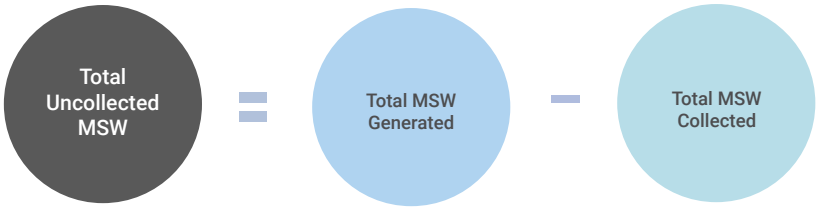
The WaCT assessment characterizes waste at the point of generation (i.e. households) and at the point of disposal. Understanding MSW composition at the beginning and end of the MSW service chain is a useful exercise for several reasons: understanding composition helps identify how the existing recovery/recycling sector is functioning, it enables further recovery facilities to be identified and planned, and overall helps to triangulate (i.e. test validity and reliability) of the collected data.

Note that MSW also includes waste from non-household sources. In Step 3, the quantities of MSW generated from commercial and institutional sources, as well as from public spaces, is estimated. However, specific composition analysis on MSW from non-household sources is beyond the scope of this tool as it is complex and resource intensive.

F. Total uncollected waste

Total uncollected MSW can be calculated by subtracting the total MSW regularly collected from the total MSW generated.

Equation 3: Total uncollected MSW



Step-by-Step Guide to Assess SDG 11.6.1 Indicator

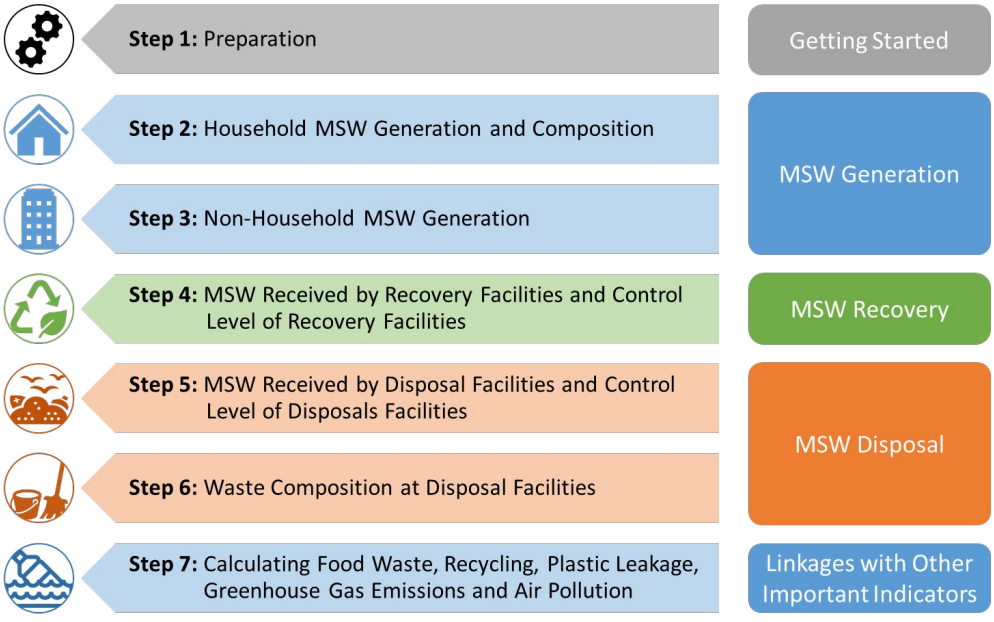
WASTE WISE CITIES TOOL'S 7 STEPS

The steps required to report SDG indicator 11.6.1 are divided into seven steps, following the waste management chain from generation to recovery and disposal. Additional steps will also be described in this chapter to identify the 'Access to Basic Municipal Solid Waste Collection Services' in relation to SDG indicator 1.4.1, and to identify the potential plastic emissions to the environment.

The steps a city needs to implement can be determined depending on the data available. UN-Habitat recommends cities to go through all the steps if the city has large amounts of uncollected waste or illegal dumping and has never done a waste amounts and composition survey (WACS) from households to estimate waste generation per capita, or if such a survey was conducted more than 5 years ago. In this context, it is important to understand that the waste received at recovery and disposal facilities sometimes does not represent the total MSW generated, especially in cities with large amounts of uncollected waste.

Cities that are confident about the accuracy of their total MSW generation data, are recommended to go through Steps 4 and 5 to identify the environmental and operational control level of their waste management facilities.

Figure 4: Waste Wise Cities Tool's 7 Steps



STEP 1: PREPARATION

1.1 Gain political and senior management endorsement and support

It is important to gain the city's Mayor or top officials' support for the assessment. This will facilitate the different approval procedures and necessary resource mobilization within the city government. Make sure the intended purpose and significance of the assessment for the improved environmental management in the city is well communicated and gain political and senior management endorsement before starting the assessment.

1.2 Establish a working team

The whole assessment requires waste sampling from 10 households for 8 days in 9 survey areas (15 survey areas for mega cities[2]), which means waste from 90 households (150 households for mega cities) needs to be collected for 8 days. To implement this operation smoothly, establish a working team of **20-30 survey helpers who are dedicated full-time for 8-10 days, led by 2-3 well trained experts dedicated for a combined total of about 6 working weeks per city**. Members of the expert team need to be trained and familiarize themselves with the methodological steps, and should have a good understanding of MSWM systems, both concepts and flows.

A 1 or 2-day workshop should be organized to train the selected 20-30 survey helpers on the methodological steps, the purpose and importance of the assessment, the detailed survey requirements and environment, health and safety (EHS) procedures.

The following points should be taken into account when establishing the expert team:

- **Language:** make sure that at least one person from the expert team speaks the main local language/dialect fluently, and that the survey helpers cover the range of local languages/ dialects prevalent in the survey area.
- **Mobility:** ideally most survey helpers should be based in the local areas where the assessment will be conducted.
- **Field visits:** the expert team, possibly accompanied by City officials, will have to conduct field visits to waste management facilities (recovery and disposal). Distance, accessibility and comfort of travel can greatly vary.
- **Environmental health and safety:** make sure that the survey team is briefed from the outset on EHS safeguards and procedures and provide the necessary tools, including personal protective equipment (PPE). --

1.3 Prepare tools and equipment

The assessment requires waste sampling through visits to 10 households each from 3 survey areas (5 survey areas for mega cities) from 3 income groups (or household types), as well as waste composition analysis at the points of waste generation and disposal. The items to be made available are listed in Step 2 and Step 6.

[2] Urban agglomerations having over 10 million inhabitants, "World Urbanization Prospects, The 2018 Revision" (PDF). UN DESA. Last access 18 June 2020. p. 55

PREPARATION

BUDGET FOR AND ORGANIZE FOR

hiring an expert team
for 6 working weeks

equipment

tools

transport/ fuel

human resources
for mobilizing 20-30 people

1.4 Identify key stakeholders and partnerships

Stakeholders include individuals and entities involved in the MSWM system in the city; those either providing, monitoring or receiving the service. Successful implementation of the assessment depends on identifying and obtaining information from the key stakeholders. The goal is to obtain as much accurate quantitative data as possible on MSW generated, collected, recovered and disposed. Gaining a clear understanding of the city's MSWM system is an essential basis for identifying key intervention areas for improvement.

Key stakeholders can include:

- **City waste management office and other departments**: Cities have statutory responsibilities for a wide range of MSWM service provisions. Different departments of the municipality besides the waste management department may need to be involved, including urban development authorities, business permit sections, environmental departments, public works departments and public health/hygiene departments
- **Public collection service providers**: often operated and supervised by the respective municipal department
- **Formal private collection service providers**: often collection services are outsourced to formal private companies or NGOs/CBOs which, in this case, are accountable to the municipality. Formal private collection companies may also be hired and paid directly by the waste generators (e.g. generators such as institutions, commercial units, industry).
- **Informal collection service providers**: organizations or individuals providing the collection service informally. These includes informal organizations or individuals providing collection services, picking recyclables from waste and/or collecting (or buying) recyclables from waste generators.
- **Informal and formal value chain enterprises:** businesses and enterprises based in the city that are involved in recyclables trading, including intermediate and apex traders.
- **Formal private recovery or disposal service providers:** registered or licensed entities involved in waste processing, recovery, and disposal. They have a business case to run their operations, need to adhere to regulations and are often supported by contract payments, gate fees or incentives from the city or national government.
- **Community-based organisations (CBOs)**: e.g. organisations engaged in self-help activities or in providing services in and to communities.
- **Non-governmental organisations (NGOs)**: organisations acting as intermediaries between governments and local communities, sometimes involved in solid waste service provision and/or providing support of informal collection/ recycling service providers.
- **National Ministries or environmental regulatory authorities** include the policy making, regulatory authorities, responsible for setting framework conditions, licensing/permitting, inspecting, and enforcing requirements for MSW collection, recovery, and disposal activities
- **Waste generators**: members of households, commercial units, institutions (schools, offices, etc.), industries, etc.

Stakeholder identification and analysis is typically an iterative process where, in interviews with stakeholders, information about other important stakeholders is obtained. Effective collaboration between key stakeholders is very beneficial. The waste management department needs to take the lead role as they will facilitate many steps of the process (contacting operators, accessing waste generators and community-based organizations, providing a list of waste collection, recovery and disposal companies operating in the city, etc.).

1.5 Prepare workflow and budget

The table below is an example workflow and lists the minimum human resources required from Step 2 to Step 7 put within 40 calendar days. Many of these steps and activities can take place in parallel if the size of the working team allows it, so the schedule can be compressed.

Preparation is of critical importance for the smooth conduct of the survey. The budget items required include hiring an expert team for a combined total period of approximately 6 working weeks, human resources cost for mobilizing 20-30 people for an 8-10 day survey, as well as tools, equipment and transport/fuel for survey activities.

