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BASEL CONVENTION

Conference of the Parties to the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal
Fourteenth meeting
Geneva, 29 April–10 May 2019
Item 4 (e) of the provisional agenda*

Matters related to the implementation of the Convention: Basel Convention Partnership Programme

Revised draft overall guidance document on the environmentally sound management of household waste

Note by the Secretariat

As is mentioned in the note by the Secretariat on the Basel Convention Partnership Programme (UNEP/CHW.14/18), the annex to the present note sets out the revised draft overall guidance document on the environmentally sound management of household waste prepared by the household waste partnership working group. The present note, including its annex, has not been formally edited.

* UNEP/CHW.14/1.

Annex

Overall Guidance Document on the Environmentally Sound Management of Household Waste

Executive Summary

[To be inserted]

Glossary

[To be inserted]

Table of Contents

[To be finalised once guidance is completed]

Introduction
Module 1. Policy, legislation and institutional framework for ESM of household waste
Module 2. Sustainable financing for ESM of household waste
Module 3. Actions for prevention and minimization of the generation of household waste [TBD]
Module 4. Separation at source, collection and transport
Module 5. Preparing for re-use of household waste [TBD]
Module 6. Recycling of household waste [TBD]
Module 7. Recovery of household waste [TBD]
Module 8. Final disposal of household waste [TBD]
Module 9. Awareness raising and communication [TBD]

1. Introduction

1.1 Environmentally sound management of household waste

The present guidance document provides guidance on the environmentally sound management (ESM) of household wastes, pursuant to decisions BC-13/14 and BC-14/[ ] of the Conference of the Parties to the Basel Convention on the Control of Transboundary Movement of Hazardous Wastes and Their Disposal (hereinafter referred to as "the Convention"). It contains best practices related to the environmentally sound management of household wastes and addresses prevention and minimization of household wastes and separation at source, collection, transport, recovery and final disposal of household wastes, taking into account the waste management hierarchy. Household waste is classified under the Basel Convention as requiring special consideration (Basel Convention, Annex II, Y46 "Waste collected from households") because it may contain hazardous materials comingled with non- hazardous waste.

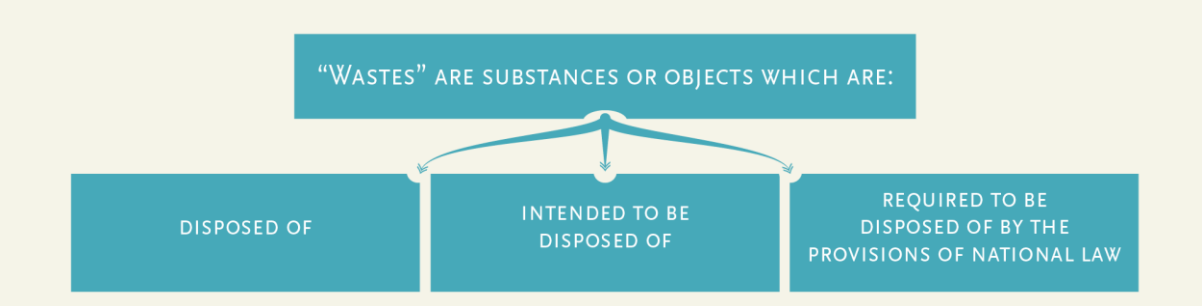
One of the challenges faced by national governments and municipalities, particularly in developing countries, countries with economies in transition and small island developing states (SIDS), is the environmentally sound management (ESM) of household waste.

Environmentally sound management of waste contributes to resource efficiency and also provides a mechanism for decoupling waste generation from economic growth and progressing towards a circular economy. However, in many countries, authorities are struggling to make the changes necessary to cope with both the increasing volume and changing composition of household waste (e.g. Kumar et al. 2017). To achieve affordable and effective ESM requires significant planning with integrated strategies relating to waste prevention and minimization, separation at source, collection, transportation, treatment, recycling, and disposal (Al Sabbagh et al., 2012).

Box Definition of waste

Individual country definitions of waste may vary, but the Convention defines waste as:

substances or objects which are –



Because the determination of what is a waste and what is not a waste may be complicated, it is important, especially when developing a waste inventory (see Module 1), that national authorities responsible for waste, provide a clear definition.