Table 5: Typical workflow from Step 1 to Step 7

Activities	DAYS (1 … 10 … 20 … 30 … 40)	Minimum Human Resource Required
Step 1: Preparation		2-3 experts
1.1 Gain political and senior management endorsement and support		
1.2 Establish a working team		
1.3 Prepare tools and equipment		
1.4 Identify key stakeholders and partnerships		
1.5 Prepare workflow and budget		
1.6 Obtain necessary data from statistics office		
Step 2: Household MSW Generation and Composition		3 experts to supervise 2 persons per survey are (18 people) for waste sampling
2.1 Preparation		
2.2 Waste sampling and waste composition analysis		
2.3 Calculate per capita household solid waste generation		
Step 3: Non Household MSW Generation		1 person per survey area to visit and interview different premises
3.1 Using the proxy for non-household MSW		
3.2 Identify premises to interview		
3.3 Interview selected premises and each contracted collection company		
3.4 Obtain waste data from public spaces		
3.5 Calculate MSW generated by non-household sources		
Step 4: MSW Received by Recovery Facilities and Control Level of Recovery Facilities		1-2 core members to establish contacts with recovery facilities
4.1 Identify recovery facilities		
4.2 Arrange visits and interviews with key recovery facilities		
4.3 Evaluate the level of control of recovery facilities		
4.4 Compile the collected information		
Step 5: MSW Received by Disposal Facilities and Control Level of Disposal Facilities		1-2 persons to visit disposal facilities to collect data
5.1 Identify disposal facilities		
5.2 Arrange visits and interviews with identified disposal facilities		
5.3 Evaluate the level of control of disposal facilities		
5.4 Compile the collected information		
Step 6: Waste Composition at Disposal Facilities		1-2 experts 5-10 persons for waste composition survey
6.1 Preparation		
6.2 Waste sampling and composition analysis		
Step 7: Calculating food waste, recycling, plastic leakage, greenhouse gas emissions and air pollution		1-2 experts to observe different aspects of swm chain
7.1 Food waste		
7.2 Recycling		
7.3 City Plastic Leakage		
7.4 Greenhouse gas emissions and air polution		

1.6 Obtain necessary data from statistics office

The data necessary for the survey includes:

- Population of the city, if possible broken down in income categories; and
- Business licensing permit data (for non-household MSW estimation).

Population

Determining the population of the city can be done by the following sub-steps:

1. Find the official population census and check the year. If the data is not older than 5 years, use the data as it is. If the data is outdated, go to the next sub-step.
2. Check if an official population projection for your city is available from the national statistics office. If yes, use the data for the year you conduct the survey. If there is no official population projection data for the subject city, go to the next sub-steps.
3. If your city has more than 300,000 inhabitants, 'Population of Urban Agglomerations with 300,000 Inhabitants or More' data is available every two years from 'Urban Agglomerations' page at UN Department of Economic and Social Affairs Population Dynamics' World Urbanization Prospects website.
4. If your city has less than 300,000 inhabitants, 'Average Annual Rate of Change of the Urban Population' data is available from UN Department of Economic and Social Affairs Population Dynamics' World Urbanization Prospects website. Use this urban growth rate to estimate the current population in your city.
5. Additional to the overall population, find out if the city's or national statistics office have data on the distribution and share of high, middle and low-income groups in your city.

Business licensing data

Business licensing data may provide the number of units for different businesses and premises in the city, such as the number of beds for hospitals, chairs for restaurants, floor space for supermarkets, students for schools, etc. This data is essential to estimate MSW generation from non-household sources. Check if the data is available from the municipal or city statistics office for the system boundary and if the data is up to date (not older than 5 years).

If the data is neither available nor up to date, use the proxy to determine MSW generation from non-household sources (see Step 3).

STEP 2: HOUSEHOLD MSW GENERATION AND COMPOSITION

This step explains how to assess per capita household solid waste generation and average household waste composition. Apply this step if there is no up-to-date data on MSW generation and composition in your city. For this assessment waste samples are needed from a given number of randomly selected households. When selecting households, the following points need to be considered:

> Waste generation differs according to the household's income-level or housing type, therefore waste samples should be collected from different income groups (or housing types) in the city;

> Waste generation from households fluctuates depending on weekdays and weekends, therefore waste must be obtained daily throughout an entire week (7 days).

> Human beings generate waste, not households. It is important to record the number of people actually living in the house, rather than taking the official average number of family members.

> Waste generation varies seasonally, as well as during festive periods. It is important to take into account those local variables that may affect waste generation during the time of the survey.

Where large seasonal variations can be expected (very distinct dry and wet seasons for example), if possible, repeat the WaCT assessment. Keep in mind that every time the assessment is repeated, it is crucial to be consistent with your method. This means, maintaining the same sample size and the same calculation methods. This will allow comparison of results at a later stage.

Waste characterization will be conducted in conjunction with waste sampling from households, and this information will give you a clearer understanding on the amounts of recyclables in your city's household waste. This information is essential, especially for expanding resource recovery efforts, and as first step towards establishing an urban circular economy.

2.1 Preparation

1. **Define sample size:** the sample size will determine the statistical significance of the results obtained. This is reflected by the statistical confidence level and margin of error. In a city with the population size of 10,000 – 10,000,000, at least 370 to 384 households need to be sampled in order to achieve the normally recommended values of a confidence level of 95% with a margin of error of 5%. However, in many situations, it may be unfeasible and costly to collect waste samples from 384 households for 7 days for a city, therefore this guide suggests to sample 90 households (10 households from 3 survey areas from high, middle and low income groups each[3]) for average cities and 150 households (10 households from 5 survey areas in high, middle and low income groups each) for megacities, which is still in the same confidence level, but with a margin of error of 10%.

2. **Select survey areas and households:** select 3 (5 for megacities) representative high, middle and low-income neighbourhoods[4] in your city and 10 households from each neighbourhood randomly. In cities where there is an updated and reliable digital census of households, the following methods could be used for simple random selection:

3 Or alternatively from three different housing types (e.g. low-income/slum dwellings, apartment blocks, individual houses.

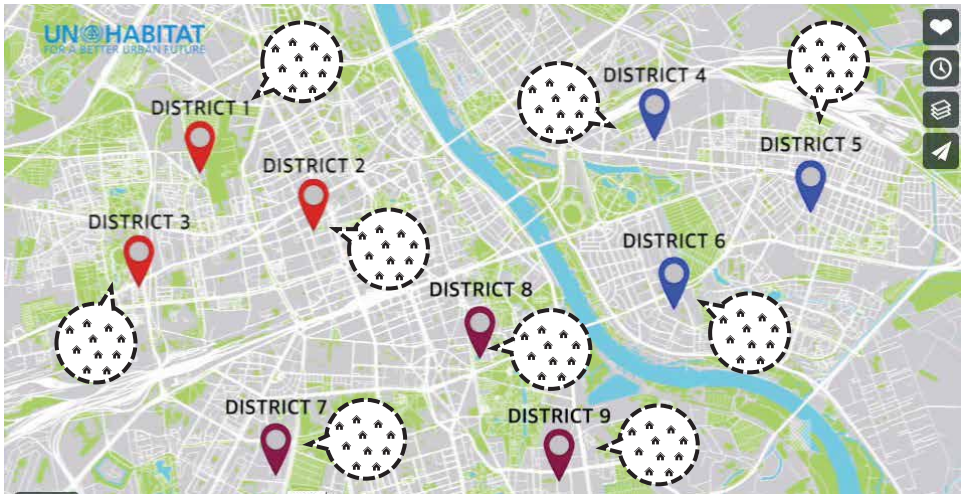
4 Ibid.

- **Option A:** the simplest way is the lottery method, where each household in the income group is assigned a unique number and the sample households are selected from this thoroughly mixed list. This way, each household has an equal chance of being selected as subject.
- **Option B:** let a computer do a random selection from your list of all households in the selected neighbourhood.
- **Option C**: obtain a map of the city with larger scale than 1:2,500 and overlay a grid of 1cm x 1 cm over the map. Each cell represents a 25 m x 25 m piece of land on the map. Assign one number to each cell and randomly select 30 cells per survey area. One household per each cell will be the random sample of household. Once in the field, be consistent on how you select your sample household from each cell. For example, always start from the households nearest to the top left corner of the cell and visit ground floor upwards in the case of high-storey buildings. If not successful, move to the next door and so on, always making sure you do not exit the cell of the grid.
- **Option D**: in the case of cities where households with different income levels are interspersed and it is difficult to clearly identify "areas" of low, middle and high income, use housing types to stratify your sampling areas instead. Obtain a map with the scale of 1:5,000 and overlay a 1cm x 1cm grid over the map. Select 30 cells randomly and identify one household per income level according to the housing types indicated in the table below.

Table 6: Housing types and income levels

Income Level	Housing Type Example
High	Luxury condominium, single detached house with garden, sophisticated alarm systems.
Middle	Apartments , single detached house without garden.
Low/ informal settlements	Slums, apartments with single rooms (apartments mud house, Rent less than 5% of GDP per capita

Figure 5: Household sampling



3. **Prepare informed consent letter from municipal government** explaining the purpose of the survey, how the information will be used and requesting the consent of households to participate in the survey. This can be shown, read to and signed by the selected households for waste sampling to obtain their consent, understanding and cooperation. Annex 1 provides an example letter.

4. **Prepare the survey team, equipment, and transport:** The below table shows the number of survey team members, transport for collected waste samples and other items needed per survey area and in total.

Table 7: Necessary tools and resources for household waste sampling

Things to Prepare	Quantity		
	1 Survey area	**9 survey areas (average city)**	**15 survey areas (mega-city)**
Survey team	2-3 people	18-27 people	30-45 people
Transportation for waste collection	1 collection vehicle trips	9 collection vehicle trips	15 collection vehicle trips
Liner bags (vol: 60L)	80	720	1200
Identification tape (tag bags)	1	9	15
Pens	3	27	45
Markers	1	9	15
Hanging Weighing scale (up to 60 kg)	1	9	15
Thick plastic sheet (at least 4 x 4 metres)	1	9	15
Waste containers or bags (60 L)	12	89	180
Scissors	1	9	15
Spades	1	9	15
Brooms	1	9	15
Camera/ Smart Phone	1	9	15
Reporting sheets	1	9	15
Informed consent letters (with space for signing and dating) for each sample member	10	90	150

The following table provides the list of compulsory personal protective equipment (PPE) required to conduct the waste composition survey. This is a basic requirement, and the list can be added to according to the specific situational requirements. The use of PPE is particularly important when the survey is conducted in a COVID-19 situation.

Table 8: Necessary PPE

Things to Prepare	Quantity		
	1 Survey area	9 survey areas (average city)	15 survey areas (mega-city)
Hat or cap (sun and dirt protection)	2-3	18-27	30-45
Glassess (eye protection)	2-3	18-27	30-45
Masks	2-3	18-27	30-45
Long sleeve shirts	2-3	18-27	30-45
Thick gloves	2-3 pairs	18-27 pairs	30-45 pairs
Apron (stomach protection)	2-3	18-27	30-45
Long pants	2-3	18-27	30-45
Rubber boots	2-3 pairs	18-27 pairs	30-45 pairs
Hand sanitizer	1	9	15
Disinfectant	1	9	15
Soap	1	9	15
First aid kit, including eye bath	1	9	15

5. **Mark each liner bag** with the house number and letter denoting the neighbourhood, the survey date and survey area. The bag will contain the waste generated in that household on the written date. Do not note the householder's name, in order to protect the confidentiality of the people who have kindly agreed to participate in your survey.

6. **Print recording sheets and prepare the WaCT Data Collection Tool**: Print the forms included in Annex 2 of this document and download the WaCT Data Collection Application (DCA) and Data Collection Manual (DCM) from the Waste Wise Cities website. Check for updated versions and make sure you are using the latest version. Carefully read the instructions on how to access and use the WaCT DCA so you can open and use the file.

7. **Find a location for the waste amounts and composition measurement:** According to the estimate of the volume of daily collected waste from the households, choose a site where you can store waste and conduct the measurement of waste as well as the composition survey. Ideally, this site should be flat and covered, have enough space, be accessible by vehicle, have access to water for drinking and washing purposes and offer protection from pests.

2.2 Waste sampling and waste composition analysis

The following is a suggested schedule for household waste sampling and composition survey, taking weekend days into consideration. Conduct the following exercise in all survey areas.

Day 0: Deploy survey team for each survey area with marked liner bags, and distribute four linerbags with the dates of day 1, 2, 3 and 4 to each household. It is important to gain the household's consent and cooperation by explaining the purpose of the survey. Once the householder has agreed to participate, ask them to store **all** the waste generated that day at home in the respective bag and not to give any materials (e.g. recyclables) to anyone outside the home.

Day 1: Use this day to check whether all the survey households have been identified, to overcome any problems or gaps, and to initiate the non-household waste survey (Step 3)

Day 2: Weekend

Day 3: Weekend

Day 4: The survey teams collect the bags of day 1, 2 and 3 (filled) while distributing the two liner bags of day 5 and 6 to each household. Bring the collected waste to the identified location for sample measurement. Before beginning with the weighing and sorting, **it is important to discard the day 1 samples**, as these might contain waste generated before the start of the survey, which would distort the data. Measure the weight of waste generated on day 2 and 3 separately, following the below steps:

a. First, weigh the collected bags from each household (for each day) separately and record the weight in the sheet (Annex 2). Weigh an empty bag and deduct the weight of the bag from each sample weight. Remember, there is no need to weigh the bags from day 1, and these should already have been set aside.

b. Prepare the buckets labelled with the 12 sorting categories around the thick plastic sheet.

1. Kitchen/canteen
2. Garden/park
3. Paper & cardboard
4. Plastic – film
5. Plastic – dense
6. Metals
7. Glass
8. Textiles/shoes
9. Wood (processed)
10. Special wastes
11. Composite products
12. Other

c. After making sure that the individual sample weights per household per day have been recorded, open the bags and spread the waste on the plastic sheet. You can mix the samples together at this point, as the composition is an average for the whole sample (i.e. not per household per day).

d. Sort the waste into the 12 categories. Annex 4 contains a sorting guideline.

e. Weigh each fraction and record it in the sheet (Annex 3). Remember to subtract the weight of the empty container from the total weight.

Day 5: Use this day to follow-up and cross check on the household sampling, overcome any problem or gaps, and conduct non-household waste survey (Step 3)

Day 6: The survey teams collect the bags of day 4 and day 5 (filled) and provide the labelled bags for day 7 and 8 to each household. Process the collected waste following the same steps done on Day 4.

Day 7: Use this day to follow-up and cross check on the household sampling, overcome any problem or gaps, and conduct non-household waste survey (Step 3)

Day 8: Use this day to follow-up and cross check on the household sampling, overcome any problem or gaps, and conduct non-household waste survey (Step 3)

Day 9: The survey team collects the bags of day 6, 7 and 8 (filled) and repeats the same steps as on Days 4 and 6

The schedule is summarized in the table below for reference:

Table 9: Schedule for MSW generation survey

Day n°	Survey Teams	Households
Day 0	Distribute bags for day 1, 2, 3 and 4 to households Ask the number of people staying at households	Provide the number of people staying at household
Day 1	Use the day for non-household waste survey (Step 3)	Fill the bag of day 1
Day 2	Weekend	Fill the bag of day 2 Store the bag of day 1
Day 3	Weekend	Fill the bag of day 3 Store the bag of day 1 and 2
Day 4	Collect the waste bags from day 1, 2, and 3 Distribute empty bags for day 5 and 6 Discard the waste bag from day 1, do not weigh it or include it in the composition survey Weigh and conduct waste composition survey for waste bags from day 2 and 3 Insert data in the reporting sheet	Provide waste of day 1, 2 and 3 Fill the bag of day 4
Day 5	Use the day for non-household waste survey (Step 3)	Fill the bag of day 5 Store the bag of day 4
Day 6	Collect the waste bags from day 4 and 5 Distribute empty bags for day 7 and 8 Weigh and conduct waste composition survey on waste bags from day 4 and 5 Insert data in the reporting sheet	Provide waste sample of day 4 and 5 Fill the bag of day 6
Day 7	Use the day for non-household waste survey (Step 3)	Fill the bag of day 7 Store the bag of day 6
Day 8	Use the day for non-household waste survey (Step 3)	Fill the bag of day 8 Store the bags of day 6 and 7
Day 9	Collect bags of day 6, 7, and 8 Weigh and conduct waste composition survey for bags of day 6, 7 and 8	Provide waste samples of day 6, 7 and 8

Note:

If the climate does not allow households to store the waste for three days, arrange more frequent waste collection to obtain the 8 days waste samples. Make sure to discard the 1st sample.

Important:

Remind households not to sell or take out recyclables so that the genuine total waste generation in the household can be properly captured.

In some cases, you might need to collect the generated waste every day from the households. For such cases, use the following schedule:

Table 10: Model waste sampling schedule for every day

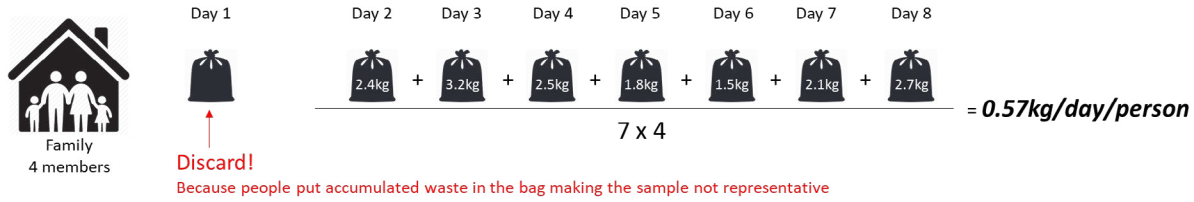
Day n°	Survey Teams	Households
Day 0	Distribute empty bags for day 1 and 2 to households Ask the number of people staying at households	Provide the number of people staying at household
Day 1	Use the day for non-household waste survey (Step 3	Fill the bag for day 1
Day 2	Collect and discard the waste bags for day 1. Do not weigh or conduct composition survey on bags from day 1. Distribute empty bags for day 3	Provide waste bag from day 1 Fill the bag for day 2
Day 3	Collect the waste bags from day 2 Distribute empty bags for day 4 Weigh and conduct waste composition survey for bags from day 2 Insert data in the reporting sheet	Provide waste bag from day 2 Fill the bag for day 3
Day 4	Collect the waste bags from day 3 Distribute empty bags for day 5 Weigh and conduct waste composition survey for bags from day 3 Insert data in the reporting sheet	Provide waste bag from day 3 Fill the bag for day 4
Day 5	Collect the waste bags from day 4 Distribute empty bags for day 6 Weigh and conduct waste composition survey for bags from day 4 Insert data in the reporting sheet	Provide waste bag from day 4 Fill the bag for day 5
Day 6	Collect the waste bags from day 5 Distribute empty bags for day 7 Weigh and conduct waste composition survey for bags from day 5 Insert data in the reporting sheet	Provide waste bag from day 5 Fill the bag for day 6
Day 7	Collect the waste bags from day 6 Distribute empty bags for day 8 Weigh and conduct waste composition survey for bags from day 6 Insert data in the reporting sheet	Provide waste bag from day 6 Fill the bag for day 7
Day 8	Collect the waste bags from day 7 Weigh and conduct waste composition survey for bags from day 7 Insert data in the reporting sheet	Provide waste bag from day 7 Fill the bag for day 8
Day 9	Collect the waste bags from day 8 Weigh and conduct waste composition survey for bags from day 8 Insert data in the reporting sheet	Provide waste bag from day 8

Note: if you are able to store the collected samples in a cool and secure area, protected from flies, pests and animals, you may be able to weigh bags and conduct the waste composition surveys in accordance with the three times weekly schedule (Table 9) while still collecting waste bags daily from households.

2.3 Calculate per capita household solid waste generation

1. **Calculate average per capita household waste generation rate:** Enter the data into the WaCT DCA. The figure below shows how the per capita household waste generation is calculated from the data collected through the waste sampling. First, it is important to discard the sample from Day 1, as people tend to put waste in the bag which has been accumulating at their home, making the sample not representative. Second, take the sum of the results from the other 7 days and divide it by the number of days and the number of people residing in the household.

Figure 6: How to estimate household MSW generation per capita for a household



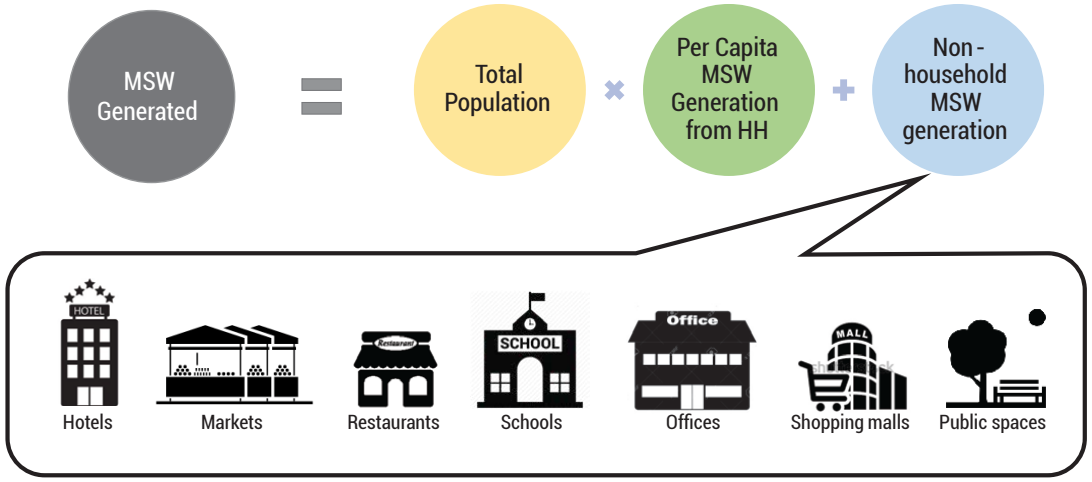
2. **Add population data for each income group:** Enter population data for each income group into WaCT DCA, then the automated excel sheet will provide total household solid waste generation in your city. This is calculated by multiplying the calculated per capita household waste generation per income level, by the population of each income level. All these are summed up to calculate the total household waste generation.


Grup Fruiter
Melinda
Kiwi
Delicato

STEP 3: NON-HOUSEHOLD MSW GENERATION

Household waste is only one part of the total MSW generated in a city. Commercial establishments (e.g. markets, restaurants, shops, hotels, etc.) and institutions (e.g. schools, administrative buildings, offices, etc.) as well as public spaces (e.g. parks and streets) also contribute considerably to the total amount of MSW generated.