Definition of hazardous waste

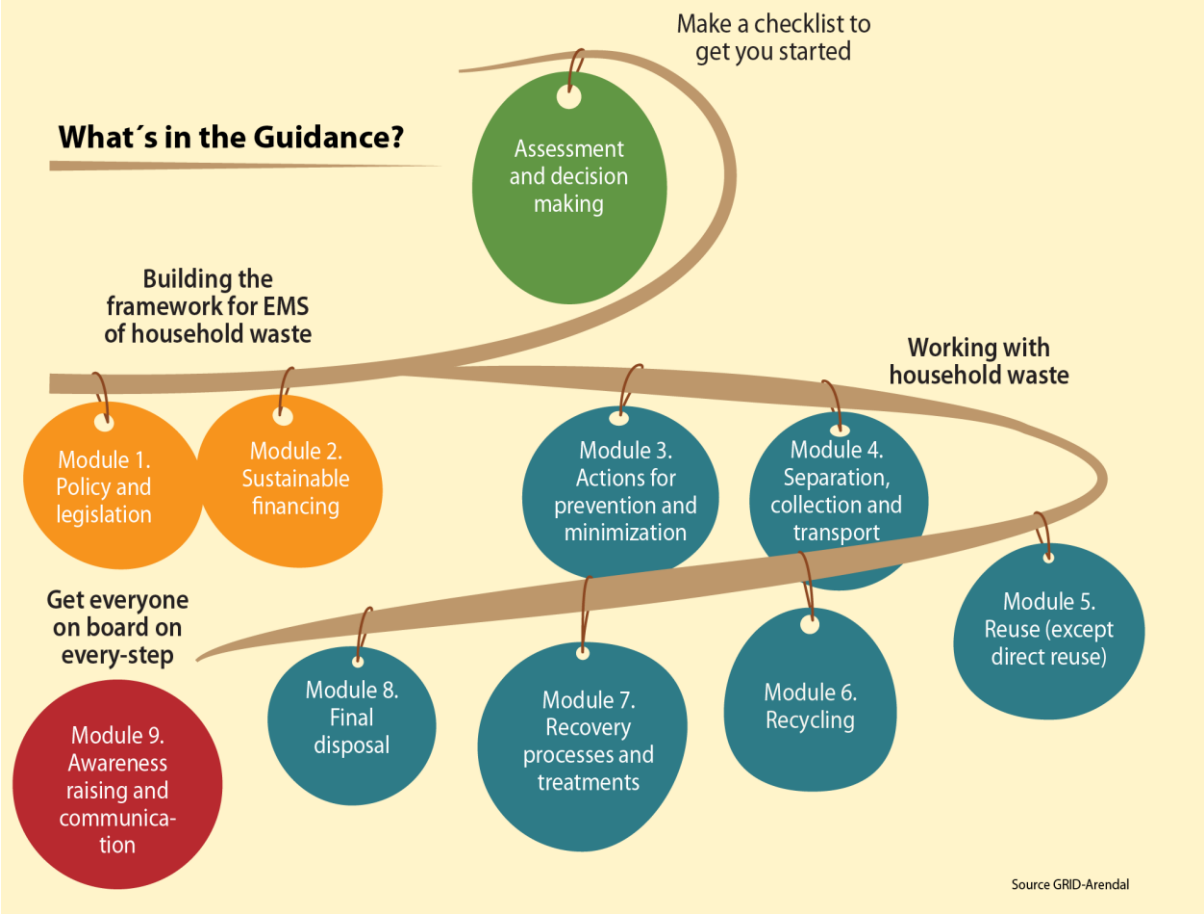
Like waste, the definition of hazardous waste may vary between countries. The definition of hazardous waste according to the Convention can be quite complex, but at its simplest, waste is hazardous if it belongs to any of the following categories:

- Clinical wastes;
- Waste oils/water, hydrocarbons/water mixtures, emulsions;
- Wastes from the production, formulation and use of resins, latex, plasticizers, glues/adhesives;
- Wastes resulting from surface treatment of metals and plastics;
- Residues arising from industrial waste disposal operations;
- Wastes which contain certain compounds such as: copper, zinc, cadmium, mercury, lead and asbestos.

Unless it can be proven that it is not:

1.1.1 Guidance to improve waste management

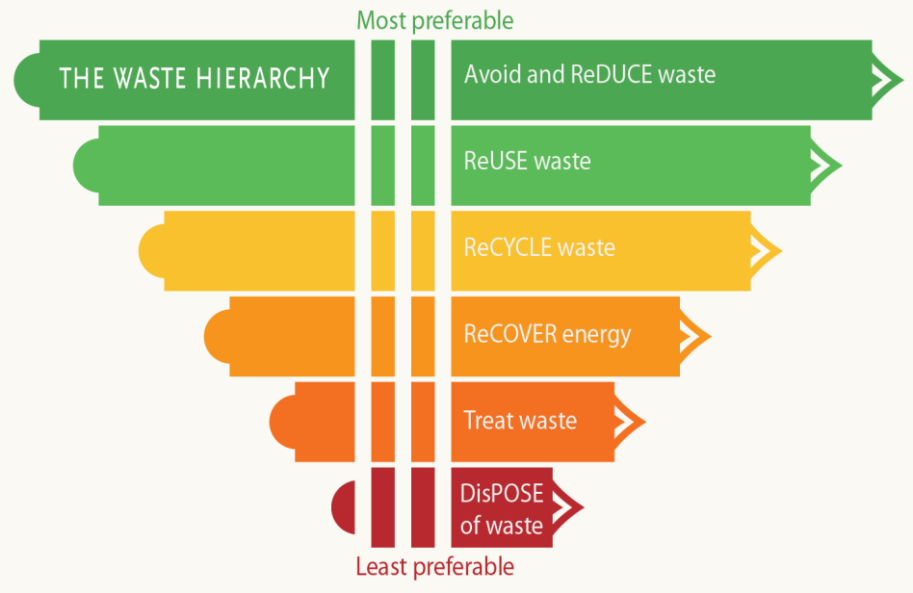
This guidance has been compiled for decision makers. Local authorities generally have responsibility for waste management within a local area, but a range of industries, businesses, communities and individuals are all involved in waste management. An objective of the guidance is to promote and share existing practical and concrete solutions in order to assist stakeholders on the ESM of household waste.



The guidance aims to:

- Inform planning, investment and management decisions for ESM of household waste by setting priorities in ESM of household waste;
- Improve knowledge of environmentally sound waste management approaches;
- Encourage information sharing between waste authorities, governments and other stakeholders;
- Enhance meeting national and international obligations for the ESM of household waste.

The guidance follows the principles of the waste hierarchy – reduce the quantity of waste generated, maximise the amount that can be reused or recycled, recover energy and dispose. It references other relevant guidance documents produced under the Basel Convention, including the practical manuals on the promotion of the environmentally sound management of wastes and guidance on the prevention and minimisation of waste, as well as the large number of technical guidelines (ref). The guidance provided in this document is general in nature and elements will be relevant to both urban and rural settings or can be adapted for different scales and locations.