Figure 7: Types of non-household MSW Generation sources



Three approaches can be used to calculate the amount of MSW generated by non-household sources, option b) will be explained in more detail in this step.

Conduct waste sampling from non-household MSW sources through random sampling, similar to the household waste survey. This approach yields more accurate results, but it is more resource intensive.

Conduct interviews with non-household MSW sources and their waste collection service providers to get approximate amounts of generated waste. This approach is less resource intensive, but the results are less accurate than option a) and it is recommended to take when you have reliable business licensing data. See more details from sub step 3.2 to 3.5.

If there are no reliable business licensing data available or no resources to conduct a comprehensive survey, use a proxy to estimate the MSW generation from non-household sources. This guide recommends the use of a proxy of 30%[5] to estimate MSW generated by non-household sources. See more details in sub step 3.1.

5 UN-Habitat conducted a research on the proportion between household and non-household waste generation using the historical data of OECD countries. This suggested about 30% of total MSW is generated by non-household sources and 70% by households. However, further study is needed to improve the sensitivity of this proxy to different City situations.

3.1 Using the proxy for non-household MSW

Where the proxy is being used for estimation of the total waste from non-household sources, the following formulas can be used.

a) Total MSW= 70% from households+30% from non household sources

$$b)\ \text{Total MSW} = \frac{\text{Total MSW from households}}{70\%}$$

If you have decided to conduct an interview-based survey to gain a more comprehensive and accurate estimate of the non-household MSW apply the following steps.

3.2 Identify premises to interview

1. **Choose "unit" for calculation:** Household waste is normally calculated through multiplying "per capita household waste generation" with total population. However, this unit cannot be used for MSW from hon-household sources. A different unit should be selected according to the type of premises and based on the business license data available in your city. The table below provides some examples. For public spaces, ask the urban planning department in your city for the data.

2. **Identify premises for interview:** After selecting the 9 survey areas (15 for mega cities) for the household survey in Step 2, identify 2 hotels, 2 restaurants, 2 schools, 2 offices, 1 shopping mall/supermarket, 1 market and 1 hospital per survey area. Choose premises that are representative of the survey area.

3. **Prepare questionnaire for interview:** Both the premises generating MSW, as well as their contracted collection companies need to be interviewed. You can find model questionnaires in Annex 5.

3.3 Interview selected premises and each contracted collection company

4. **Schedule visits to selected premises:** Visit selected premises on the days not needed for the household survey, as described in Step 2. Ask the manager, where they store the waste generated from the premise, note the volume, and if possible, weigh the waste. Waste generated from markets are typically difficult to estimate, therefore it is recommended to organize a weight measurement if there is a weighbridge in your city. Ask the market operator when the waste is collected and bring it to the weighbridge to measure the waste weight, so that waste generation per stall per day can be calculated.

Table 11: Suggested units for aggregation of generations rates in premises and institutions

Generator	Recommended Unit	Comment
Hotel	# of beds	If there is a shopping centre or restaurant, assess separately
Restaurant	# of tables/chairs	
Schools	# of pupils	If there is a canteen, assess separately as restaurant
Offices	# of employees; Square meters	If there is a canteen, assess separately as restaurant
Markets	# of stalls; type of goods (vegetable market vs electronics market)	
Hospitals	# of beds	
Public spaces	Square meters	Tonnes collected will be divided by the sqm of served areas

5. **Interview waste collection service providers:** When interviewing premises, ask which waste collection service providers they have contracted. Interview these collection companies (per phone is sufficient) and ask how much waste they collect from the said premise. You can find model questionnaires in Annex 5.

3.4 Obtain waste data from public spaces

1. **Identify responsible entity/department for public space cleaning:** Identify responsible entity or department for public space cleaning in your city.

2. **Obtain data related to waste from public spaces including:** 1) average collected tonnage of waste daily, 2) approximate square meters of the cleaned area for the collected tonnage of waste. Also obtain the total sqm of public spaces in the city.

3.5 Calculate MSW generated by non-household sources

1. **Calculate per unit waste generation from different premises:** Once the data from all the premise types and public spaces is collected, enter data into the WaCT DCA.

2. **Estimate total MSW generated by non-household sources:** Enter the total number of units (chairs, rooms, students, employees, stalls, beds, square metres) derived from the business licensing data and public space data into WaCT DCA to obtain total MSW generation per day from each premise and total MSW generated from non-household sources.

STEP 4: MSW RECEIVED BY RECOVERY FACILITIES AND CONTROL LEVEL OF RECOVERY FACILITIES

Some of the MSW collected from households or non-household sources will be delivered to recovery facilities. It is important to identify this amount, since it is an essential part of the Total MSW collected. It is also a very important exercise to understand how much recovery capacity your city has compared to the quantity of recyclables in the MSW stream, and how the recyclable material moves through the recovery chain. This will directly inform national policy with regards to establishing a circular economy including extended producer responsibility systems, deposit refund schemes, bans of non-essential single use plastics, etc. This step also helps local governments and waste management operators to optimise their operations, and plan waste management interventions in an inclusive manner.

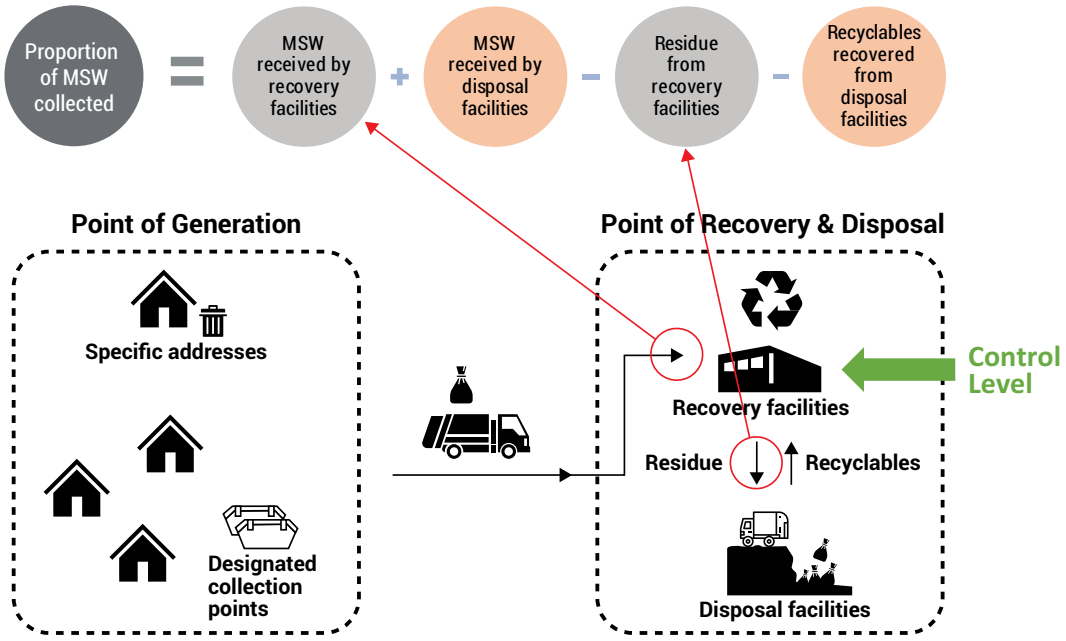
If possible, it is recommended to extend the survey area for this step beyond the system boundaries for the city assessment. Representative data collected at the national level can also be used for reporting on SDG indicator 12.5.1 *National recycling rate and amount of material recycled*.

The diagram below shows the data to be collected through this step, which includes MSW received by recovery facilities and residue from recovery facilities (both marked in light grey). Data is obtained through interviews with identified recovery facilities that receive MSW.

4.1 Identify recovery facilities

1. **Make a list of major recovery facilities:** through business licensing data, identify and list recycling and recovery facilities who deal with MSW generated in your city. It is possible that business licensing only covers the larger formal operators, so it is recommended to ask some of them who else is involved in the waste recovery chain in your city. Add those facilities to the list.

Figure 8: Information to be collected in Step 4



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2. **Categorise the recovery facilities in the list:** according to the key definitions of recovery, identify "Intermediate Traders", "Apex traders" and "End of Chain Recyclers/Recoverers". It is possible that there are no end of chain recyclers/ recoverers for specific materials in the city, with apex traders exporting the material for further processing.

3. **Determine the system boundary and priority interviews:** sketch out the recovery system in the city identifying each of the recovery facilities that you would like to interview. Note that the focus of data collection (for the purposes of the WaCT) is on the facilities that are the **first point of entry** into the recovery system for each of the MSW/materials streams. Depending on the complexity of the recovery system in the city, and the time (and budget) you have available for the assessment, select a number of interviews to key recovery facilities that will allow you to profile the recovery system in sufficient detail.

4.2 Arrange visits and interviews with identified recovery facilities

1. **Establish contact with the key recovery facilities** through phone call or email and set up an appointment for a site visit and an interview. Permission from the authorities may be required for visiting the recovery facilities, and when on-site the survey team should comply with the necessary health and safety procedures. Make sure you plan for this in advance.

2. **Interview identified recovery facilities** face-to-face using the questionnaire in Annex 6. The focus is on identifying how much recyclable material is entering the recovery system, and the level of control of the recovery facilities at the point of entry of materials into recovery facilities. Ask the facility managers what quantities of different materials they receive from the MSW stream daily, from where they receive the materials, whether from multiple small operators, collection systems, or other recovery facilities. If the answer is another recovery facility then you can be sure that you have not yet identified the first point of entry into the recovery system, and you need to go and interview the other recovery facility identified. Note that in some cases a recovery facility may be the first point of entry for some materials, but not for others, so make sure to keep your data sets for different materials and build up a comprehensive picture of the recovery system.

3. **Quantifying rejects from the recovery system:** Not all the materials that enter the recovery system will be recycled or recovered; some "rejects" will leave the system and need to be disposed of as waste. The WaCT uses a proxy estimate for materials loss within the recovery system of 10%. A proxy estimate is sufficient for the purpose of the WaCT assessment because a more detailed and accurate assessment can take considerable time (and budget) and distracts attention away from understanding the quantities and level of control at the point of entry into the recovery system. If you have sufficient resources to profile the materials losses through the whole recovery system (value chain) then that information will help you identify detailed interventions. ,However, for the purpose of the WaCT assessment this level of detail is not strictly necessary.

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4.3 Evaluate the level of control of recovery facilities

1. **Evaluate the control level of the recovery facilities:** After interviewing the recovery facility, check its operations and processes as well as environmental control level according to the ladder of control. The subject recovery facility has the level of control where you have checked the most boxes.

4.4 Compile the collected information

1. **Input of the collected data:** After interviewing the recovery facilities using the questionnaire in Annex 6 and determining their level of control, compile the information for the WaCT DCA.

2. Assessing the recovery system in a city can be a challenging task. Remember that the focus of the WaCT assessment is to identify the amounts of materials going into the recovery system at the first discernible point of entry.