1.2 About household waste

Increasing urbanisation and population growth have put enormous pressure on traditional waste disposal methods such as landfill. There is an increased awareness that poorly designed and maintained landfills are a significant health hazard, produce large quantities of greenhouse gases and odours and leach toxic substances into the environment. Addressing these problems provides lucrative prospects for continued development in waste prevention, reuse, recycling and energy recovery markets.

Table 2.1 Ranges of Average National Waste Generation by Region

kg/capita/day

	2016 Average	Min	25th Percentile	75th Percentile	Max
Sub-Saharan Africa	0.46	0.11	0.35	0.55	1.57
East Asia and Pacific	0.56	0.14	0.45	1.36	3.72
South Asia	0.52	0.17	0.32	0.54	1.44
Middle East and North Africa	0.81	0.44	0.66	1.40	1.83
Latin America and Caribbean	0.99	0.41	0.76	1.39	4.46
Europe and Central Asia	1.18	0.27	0.94	1.53	4.45
North America	2.21	1.94	2.09	3.39	4.54

Note: kg = kilogram.

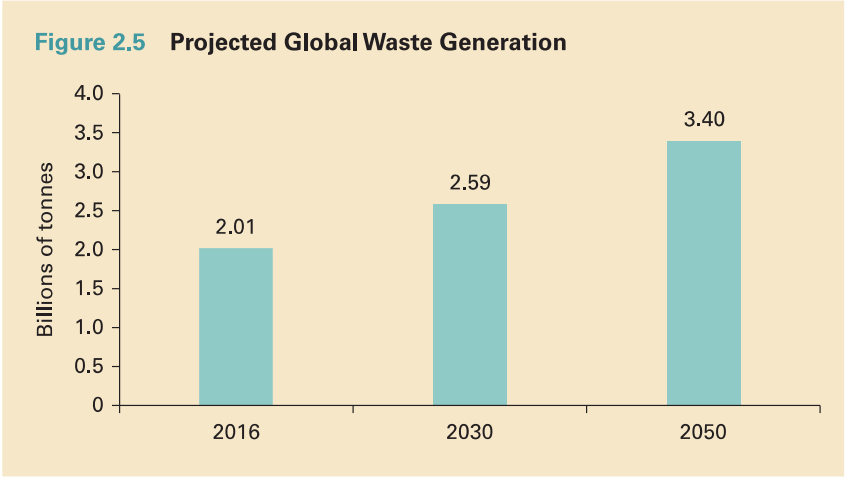


Figure 1 Summary of urban municipal waste generation by region and projected global waste generation (Kaza et al. 2018).

IMPACT OF IMPROPERLY DISPOSED HOUSEHOLD WASTE

WASTE DISPOSAL	CONSEQUENCES	NEGATIVE EFFECT	ECONOMIC IMPACT
UNSINTARY LANDFILL	Contaminated leachate into soil and groundwater	May contaminate drinking water; run-off can contaminate streams and lakes	Loses from reduction in productivity due to ill-health; absence from work; increase in health care costs; may be necessary to drill new drinking water wells
	Requires land that could be better used for food production, housing or public amenity	Removal of habitats; loss of productive land (farm and forest); reduction in human well-being when changing from healthy land to waste fields	Higher food prices; lower land price; increased traffic on roads
	Landscape changes	May impact surface and groundwater flow	Losses from flooding and ecosystem damage
	Degassing	Greenhouse gasses directly into the air; odours from the waste	Contribute to climate change impacts; reduction in land value due to odours; fire hazard
	Wind	Spreading the waste outside the waste area	Potential loss due to spread of disease-causing pathogens
UNCONTAINED RUBBISH	Blocks drains and clogs waterways	Potential for increased flooding; ecosystem damage	Damage to infrastructure and potential loss of life
OPEN BURNING	Atmospheric pollution which may contain toxic chemicals	Potential to impact a large area	Increased health costs due to respiratory health problems
	Fallout of contaminated soot may pollute waterways and drinking water	Potential human and environmental impacts	Potential loss of income due to spread of toxins and pathogens

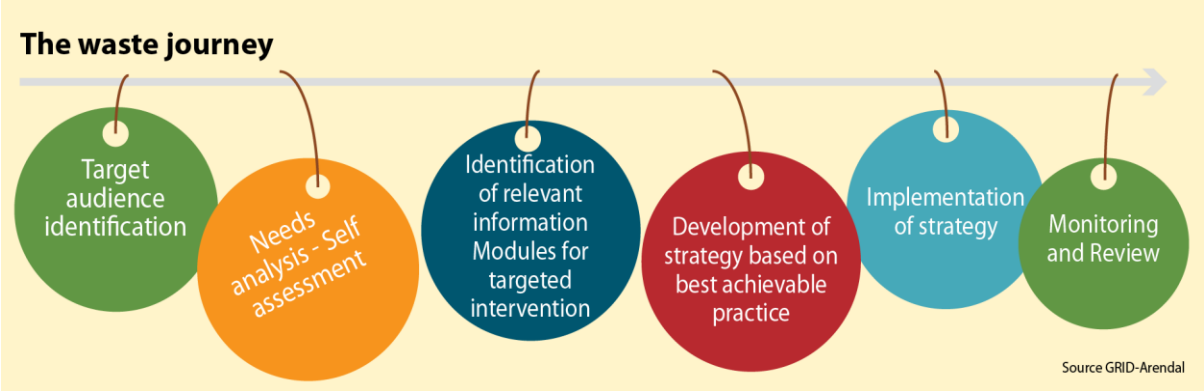
Table 1. Impact of improperly disposed household waste

1.3 Assessment and Decision-Making

While most developed countries have introduced complex household waste management practices, many developing, and transition countries are still struggling with sound management of the ever-increasing volume of household waste (UNEP Basel Convention).