3. The WaCT DCA has been designed to help avoid double counting errors, and also includes a proxy of 10% for 'rejects' that come out of the recovery system as waste. The data on the quantity of materials entering the recovery system will help you to understand both the quantity of MSW collected for recovery, and also the recycling/ recovery rate. Note that these two numbers will be 10% different, the effect of using the proxy, so double check your outcomes.

4. Read the instructions in the WaCT Data Collection Manual (DCM) as to how to fill in the WaCT DCA carefully and check on the Waste Wise Cities website for training videos, frequently asked questions, and updates.

Dumpsites receive

40%

of World's Waste

Waste Wise Cities Tool

STEP 5: MSW RECEIVED BY DISPOSAL FACILITIES AND CONTROL LEVEL OF DISPOSAL FACILITIES

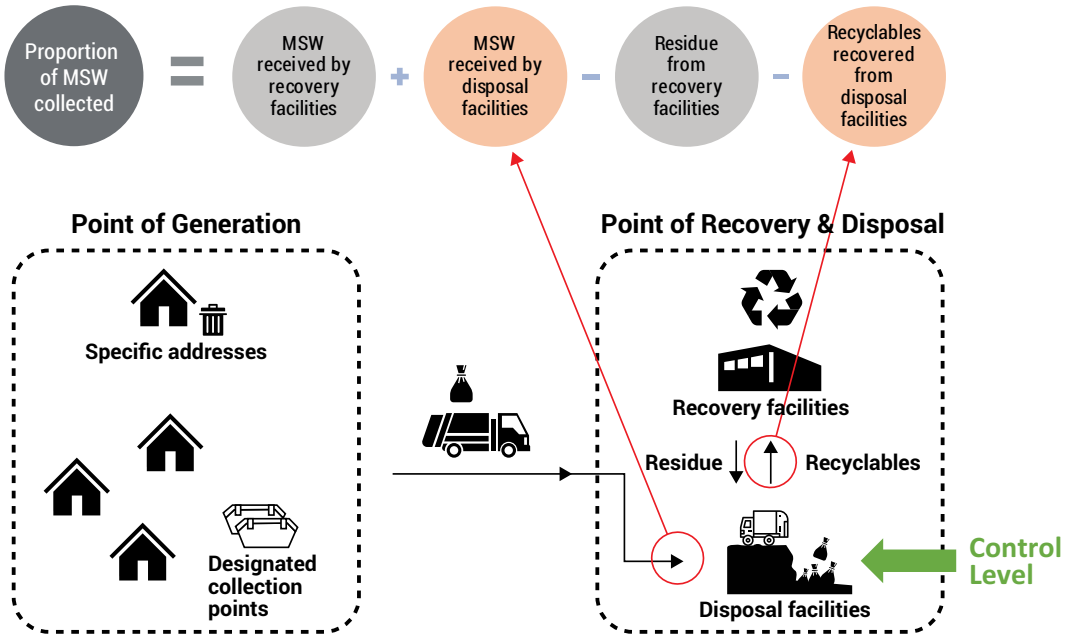
Globally, uncontrolled disposal sites receive 40% of world's waste and serve about 3-4 billion people. As urbanization and population growth continues, without urgent intervention it is expected that situation could worsen, mainly in low-and-middle income cities.

Uncontrolled disposal facilities offer no protection to water, soil and air pollution. Under the business-as-usual scenario uncontrolled disposal will account for 8-10% of global anthropogenic GHG emissions by 2025. Uncontrolled disposal is the major source of plastic pollution emissions to the environment. As these sites are often accidentally or purposely set on fire, they are a major source of local air pollution that acutely affects the health of neighbouring communities, as well as further contributes black carbon GHG emissions. Leachate emitted from disposal facilities have the potential to pollute waterways, and uncontrolled landfill gas emission represent health and safety as well as environmental concerns.

This Step includes a methodology to measure the MSW amounts received by disposal facilities, the level of control of such facilities and how to estimate the recyclables recovered from disposal facilities to the recovery chain (marked in orange in Figure 9).

Step 5 is extremely important for cities to protect the environment from pollution from uncontrolled disposal facilities. The focus of Step 5 is to understand the current status of operational control of each disposal facility, so that measures can be identified, designed and implemented to bring these facilities up to at least to basic levels of control. For those cities that have already achieved basic level of control over their disposal facilities, further steps can be taken to upgrade the facilities to improved and full control as indicated in the ladder of control level.

Figure 9: Information to be collected in Step 5



5.1 Identify disposal facilities

1. **Identify all disposal facilities** receiving MSW generated from the city according to the definitions under disposal. It is important to include disposal facilities that might not be legally approved (or licensed/permitted), but nevertheless are acknowledged by the local authority. Even when disposal facilities are located outside of the city, include them if they receive MSW generated from the city.

5.2 Arrange visits and interviews with identified disposal facilities

1. **Arrange a visit for the identified disposal facilities:** once all the disposal facilities have been identified, arrange site visits to each of them. Permission to visit these facilities may be required from the city waste management department, and while on-site the survey team should comply with the necessary EHS procedures. Make sure you plan for this in advance.

2. **Obtain records of waste received by the disposal facilities:** quantitative data of waste arriving at the disposal facility can be obtained through the following three approaches:

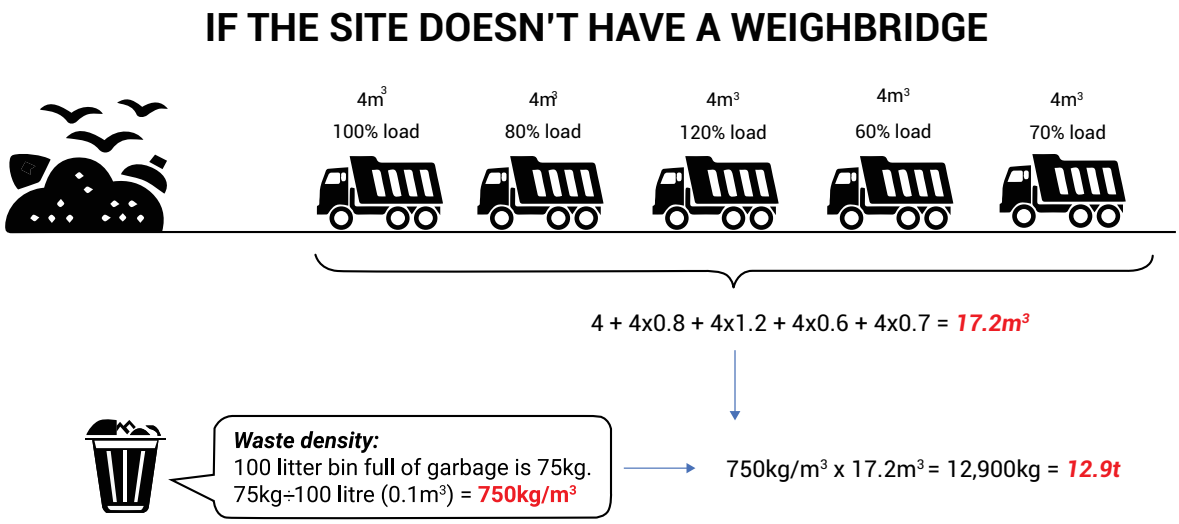
   → **Weighbridge:** check whether there is a functioning weighbridge at the site. If yes, request the recorded weights of received waste for a period of two weeks. If the climate of the city under assessment has very marked seasonal variations, try to obtain recorded amounts for a period of two weeks per season. Use the obtained records to calculate the daily average amount of waste received by the site. In case there is no weighbridge, explore the possibility of renting one for a period of a week.

   → **Vehicle counting:** if no weighbridge is available, an alternative method is counting the number of trucks coming to the site for a period of 5-7 days. The surveyor sits at the entrance and counts the trucks entering the landfill. In addition, whenever possible, two parameters should be assessed for each truck: maximum capacity (volume in m^3) and load (the degree to which the load reaches the capacity, in %). These parameters can be obtained through observation, or if possible, by interviewing the disposal facility operator or truck driver. These data should be supplemented by the waste density measurement described in Figure 10 below.

   → **Interview the operator:** interview the disposal facility manager to obtain the same information referred to above (i.e. number of trucks arriving per day at the site(s), the maximum capacity (volume, e.g. m^3) and the load (%). This approach is recommended in cities with a reduced number of collection service providers, or in cities where it is not possible to visit the disposal facility.

When conducting b) and c) above, measure the density of waste. This can be easily combined together with the waste characterization in Step 6.

Figure 10: waste density measurement method



3. **Interview waste pickers:** Ask waste pickers working at the disposal site for the average quantity of materials they collect and sell weekly or monthly from the disposal site, thus estimating the average amount collected and recovered to the recycling value chain. Also find out the total number of waste pickers working at the disposal site.

4. **Estimate total waste materials diverted from the disposal facility to the recovery chain:** By multiplying the average daily amount of waste collected by waste pickers with the total number of waste pickers working in the disposal site, estimate the total waste materials collected from the disposal site and brought into the recovery chain.

5.3 Evaluate the level of control of disposal facilities

1. **Evaluate the level of control of the facilities:** the visits to find out the amount of waste delivered to the disposal sites should also be used to evaluate the level of control of the disposal facilities. Check its operations and processes as well as environmental control level according to the ladder of control. The subject disposal facility is assigned the level of control where you have checked the most boxes.

5.4 Compile the collected information

1. **Input the collected data:** After visiting the disposal facilities, interviewing their site managers, and determining their level of control, enter the obtained information into the WaCT DCA.

STEP 6: WASTE COMPOSITION AT DISPOSAL FACILITIES

This step provides the instructions to measure the composition of waste at disposal facilities. The waste composition survey takes one or two days.

6.1 Preparation

1. **Recruit and train workers:** for the composition survey around 15 workers are needed. If there are many waste pickers working at the disposal site, consider hiring some of them. All workers should be trained properly on the aim of the composition survey, the main steps and the health and safety procedures. Since sorting waste can be hazardous, personal protective equipment (i.e. gloves, masks and boots) must be used, avoid dehydration and take adequate breaks. Give clear instructions that if any medical or other hazardous waste is spotted in the sample, the sorting procedure must immediately stop.

2. **Acquire necessary equipment**: Table 12 shows the main items that are required for characterizing the waste at a disposal site. This includes a basic PPE requirement which can be added according to the specific situational requirements. The use of PPE is particularly important when the survey is conducted in a COVID-19 situation. Check with the disposal facility in advance whether they have some or all of these items, and whether there are additional requirements for fluorescent jackets, protective hats, and protective shoes (e.g. steel toe cap and soled boots).When working on a disposal facility, always take great care to ensure that your survey team strictly follows health and safety protection requirements.