Municipalities and other relevant bodies involved in improving household waste management need to understand and assess current practices in order to identify and address the key challenges in moving towards ESM. An assessment checklist has been developed to help facilitate the policies and strategies required to deal effectively with household waste within an ESM framework (see Appendix 1).

To promote the ESM of household waste, including its prevention and minimization, managing authorities also need to understand how and where the generation of household waste is occurring and how it is handled by the public in their households.



Who should use the Checklist?

The checklist is aimed at assisting:

- Government Institutions;
- Municipalities;
- Practitioners (e.g. official or unofficial, licensed or unlicensed collectors, transporters, disposal operators, scavenger groups etc.).

Why use the check list?

The check list aims to assist users to identify their requirements and determine the current status or their waste management system and plan the future actions that may be required to develop and implement an environmentally sound waste management system.

Module 1 – Policy, legislation and institutional framework for ESM of household waste

1.1 Strategic waste management planning

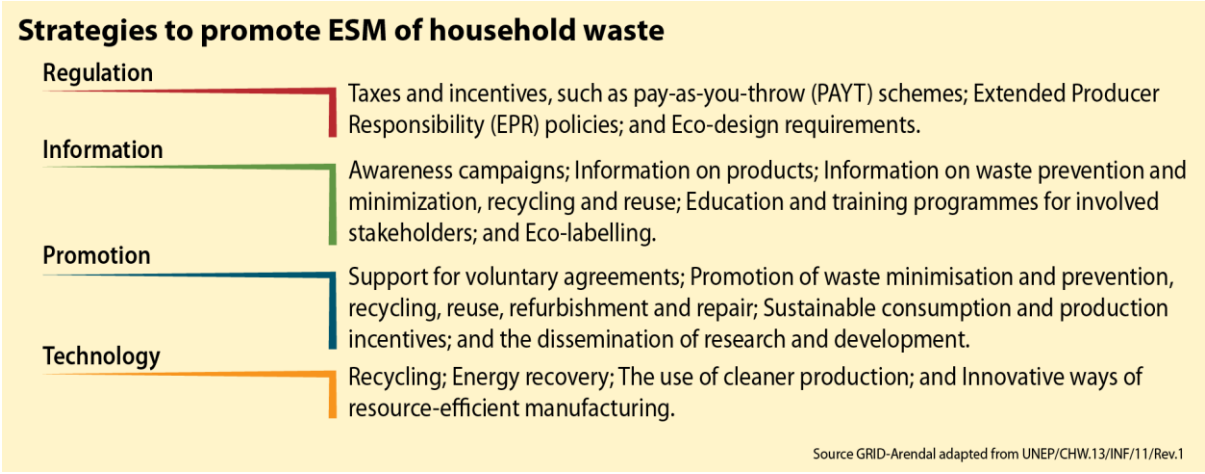
1.1.1 Developing strategies that support ESM of household waste

Strategies to support the ESM of household waste requires should integrate the interests of communities, business and governments. They should build on existing initiatives to develop cost effective priority actions. In developing appropriate strategies, the Basel Convention guidance on the prevention and minimisation of hazardous and other waste () suggested steps that are also relevant to household waste. These include:

- Determine the scope and timeframe of the strategy;
- Define the objectives driving the strategy (e.g. to increase community recycling rates);
- Determine the priority areas for achieving the objectives.

To be successful, the strategy needs to be able to motivate stakeholders to change behaviour. This often requires additional effort, so it is important that stakeholders are provided with information and evidence of the benefits of adopting new behaviours or developing new methods and technologies.

Strategies to promote ESM of household waste can be divided into four main categories:



A comprehensive strategy aimed at achieving ESM of household waste needs to involve the complete waste management sector, including waste collection, transport, processing (including the informal sector) and disposal, the business sector (including recyclers, reuse and repair) and product manufacturers and designers.

Government Waste Authorities – Legislation creates a framework for proper management of waste including the protection of human health and the environment and provides a platform for an effective waste industry. Laws pertaining to waste are many and varied and are dealt with under numerous state, federal and international laws, regulations, and codes of conduct, depending upon the type of waste and the stage it is at in its lifecycle.

Waste legislation is generally changing from being focused on the public health and environmental protection, to minimising waste and instituting reuse and recycling. Modern frameworks emphasise waste avoidance, minimisation, resource recovery and use a risk-based approach to manage safety and environmental concerns. This change has been in line with a growing shift in community attitudes and expectations. To promote ESM of household waste, governments need to establish integrated policies that support the waste hierarchy model.

Householders – Householder behaviour pays a huge role in minimizing waste and maximising the recovery of resources for recycling. Separating recyclables such as glass, plastic, paper and metal at the source ensures more efficient and cost-effective recycling. But recycling is only one part of the story – a shift towards more sustainable consumption is also required. Purchasing decisions can be based on product durability, recycled content and recyclability.

Waste businesses – There are increasing opportunities to create value from waste as recycling and energy recovery technologies advance. However, governments need to set recycling targets and provide incentives. Recycling is only possible if it is economically viable which means that the market has to function properly.

Product manufacturers and retailers – Environmentally green products often come at a premium to other products. Retailers sell products in packaging that becomes waste. There is a need for shared responsibility to ensure affordability of green products, reduce packaging, and to make sure products are recyclable. Policy approaches that make manufacturers take some responsibility for the treatment or disposal of post-consumer products (extended producer responsibility) are required. This provides manufactures with incentives to prevent waste at the source, promote product design for the environment and support the achievement of public recycling and materials management goals (OECD 2018).

Return waste and collect compost and second hand products

ReTURN

The Norwegian waste center in Aust Agder accepts 18 types of sorted household waste including hazardous waste like asbestos and chemicals. The service is connected to a household-waste handling fee which is paid by each property owner. Sorted house hold waste and hazardous waste can be delivered for free. In addition there is an allowance of 6x 400 kg per year for unsorted waste or chargable waste.

ReTURN

There is a charge for gypsum and wood waste from building materials (excluding impregnated wood which is considered hazardous waste and is free of charge).

ReTAKE

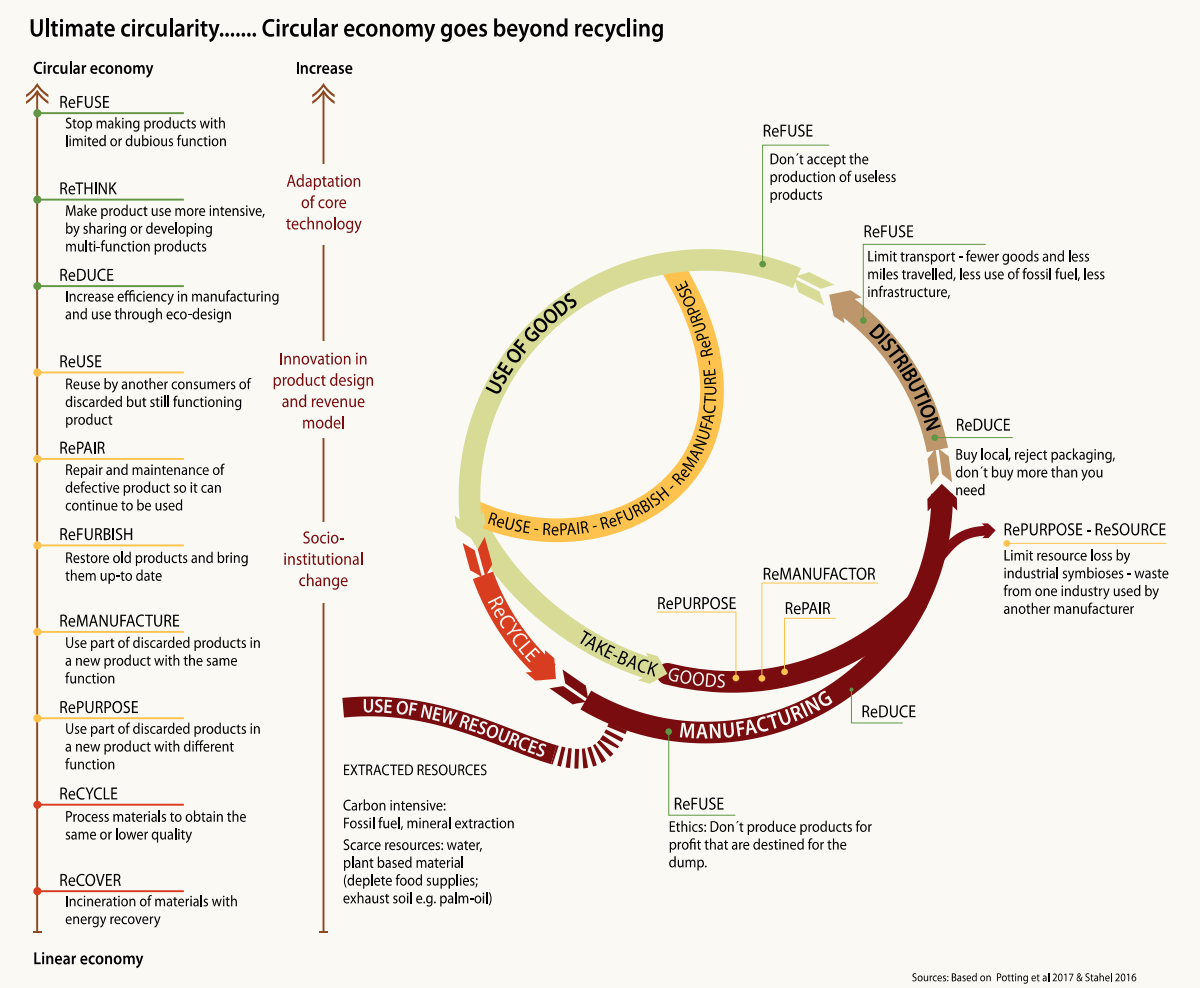
The center shop sells compost, mulch and discarded, but still usable products, such as household appliances, books, furniture, clothes etc.

Source: Agderrenovasjon, Østerhus, Grimstad, Norway. Photo credit: Elaine Baker

1.2 Decoupling waste generation from economic growth

Breaking the relationship between economic growth and the generation of waste through inefficient resource use, is referred to as decoupling. As the world's population expands and resources shrink it is not sustainable to maintain the "take, use, dispose" model of consumption that underpins the linear economy. The proposed alternative model incorporates the efficient use of resources and waste prevention and minimisation. Transitioning to this more circular economy,

where resources are maximized requires a major shift in institutional, business and consumer thinking – a shift towards recognition of the finite nature of natural resources and the inability of the planet to accommodate increasing levels of waste without significant environmental impact. The ESM of household waste is one of the important elements in the transition to a circular economy that promotes intelligent equitable growth.



1.3 Characterising household waste

Determining the type and amount of household waste generated is important in developing a waste management strategy. Understanding waste can help identify opportunities for waste reduction, establish a baseline for the evaluation of policy effectiveness, determine infrastructure needs and householder. Methods of waste characterisation include both quantitative and qualitative methods (e.g. on site weighing and identification, interview and questionnaires for householders etc).

Box Case Study

Box Waste Inventory

End box

1.4 Regulatory frameworks

- Socio-economic instruments and financing models including job creation [Note: Title to be renamed];
- Responsibilities and duties of each stakeholder [Note: Should not have overlapping decisions, one strategic waste management approach applied, role of generators, define the responsibilities of stakeholders, should have legislation to give mandates, table of model legislation, could adapt “Table 1 National Legal Framework for ESM and Implementation Capacity”; will include EPR];
- Including informal sector into formal waste strategy [to reference ESM Toolkit once adopted].