Table 12: Items required for a waste composition survey per survey group

Items	Quantity
Pencil and notebook	At least one person noting
Recording sheet	3
Standing/ hanging weigh scale (up to 100 kg)	1
Shovels	8
Thick plastic sheet (at least 5 x 5)m	2
Waste containers or bags (60 L)	24
Scissors	2
Brooms	2
Camera/smart phone	1

Table 13: Necessary PPE Composition Analysis Disposal Site

Items	Quantity
Hat or cap (sun and dirt protection)	1 per survey team member
Glasses (eye protection)	1 per survey team member
Masks	1 per survey team member per day
Long sleeve shirts	1 per survey team member
Thick gloves	1 pair per survey team member
Apron (stomach protection)	1 per survey team member
Long pants	1 per survey team member
Rubber boots	1 pair per survey team member
Hand sanitizer	2
Disinfectant	2
Soap	2
First aid kit, including eye bath	1

3. **Prepare site for the survey:** find a place where you can store and handle a sample of around 200 – 300 kg of waste. Ideally, this site should be flat and covered, have enough space, be accessible to vehicles, and have access to water for drinking and washing purposes and offer protection from pests. Cover the surface with a thick tarpaulin, on top of which the waste sample will be deposited.

6.2 Waste sampling and composition analysis

1. **Number of samples:** for this assessment a minimum of 3 trucks per income level (low, medium and high) service areas (or correspondingly from different household-type service areas) needs to be sampled.

2. **Select trucks for waste sampling:** before selecting a truck for sampling, check with the truck drivers (or the disposal facility manager) from which area the truck is delivering the waste. Make sure only trucks containing purely MSW are sampled. Take a 200-300kg sample from the truck. Direct the driver to safely park alongside the tarpaulin. Deposit (either through hydraulic or manual unloading) the sample on top of the tarpaulin. Be extremely careful to ensure that the truck emptying process is safely completed, and that no one is in proximity to the falling waste as it is being unloaded.

3. **Quartering technique:** once you accumulated the MSW sample of 200-300 kg you need to derive a representative sample of around 50-70 kg for the analysis. The most commonly used technique for this is called "The Quartering Technique":

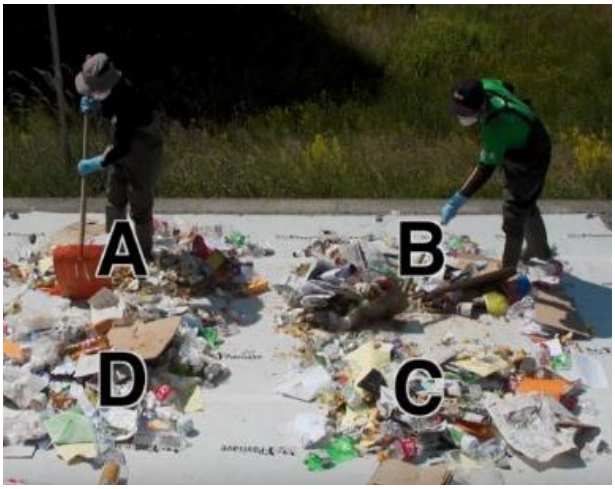
    - First mix the waste sample as thoroughly as possible. You can use your shovels for this.
    - Then spread out the waste on the surface so that it forms a flat layer.
    - Divide the waste layer into four parts: ABCD (see Figure 11 left).
    - From those four portions, discard two opposing quarters, say B and D.
    - Mix the remaining two quarters.
    - Repeat the quartering process once more. The derived sample will be approximately one quarter of the size of the original sample, around 50-70 kg.

4. **Sort the waste:** Prepare labelled containers and sort the sample of 50-70 kg into 12 categories in the respective container (see Figure 11 right):

1. Kitchen/canteen
2. Garden/park
3. Paper & cardboard
4. Plastic – film
5. Plastic – dense
6. Metals
7. Glass
8. Textiles/shoes
9. Wood
10. Special wastes
11. Composite products
12. Other

5. **Weigh the waste fractions**: weigh each fraction in their containers and record the weight. Remember to subtract the weight of the empty container from your results.

Figure 11: Quartering technique (left) and sorting (right)



An estimated 820 million people do not have enough to eat

(WHO, 2018)

STEP 7: CALCULATING FOOD WASTE, RECYCLING, PLASTIC LEAKAGE, GREENHOUSE GAS EMISSIONS AND AIR POLLUTION

Parameters of SDG indicator 11.6.1 are closely linked with other waste SDGs (12.3 on food waste and 12.5 on recycling). Additionally, the WaCT has been developed in parallel with the Waste Flow Diagram (WFD) for the estimation of potential plastic leakage from the MSWM systems. The WaCT also generates input for assessment of air pollution and greenhouse gas emissions with the Solid Waste Emissions Estimation Tool (SWEET).

This step introduces these different SDG indicators, the WFD and SWEET, for which data produced by WaCT and SDG indicator 11.6.1 can be utilised.

7.1 Food waste

Food waste is one of the core global issues for us to achieve sustainable production and consumption pattern by 2030. Currently, total food waste for the edible parts of "primary product equivalents" amounts to 1.3 billion tonnes (FAO,2013), while an estimated 820 million people do not have enough to eat (WHO, 2018). Not only are the resources that went into creating uneaten food wasted, but when food waste goes to landfill sites, it decomposes without access to oxygen and creates methane, which is 24 times powerful in greenhouse gas effect than CO_2.

SDG 12.3 calls for a halving of food waste at retail and consumer level and reduce food losses along production and supply chains. SDG target 12.3 has two components, food loss and food waste that should be measured by two separate indicators. Sub-indicator 12.3.1.a, food loss index, focuses on food losses that occur from production up to (and not including) the retail level. It measures the changes in percentage losses for a basket of 10 main commodities by country in comparison with a base period. Sub-indicator 12.3.1.b, food waste index, focuses on retail and consumption levels.

Data collected for the assessment of SDG indicator 11.6.1 can contribute to estimate SDG indicator 12.3.1.b *Food Waste Index,* by providing *household food waste generation per capita* through the below formula..

Per capita household food waste generation=

Per capita MSW generation rate (kg/cap/d) x proportion of food waste

7.2 Recycling

Recycling is a central pillar in the transition towards a circular economy which governments and private sector work together in order to create long term, sustainable economies. In many ways, recycling is seen as a final effort to effectively utilize resources after people try to both reduce their consumption and find more efficient processes in production. Recycling is a vital way to reduce the environmental impact of natural resource extraction, which is rapidly damaging natural ecosystems. By investing in recycling and transforming already extracted resources, economies can make significant strides in decoupling economic growth from resource use.

Step 4, which collects data on the quantity of materials entering the recovery system through interviews with recovery facilities, can provide data necessary for SDG indicator 12.5.1 *National Recycling Rate*.

The recovery system combines different types of recovery activity, including recycling, incineration with energy recovery and other recovery processes. Recycling is a recovery process that is defined as "Any reprocessing of waste material in a production process that diverts it from the waste stream, except reuse as fuel". Thus the materials destined for recycling can be differentiated from the materials destined for recovery, by understanding the destination of those materials.

For the purpose of consistency with the Basel Convention reporting and correspondence with EUROSTAT reporting system, Recovery operations R2 to R12 listed in Basel Convention Annex IV, are to be considered as 'Recycling'. The questionnaire for recovery facilities in the Annex 6 can be integrated into national recycling monitoring system by national government, which can in turn to be used to report on SDG 12.5.1, by providing city recovery rate.

$$\text{City Recovery Rate} = \frac{\text{Total recovered materials (t/day)}}{\text{Total MSW Generated(t/day)}} \times 100\ (\%)$$

7.3 City Plastic Leakage

The Waste Flow Diagram (WFD) is a rapid and observation-based assessment tool visualizes the MSW flows applying material flow analysis. Hence it calculates the total potential plastic leakage into the environment from the MSW system and determines the eventual fate of this uncontrolled waste. Additionally, the WFD enables scenario building, forecasting how proposed interventions may impact the solid waste management system and plastic pollution. When applied at different stages of a project it helps to monitor the effectiveness of applied interventions. Results allow benchmarking and comparison between plastic pollution of different cities.

Both, the WaCT and the WFD, were developed in harmony. The data collected in Steps 1-6 provides direct input for the WFD. The WFD was developed in cooperation by GIZ, the University of Leeds, Eawag-Sandec and Wasteaware. The tool and detailed guidance are available here: https://plasticpollution.leeds.ac.uk/toolkits/wfd/

7.4 Greenhouse Gas Emissions and Air Pollution

Municipal solid waste is a significant source of methane and black carbon, two short-lived climate pollutants. As the third largest man-made source of methane, waste contributes to climate change and ozone pollution. Open waste burning and the use of polluting collection vehicles emit black carbon, a key component of particulate matter (PM2.5) air pollution. When unsustainably managed, waste is also a breeding ground for toxins and microbes that contaminate the air, soil, and water.

The emissions of methane and black carbon from a city can be quantified using the Solid Waste Emissions Estimation Tool or SWEET. Information collected using the WaCT can be used to populate SWEET.

SWEET is an Excel-based tool that quantifies emissions of methane, black carbon, and other pollutants from sources in the municipal solid waste sector. The tool provides emissions and emissions reduction estimates at the project-, source-, and municipality-level. Cities can use this information for multiple purposes, including establishing a baseline scenario, comparing a baseline scenario to as many as four alternative scenarios, analyzing specific projects for potential emissions reductions, estimating the contribution of activities in the waste sector to overall city emissions reduction goals, and tracking progress over time, among other things.

SWEET was developed by the U.S. Environmental Protection Agency with support from Abt Associates and SCS Engineers on behalf of the Climate and Clean Air Coalition Municipal Solid Waste Initiative. SWEET and its manual are available here: https://www.ccacoalition.org/en/resources/solid-waste-emissions-estimation-tool-sweet-version-31

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10. UNSD/UNEP Questionnaire on Environment Statistics (waste section) (https://unstats.un.org/unsd/envstats/questionnaire)

11. UNSD Indicator Tables (waste) (https://unstats.un.org/unsd/envstats/qindicators)

Annexes

Annex 1: Sample introduction letter

LETTER OF INTRODUCTION

Dear Madame, Sir,

We are glad to inform you that *[name of organisation/local government]* is conducting a survey to collect data on the Sustainable Development Goal indicator 11.6.1 in *[name of city/municipality]*. This includes collecting information and waste from households and institutions.

Background of the study is the 2030 Agenda for Sustainable Development, adopted by all United Nations Member States in 2015, which provides a shared blueprint for peace and prosperity for people and the planet, now and in the future. At its heart are the 17 Sustainable Development Goals (SDGs), which are an urgent call for action to all countries in a global partnership.

SDG 11 aims at "making cities and human settlements inclusive, safe, resilient and sustainable". Target 11.6 intents "by 2030, [to] reduce the adverse per capita environmental impact of cities, including by paying special attention to air quality and municipal and other waste management".