1.5 Institutional capacity building [Note: Transparency in operation and accountability, enforcement].

Module 2 - Sustainable financing for ESM of household waste

2.1 Introduction

The sustainable management of solid waste from cities and communities is essential to the physical and economic health of society. However, both the physical infrastructure and the long-term operation of waste management can be the single highest budget item for many local administrations. Cities in low-income countries are spending about 20 percent of their budgets on waste management, whilst over 90 percent of waste in low-income countries is still openly dumped or burned. As cities grow rapidly, waste management systems and budgets also need to grow in order to manage the increasing amounts of waste generated. Both low- and middle-income countries often face budget shortfalls for waste services and thus reduction of costs and recovery of fees is integral to the development of the sector.

Besides instruments such as infrastructure investment, policy reform and technical assistance that may help build the necessary waste management facilities, achieving the environmentally sound management of wastes from households will be optimized by using all economic instruments as described in this module (see also the draft practical manual on financing [reference to be added following its adoption]). The economic Instruments are not mutually exclusive, for example householders may be provided with a bag collection for different waste fractions from their door, as well as having a local civic amenity site / container park where they may take wastes for free or with a fee, and scrap-yards where certain wastes can be sold, alongside Extended Producer Responsibility 'take-back' Schemes for particular wastes as :Packaging & Packaging Wastes, for Waste Electronic Equipment, for Lead Acid Batteries etc. Furthermore, ensuring fair competition between public and private service providers, including the informal sector will optimize costs and benefits of household waste management.

The environmentally sound management of wastes from households can only be achieved with the understanding, cooperation and involvement of all citizens, as well as both private, public and voluntary operators, non-governmental organizations and local, regional and national governmental organizations. It follows that identifying and then communicating with all stakeholders is essential.

2.2 Guiding Principles related to financing

These guiding principles or "best practice statements" are intended to help orientate readers towards the better choices of financing mechanisms and best practices. They include the: Polluter Pays Principle; Principle of (full) Cost Recovery; Principle of Equivalence; Affordability Principle; Transparency Principle; Social Responsibility Principle; Fair Competition Principle. These are further elaborated here:

The **Polluter Pays Principle** holds those who produce a burden to environment (in the form of a pollution or waste) responsible for the costs associated with the management of the waste. Therefore, whoever generates waste has to pay for its reuse, recovery or disposal. In this context, the "pay-as-you-throw" concept relates to the allocation of the costs to the different quantities of waste generated by a polluter.

The **Principle of (full) Cost Recovery** requires that all costs related to waste are properly accounted for and, in accordance with the polluter-pays-principle, assigned to the respective waste

generators. The means that the total expenses for all steps of waste management should be recovered. The incomplete recovery of costs can lead to lack of or reduced services, and if services are provided, they may be diverting funds from other services. The principle of cost recovery is not an income generating scheme in that payments should not exceed the cost of waste management.

The **Principle of Equivalence** aims to maintain the balance between the actual delivery of services and the cost of services. Improvement in waste services or in individual waste reduction (that decreases the cost of service delivery), should be reflected in the amount charged for services.

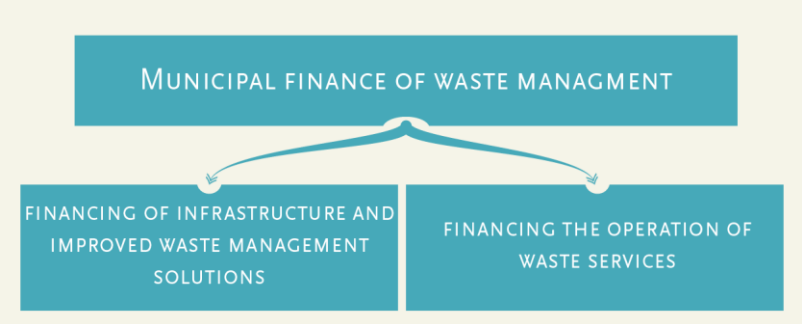
The **Affordability Principle** aims to ensure that no part of society is overloaded with payment obligations for waste services and environment protection. 'Affordability of Costs' and the 'Willingness to Pay' go hand in hand. If people are willing to pay for the costs of a service, it is an indication that the service is valued. However, the willingness to pay for certain services is limited by how much one can afford. This discrepancy often limits the possibilities in the develop of the waste management system or reduces the ability of service providers to fully recover costs. It is there necessary to understand the limit of affordability in order to prevent failure in cost recovery.

The **Transparency Principle** requires the local government authority to publicly reveal the benefits and costs of all waste management services. It is most important that the users of the waste services understand the fee structure for the services they receive and their obligations to pay. Independent auditing and annual reporting of waste volumes and values assist in providing transparency. Tenders for local authority waste management contracts should be open and transparent.

The **Social Responsibility Principle** aims at encouraging and supporting voluntary initiatives including those run by citizen groups, by informal sector cooperatives and environmental non-governmental organizations.

The **Fair Competition Principle** between public and private waste management service providers, including the informal sector will help to optimize the costs and benefits of managing household waste and similar wastes.

2.3 Waste service finance



2.3.1 Financing of infrastructure

Investments made by the municipality into waste management infrastructure generally includes, waste collection equipment such as containers, dustbins, collection vehicles, etc, and the establishment, operation and aftercare of waste management and disposal sites and treatment facilities. The investment in infrastructure is generally the largest one-off investment so

municipalities need to develop adequate financing models, which take account of all the advantages and risks associated with the respective investment.