To monitor the progress towards this target, an indicator 11.6.1 "proportion of Municipal Solid Waste collected and managed in a controlled facility out of total Municipal Solid Waste generated, by cities" was set, and *[name of organisation/local government]* would like to obtain information to assess this. The data obtained from the survey will be used to develop strategies and plans to improve waste management and achieve better urban living environment for residents in *[name of the city]*.

We would appreciate your collaboration in allowing *[name of organisation/ local government]* staff to collect the information and material necessary for assessing SDG indicator 11.6.1.
Sincerely,

.....

Name of signatory
Position
Name of organisation/local government

Annex 2: Recording sheet for household waste sampling

This form should be used for each survey area.

Survey Area:	**HH1**	**HH2**	**HH3**	**HH4**	**HH5**	**HH6**	**HH7**	**HH8**	**HH9**	**HH10**
Number of residents										
Weight of bag (in kg)										
Day 2, Date:										
Day 3, Date:										
Day 4, Date:										
Day 5, Date:										
Day 6, Date:										
Day 7, Date:										
Day 8, Date:										

Annex 3: Recording sheet for waste composition analysis

This form should be used for both household surveys (Step 2) and disposal facility surveys (Step 6). Print one of these sheets for each survey area (total 9 sheets), and for the disposal facility composition survey (total 3 sheets).

Survey Area: **Categories**	**Composition analysis 1 (kg)**	**Composition analysis 2 (kg)**	**Composition analysis 3 (kg)**	**Sum (kg)**	**Average (kg)**
1.Kitchen/ canteen waste					
2. Garden/ park waste					
3. Paper & cardboard					
4. Plastics - film					
5. Plastics - dense					
6. Metals					
7. Glass					
8. Textiles & shoes					
9. Wood (processed)					
10. Special wastes					
11. Composite products					
12. Other					
Total					

Annex 4: Sorting guideline

Waste shall be sorted in the following categories:

1	Kitchen/ canteen waste	Cooked or uncooked food, organic waste from food preparation
2	Garden/ park waste	Non-food biodegradable materials resulting from landscaping
3	Paper & cardboard	Paper & cardboard packaging, paper & cardboard products
4	Plastics - film	Thin plastic used in packaging and for other purposes
5	Plastics - dense	Hard plastics used in packaging and for other purposes
6	Metals	Ferrous and non-ferrous metals packaging and products
7	Glass	Glass packaging and products
8	Textiles & shoes	Clothes and other textiles, as well as shoes
9	Wood (processed)	Untreated and treated processed wood
10	Special wastes	Waste electric and electronic equipment (anything with a cable), batteries/ accumulators, other hazardous waste
11	Composite products	Products that are made of more than one of the above, for example drink containers (“tetra pack”), products made of a combination of plastic, metal and glass and similar.
12	Other	Anything that cannot be classified in one of the above categories

Remarks for sorting:

- **Packaged food**
  Separate as far as possible,
  e.g. eggshells in plastic packaging: put the egg shells to “1: Kitchen/canteen waste” and the plastic packaging to “5: Plastics – Dense”

- **Hazardous waste**
  Handle with care! Do not drain! Keep in packaging and classify content and packaging as “10: Special Wastes”
  Empty packaging is not any longer considered hazardous, thus classify it according to the packaging material.

1 Kitchen/ canteen waste

Bread, coffee grinds, cooked or uncooked food items, food leftovers, fruit and vegetables, meat and fish, pet foods, tea bags, peels, skins, shells, pips and stones,
etc.

2 Garden/ park waste

Flowers; Fruit and vegetable garden waste; Grass Cuttings; Hedge trimmings; Leaves; Pruning; Tree branches; Weeds,
etc.

3 Paper & cardboard

Brochures, magazines, newspapers; cereal packets, noodle boxes; Fast Food Paper bags/wrapping; Cards, books, wallpapers; Paper bags, tissue boxes, wrapping paper, tissue paper, Writing paper, printouts, envelopes, folders, files, letters, directories, tickets,

etc.

4 Plastics - film

Biscuit wrappers; Cling film; Frozen food bags; Packaging plastic film; Cellotape; Garden sheets; Non-packaging film; Plastic bags; waste liner bags;

etc.

5 Plastics - dense

All plastic bottles/jars;

Appliance packaging; Egg boxes; Food packaging trays; Plastic lids; Ready meal trays; Bank/credit cards; Buttons; CDs; music cassettes; Cosmetic/glue/paint applicators; lighters; pens;

etc.

6 Metals

Packaging for carbonated drinks;

Shoe polish cans; Tinned food; Aerosols (deodorant, perfume, hairspray); Aluminium foil sheets;

Other food/non-food/pet food containers;

Bike parts; Building materials; Car parts; Cutlery; Keys; Metal shelves; Nails; Paper clips; Plumbing; Pots and pans; Radiators; Ring pulls; Safety pins; Screws; Tools; Locks;

etc.

7 Glass

Alcoholic and non-alcoholic drinks bottles/jars;Food jars;

Medicine bottles;Cookware;Flat glass (e.g. table top, window, mirrors, reinforced, windscreens);Mixed broken glass;

etc.

8	Textiles & shoes

Clothes

Balls of wool; Blankets; Carpets; Cloths; Cords; Curtains;

Household soft furnishings and upholstery; Mats; Pillow cases; Rags; Ropes; Rugs; Sheets; Threads; Towels;

Shoes (incl. flip-flops);

etc.

9	Wood (processed)

Bottle corks, Cork packaging,: Pallets;

Solid timber and timber fragments;

Particle board (e.g. chipboard, plywood, mdf)

Wood fencing; Wooden furniture; Wood work tops;

etc.

10	Special wastes

All Waste Electric and Electronic Equipment, such as clocks, toaster, electric tools, hair dryer, telephones, Laptops, PCs, printers, screens, smoke detector, etc;

Batteries/Accumulators (e.g. Lead acid, Nickel cadmium, Lithium Ion);

Other Hazardous Waste such as Asbestos; Fire extinguishers; chemicals; Glues and solvents; Medicines; Paint products, etc.;

Used face masks and gloves

11	Composite products

Composite Packaging, such as Aluminium-foil coated card and drinking containers (“tetrapack”);

Products made out of different materials, e.g. Scissors, knifes, razors, umbrellas, etc.

12	Other

e.g.

inert (Boulders; Bricks; Gravel; Pebbles; Sand; Soil; Stones; Ceramics, Clay plant pots; Crockery; Stone/ceramic floor and wall tiles; Vases);

Nappies/diapers;

Rubber;

Light bulbs (all kinds)

Annex 5: Questionnaire for non-household waste generation

Surveyors name : _____

Survey area : _____

Questions for premises

Name of the premise : _____

Type of business and size (tick the box on the left and provide the size (add other categories and change the unit of size depending on your business permit system)

	Type	Size	
☐	Hotels	# of rooms	
☐	Restaurant	# of chairs/customers	
☐	Supermarket	Sqm	
☐	Shop	Sqm	
☐	Market	# of stalls	
☐	Shopping malls	Sqm	
☐	School	# of pupils	
☐	Office	# of employee	
☐	Hospital	# of beds	

Q1. How much MSW do you generate per day (especially important in hospitals, we don't need to know biomedical or hazardous waste)?

☐ _____kg/day

☐ Do not know

Q2. Who collects your waste?

☐ City government

☐ Commercial waste collector Name: _____

contact number: _____)

Questions for waste collector

Name of the waste collector : _____

Q1. How much waste do you collect from the above premise and how often?

(_____kg per _____ day(s))

Annex 6: Recovery survey questionnaire

Facility / Company Name : _____

Location : _____

Contact Person : _____

Telephone / Email : _____

Q1. Which category in the recovery value chain below best describes your operation?

- ☐ **End-of-chain recycler/recoverer** who receives materials from apex traders or directly from both formal and informal MSW collection systems and processes them into materials and products that has value in the economy either through recycling, incineration with energy recovery, or other recovery process.
- ☐ **Apex trader** who receive materials from intermediate traders or directly from both formal and informal recyclable collection systems (including waste pickers), store and prepare these materials for onward trading to end-of-chain recyclers/recoverers .
- ☐ **Intermediate trader** who receive materials from both formal and informal recyclable collection systems (including waste pickers), store and prepare these materials for onward trading to apex traders.

Q2. Which recyclable material(s) do you handle? Please tick all that apply.

☐ PET ☐ HDPE ☐ PP ☐ PVC ☐ LDPE & Films

☐ EPS ☐ Other plastics ☐ Paper or Cardboard ☐ Glass

☐ Metal ☐ Organic waste ☐ Mixed waste

☐ Other (Specify: _____)

Q3. For each of these recoverable/recyclable materials you receive from the MSW stream(s), please provide how much you source from which suppliers and/or cities. (use a separate line for every combination of material, trader and source city):

Table Q3

Recyclable material	Name of supplier (where applicable)	Type of supplier*	Amount you source (kg/d)	Source City	Point of entry into recovery system (Y/N)**

** "Type of supplier" includes 1) MSW collection system, 2) Many small suppliers (e.g. waste pickers), 3) Intermediate traders and 4) Apex traders*

*** "Point of entry into recovery system" is YES (Y) if the material is received from any person, trader or facility that is NOT itself being included in the survey programme. If the person, trader or facility that the materials have come from is already included in the survey programme then the answer to the "Point of Entry" query should be NO (N). If NO is checked here, please ensure that for this material, the actual point of entry to the recovery system has been identified. This column should be filled by surveyor, not answered by recovery facilities.*

Q4. For each of these recoverable/recyclable materials you receive from non-MSW stream (s), please provide how much you source from which companies.

Table Q4		
Recyclable material	**Name of supplying company**	**Amount you receive (kg/d)**

Q5. From the total amount you receive, how much do you estimate has been collected informally*?

☐ 0% - 19% ☐ 20% - 39% ☐ 40% -59%

☐ 60% - 79% ☐ 80% - 100%

**The informal sector refers to individuals or enterprises who are involved in private sector recycling and waste management activities which are not sponsored, financed, recognised, supported, organised or acknowledged by the formal solid waste authorities, or which operate in violation of or in competition with formal authorities (Scheinberg et al., 2010)*

Q6. What share of the total material recovered in your city do you reckon you process?

☐ 0% - 19% ☐ 20% - 39% ☐ 40% -59%

☐ 60% - 79% ☐ 80% - 100%

Q7. Please tell us how much residue/rejects are generated during your recovery process in tonnes per day and where the residue is transported.

Table Q7		
Material description	**Destination**	**Amount you generate (t/d)**

Q8. What is your current spare capacity? _____ **t/d**

Annex 7: Decision making tree for determining control level of waste management facilities

To determine the level of control of your waste management facilities you can use the following decision-making trees.

1. Answer the questions below one-by-one, starting from the top.
2. If the answer is "Yes" jump directly to the question number indicated. If the answer is "No" jump directly to the question immediately below.
3. Continue until you arrive at a determination of the level of control.