Sources of finance for infrastructure include:

- Grants are issued for special purposes, are free of interest and do not need to be re-paid. These can come from national government, international donors, climate funds, development aid etc.
- Loans have to be re-paid, and generally include interest and often have to be secured by guarantees from local or state level. Loan insurance may also be required. Loans can be sourced from (inter)national banks, donors, investors/investment funds.
- Bonds can be issued to investors by the city or a state to raise capital for large infrastructure projects. Money is repaid to the bond holders with interest. Bonds can be a cost-effective long-term borrowing strategy for authorities.
- Outsourced through Public-Private Partnerships (PPP).

Box Climate protection related finance

A number of institutions have started to provide funding for waste management infrastructure projects that support the reduction of greenhouse gas emissions. These projects require the determination, monitoring and reporting of the greenhouse gas emission reduction allowing for the quantification of current and future avoided emissions (generally expressed as CO2-Equivalents).

The Climate and Clean Air Coalition (CCAC) has published a primer for cities wanting to access finance for municipal waste projects that support climate change mitigation (Gorelick 2017). The primer outlines a finance road map that includes the necessary steps required to secure finance for large projects. To assist with planning and feasibility studies, the primer includes a data collection tool for assessing the budget required by a municipality for the allocation of services, as well as its revenue and debt.

http://www.waste.ccacoalition.org/file/2514/download?token=u_FHKJGO.

Funding Resources

- The UNFCCC Green Climate Fund (GCF) supports project preparation and large-scale project funding. https://www.greenclimate.fund/who-we-are/about-the-fund.
- The Climate Technology Centre and Network (CTCN) is a technology mechanism of the UNFFCCC that can provide technical assistance to develop projects for funding under the GCF or stand-alone projects.
- The NAMA-Facility is funded by European states to accelerate low carbon development. The facility provides grants for climate mitigation projects.
  A recent example is a project which supports the government of Mozambique in addressing the challenges associated with urban waste management (Mozambique's Sustainable Waste Management – Laying the Foundations for a Circular Economy NAMA. https://www.nama-facility.org/projects/mozambique-sustainable-waste-management-laying-the-foundations-for-a-circular-economy/).

End box

2.3.2 Financing the operation of waste services

Financing waste services and annual running costs of a waste system, includes all operational costs, the depreciation of infrastructure project costs, services rendered by third parties/private sector etc. The World Bank's review, (Kaza 2018), documents the cost of

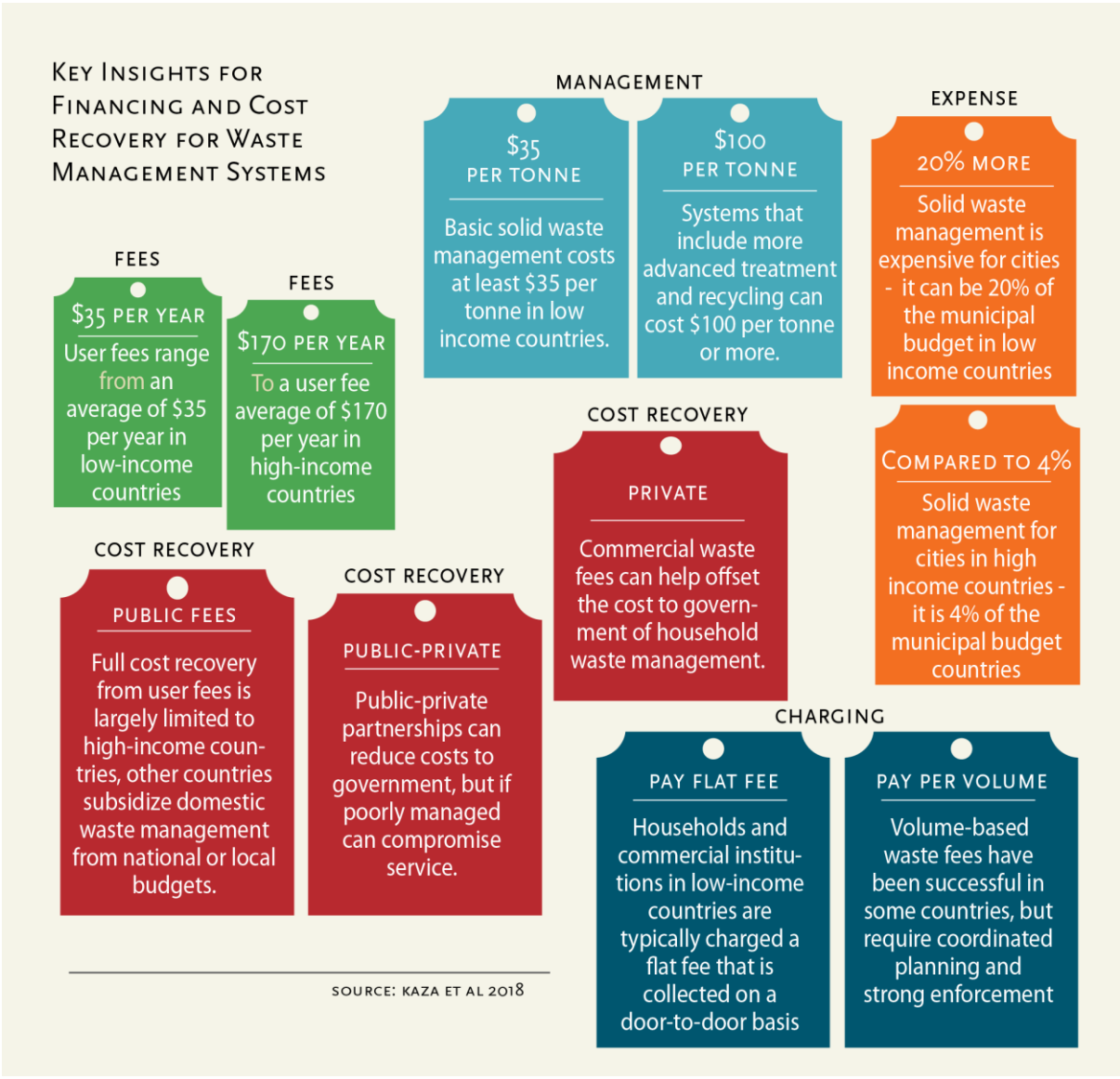


Figure 1: Key Insights for Financing and Cost Recovery for Waste Management Systems (Kaza at al. 2018).