LANDFILL				
Question			Next Question	
			Yes	No
Security	F1	Is there a physical boundary surrounding the site and supervised access control 24/7	F2	I1
Water and leachate control	F2	Does site engineering prevent surface and groundwater ingress into the landfill	F3	I2
	F3	Is there functioning leachate containment and management	F4	I3
Slope stabilisation	F4	Are the slopes stabilised, including erosion control, to mitigate risk of landslide	F5	I4
Waste handling, compaction and cover	F5	Is waste deposited in clearly defined operational areas with strict management control	F6	I5
	F6	Is waste layered and compacted promptly	F7	B5
	F7	Is daily and intermediate cover applied to waste	F8	I7
Fire control	F8	Is their zero evidence of burning of waste on the surface of the landfill	F9	L3
Landfill gas management	F9	Is landfill gas controlled, including utilisation where practicable	F10	I9
Staffing	F10	Is it staffed full time with professionally qualified personnel	F11	I10
Records	F11	Does the site have a functional weighbridge in use, recording waste quantities by waste types	F12	L3
Environment, Health and Safety (EHS)	F12	Are EHS measures implemented in accordance with a professional risk assessment and operating plan	F13	I12
	F13	Are there showering and sanitary facilities	F14	I13
	F14	Is an environmental monitoring system in place with annual reporting capability	F15	B13
Site planning	F15	Is there a site development and operational filling plan in place	F16	I15
	F16	Is there a post closure plan in place	End >> Full Control	End >> Improved control
Security	I1	Is there a physical boundary surrounding the site and supervised access control	I2	B1
Water and leachate control	I2	Does site engineering prevent surface water ingress into the landfill	I3	B2
	I3	Are measures taken to prevent seepage of untreated leachate into surface and groundwater	I4	B3
Slope stabilisation	I4	Are the slopes stabilised, mitigating risk of landslide	I5	L2

Waste handling, compaction and cover	I5	Is waste deposited in a supervised operational area	I6	B4
	I6	Is waste layered and compacted promptly	I7	B6
	I7	Is waste periodically covered	I8	B7
Fire control	I8	Is their zero evidence of burning of waste on the surface of the landfill	I9	L3
Landfill gas management	I9	Is landfill gas controlled, including venting or flaring	I10	B9
Staffing	I10	Is the site staffed with trained personnel	I11	B9
Records	I11	Functional weighbridge in use with data for each delivered waste load recorded in a register	I12	B10
EHS	I12	Are procedures in place to ensure the health and safety of workers	I13	B11
	I13	Are there toilets and hand washing stations	I14	L5
	I14	Is an environmental monitoring system in place with annual reporting capability	I15	B13
Site planning	I15	Is there an operational filling plan in place	End >> Improved control	B13
Security	B1	Is there boundary and access control allowing single point of supervised access	B2	L1
Water control	B2	Is there any perimeter drainage maintained around the site	B3	L2
Slope stabilisation	B3	Are the slopes stabilised, mitigating risk of landslide	B4	L2
Waste handling, compaction and cover	B4	Are waste trucks directed to a specific operational area of disposal	B5	L2
	B5	Is there heavy mechanical equipment reliably available	B6	L2
	B6	Is waste layered and compacted within the specific operational area	B7	L2
	B7	Is there some use of cover material	B8	L2
Fire control	B8	Is their zero evidence of burning of waste on the surface of the landfill	B9	L3
Staffing	B9	Are staff on site during operational hours	B10	L4
Records	B10	Is there a functional weighbridge in use	B11	L5
EHS	B11	Are there toilets and hand washing stations	B12	L6
	B12	Are basic personal protective equipment in use	B13	End >> No control
Other	B13	Is there a site drawing showing the landfill boundary and filling area	End >> Basic Control	End >> Limited Control
Security	L1	Is there some level of access control to limit unauthorised dumping	L2	End >> No control
Waste handling, compaction and cover	L2	Is there heavy mechanical equipment available for minimum levelling and compaction	L3	End >> No control
	L3	Is there only limited evidence of burning of waste on the surface of the landfill	L4	End >> No control
Staffing	L4	Do staff check the site regularly	L5	End >> No control
Records	L5	Are waste deliveries recorded	L6	End >> No control
EHS	L6	Are basic personal protective equipment in use	End >> Limited Control	End >> No control

OTHER RECOVERY FACILITIES

Question			Next Question	
			Yes	No
Identity	F1	Is the facility registered/licensed	F2	I1
	F2	Does the site have clearly marked boundaries	F3	B2
Security	F3	Is there a physical boundary surrounding the site and supervised access control 24/7	F4	I3

Standards	F4	Is the facility engineered with process control	F5	B3
	F5	Does the facility have environmental pollution control compliant with applicable environmental standards	F6	I5
Circularity	F6	Are materials extracted being delivered into recycling/ recovery markets	F7a	B3
	F7a	Does the facility process organic waste	F7b	F8
	F7b	Is the nutrient value of biologically recovered materials utilized in agriculture/horticulture	F8	I6
Residues	F8	Are residues managed in accordance with applicable environmental standards	F9	I7
Fire control	F9	Are fire prevention and control measures in place	F10	I8
Staffing	F10	Is it staffed full time with professionally qualified personnel	F11	I9
EHS	F11	Are EHS measures implemented in accordance with a professional risk assessment and operating plan	F12	I10
	F12	Are there showering and sanitary facilities	F13	I11
Records	F13	Are incoming/outgoing materials weighed and recorded in a register	End >> Full control	End >> Basic control
Identity	I1	Is the facility registered	I2	L1
	I2	Does the site have clearly marked boundaries	I3	L1
Security	I3	Does the site have boundary and supervised access control	I4	B3
Standards	I4	Is the facility engineered with process control	I5	B3
	I5	Are some environmental pollution control measures taken	I6	B3
Circularity	I6	Are materials extracted being delivered into recycling or recovery markets.	I7	B3
Residues	I7	Residues disposed of into the city MSW system	I8	B3
Fire control	I8	Are fire extinguishers available on site	I9	B3
Staffing	I9	Is the site staffed with trained personnel	I10	B3
EHS	I10	Are EHS measures implemented for all people on site	I11	B3
	I11	Are there toilets and hand washing stations	I12	B3
Records	I12	Are incoming/outgoing loads weighed and recorded in a register	End >> Improved control	End >> Basic control
Identity	B1	Is the facility registered	B2	L1
	B2	Does the site have distinguishable boundaries	B3	End >> No control
EHS	B3	Is there personal protective equipment in use and water for hand washing	End >> Basic control	End >> No control
Identity	L1	Does the site have distinguishable boundaries	L2	End >> No control
EHS	L2	Is there personal protective equipment in use and water for hand washing	End >> Limited control	End >> No control

INCINERATION				
Question			**Next Question**	
			Yes	**No**
Identity	F1	Is the facility registered and licensed/permitted	F2	I1
	F2	Does the site have clearly marked boundaries	F3	B2
Security	F3	Is there a physical boundary surrounding the site and supervised access control 24/7	F4	I3

Standards	F4	Is the facility engineered with process control	F5	L3
	F5	Is there continuous monitoring and recording of operating parameters and emissions	F6	I5
	F6	Does the facility have flue gas controls compliant with applicable environmental standards	F7	I6
	F7	Are process controls and instrumentation systems routinely calibrated	F8	I7
	F8	Are there asset management and maintenance plans in place	F9	I8
	F9	Is there evidence of maintenance according to the maintenance plan	F10	I9
	F10	Are emissions periodically sampled and tested by external laboratories	F11	I10
Circularity	F11	Does the facility have energy recovery and utilisation	F12	B8
Residues	F12	If effluents are generated, are they managed in compliance with applicable environmental standards	F13	I11
	F13	Are de-ashing and flue gas treatment residues managed in compliance with applicable environmental standards	F14	I12
Fire control	F14	Are fire prevention and control measures in place	F15	I13
Staffing	F15	Is it staffed full time with professionally qualified personnel	F16	I14
EHS	F16	Are EHS measures implemented in accordance with a professional risk assessment and operating plan	F17	I15
	F17	Are there showering and sanitary facilities	F18	I16
Records	F18	Are incoming/outgoing materials weighed and recorded in a register	End >> Full control	End >> Basic control
Identity	I1	Is the facility registered	I2	L1
	I2	Does the site have clearly marked boundaries	I3	B2
Security	I3	Does the site have boundary and supervised access control	I4	B3
Standards	I4	Is the facility engineered with process control	I5	L2
	I5	Is there continuous monitoring of operating parameters and emissions	I6	B4
	I6	Does the facility have flue gas treatment system	I7	B5
	I7	Are monitoring systems routinely calibrated	I8	B6
	I8	Is there a maintenance plan or documented maintenance schedules	I9	B7
	I9	Is there evidence that equipment is well maintained	I10	L3
Circularity	I10	Does the facility have energy recovery and utilisation	I11	B8
Residues	I11	If effluents are generated, are they discharged to a permitted discharge point	I12	L5
	I12	Are solid residues disposed at facility designated for incineration residues disposal according to applicable environmental standards	I13	L5
Fire control	I13	Are fire extinguishers available on site	I14	B10
Staffing	I14	Does site have sufficient number of trained staff for level of operation	I15	B10
EHS	I15	Are EHS measures implemented for all people on site	I16	B11
	I16	Are there toilets and hand washing stations	I17	B11
Records	I17	Are incoming/outgoing loads weighed and recorded in a register	End >> Improved control	End >> Basic control
Identity	B1	Is the facility registered	B2	L1
	B2	Does the site have distinguishable boundaries	B3	End >> No control
Standards	B3	Is the facility engineered with process control	B4	L2
	B4	Are operating parameters (temperature, smoke etc) continuously monitored and recorded	B5	L2
	B5	Does the facility have some form of flue gas control	B6	L3
	B6	Are monitoring systems occasionally calibrated	B7	L3
	B7	Is there evidence equipment is well maintained	B8	L3

Residues	B8	If effluents are generated, are they discharged to a permitted discharge point	B9	L4
	B9	Are solid residues disposed at facility designated for incineration residues disposal according to applicable environmental standards	B10	L4
Staffing	B10	Does facility have a trained supervisor and staff on site during operating hours	B11	L4
EHS	B11	Is there personal protective equipment in use and water for hand washing	End >> Basic control	End >> No control
Identity	L1	Does the site have distinguishable boundaries	IL2	End >> No control
Standards	L2	Are operating parameters logged	IL3	End >> No control
	L3	Is there some evidence equipment is maintained	IL4	End >> No control
Staffing	L4	Does facility have staff on site during operational hours	IL5	End >> No control
EHS	L5	Is there personal protective equipment in use and water for hand washing	End >> Limited control	End >> No control

X1	FULL CONTROL
X2	IMPROVED CONTROL
X3	BASIC CONTROL
X4	LIMITED CONTROL
X5	NO CONTROL

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GPML Global Partnership on Marine Litter

IMPLEMENTING THE NEW URBAN AGENDA

11 SUSTAINABLE CITIES AND COMMUNITIES