2.4 Waste operators

In developed countries waste management services are often delivered by state-owned enterprises, or in partnership with privately owned businesses. In developing states, the informal sector often plays a significant role.

2.4.1 State or Municipal owned waste companies

[TBD]

2.4.2 Private sector waste companies

The private waste companies are those economic enterprises run by individuals (as opposed to the state) for profit.

As it is difficult for municipalities in developing countries to pay private operators to cover the cost of all waste management services, the central government often has to provide additional funding. [TBD]

2.4.3 Informal sector

In most developing countries, 15 to 20 percent of waste is managed by the informal sector which can be considered to be part of the private sector as the informal sector workers are essentially self-employed. The private network is therefore composed of an informal collection service, while the rest of the waste management chain might include local operators or global corporations.

The challenge in developing countries includes integrating informal waste collectors into formal waste management programmes. Municipalities can integrate waste pickers into the collection of waste at the source, by giving them rights over recyclables and guaranteeing them regular access to waste. To assign these rights, municipalities must enter into direct contractual or covenant relations with informal sector organizations. Given limited business knowledge, education, and socio-economic means, the informal sector needs support to organize into cooperatives or other legal structures. Municipalities or NGOs can provide legal support in establishing cooperatives, providing training, and creating other services to improve working conditions (such as identity cards and access to health insurance).

Box Waste Pickers

Waste picking provides jobs for millions of people around the world (WIEGO 2018). However, the contribution of waste pickers to waste recycling is poorly understood. In some place in the world, waste is only collected by waste pickers. The increasing privatisation of waste management threatens the livelihoods of waste pickers and has led to conflicts in some locations (e.g. conflict in Delhi over waste to energy incinerators, Demaria and Schindler, 2016).

Waste Pickers part of the waste management solution.

Benefits	Actions required to improve conditions for workers and sustainability of livelihoods
• Efficient – 70% of waste recycled in Santiago de Chile; 80% of waste recycled in Cairo. • Labour intensive solution as opposed to capital intensive, so easier to establish in developing countries • Provides jobs and income for people • Reduces pollution, diverts recyclables from landfill or entering waterways • Reduces raw material costs for local industries by providing recycled material	• government recognition as workers, and formal inclusion in waste management • strengthening organization through the establishment of co-operatives to improve working conditions • develop supportive and inclusive policies and laws that enable both formal and informal systems of waste management and recycling. • development of programs that provide stability of employment – need to be considered when considering the adoption of other technologies such as incineration

• Save municipalities the cost of collection and transport fleets	that displace waste pickers and reduce recycling.

Waste for recycling in Istanbul.

End box

A review of the informal waste sector by GIZ (2012) found several conditions important for integration, including inclusion of informal waste workers contribution in public policies, regulations, and procedures, the organisation of informal workers, the technical and managerial capacity these workers have as economic actors, and the networks they establish with formal companies and other institutions like providers of business or financing services.

2.4.4 Voluntary sector

One way to dispose of still useful waste is to give it away to charities and other non-profit organizations. These organisations can sell the material or redistribute it. The items are generally collected via charity bins or charity shops, and include things like second clothes, used appliances and furniture [include definition of these items as waste varies between countries]. Charities that derive an income from the collected material, can manage it themselves, or enter partnerships with specialist waste companies that recycle the material and pay the charities a share of profits.

Charity bins in Perth Australia

Citizen volunteers can also be effective in cleaning public areas such as parks and beaches. Clean up days can be organised by governments (often one day a year) or citizen groups, such as local residents, schools, religious organisations, businesses etc. The most famous recent clean up by volunteers is Versova Beach in Mumbai. Before the clean up the beach was meters deep in rubbish. It took almost two years for an army of volunteers to remove the rubbish – more than 5000 tonnes of mostly plastic.

Volunteers, led by local lawyer Afroz Shah, clean up Versova Beach in Mumbai.

2.5 Employment in the waste sector

The International labour organization estimates that 15 to 20 million people work in the informal waste sector and 4 million are employed in the formal waste sector (ref). It is estimated that an additional 9 to 25 million jobs could be created by adopting a circular economy approach to waste management.

2.6 Organisational aspects

2.6.1 Results based financing

Results-based financing (RBF) is a financial mechanism where payment for solid waste services are tied to the achievement and verification of pre-agreed targets. A basic feature of RBF is that financial payments or in-kind rewards are provided to a service provider conditional on the recipient undertaking a set of pre-determined actions or achieving a pre-determined performance goal. RBF offers opportunities to innovate in the use of development finance in the solid waste sector and to achieve results. Until recently, RBF principles and designs had not been widely applied in the solid waste sector, apart from the use of some performance-based contracting with private providers of solid waste services and carbon finance for methane mitigation. Given existing weaknesses and the challenges that cities face regarding solid waste management and service delivery, RBF can benefit the sector by ensuring that public funds are used efficiently and transparently.

The RBF model to improve solid waste service delivery and fee collection is an appropriate model for low income countries where service delivery is poor or non-existent or where fee collection to support waste collection and disposal is a major challenge. It is also an appropriate model to jump start the solid waste services in fragile and post-conflict situations. The RBF model to promote recycling and source separation is a good model for cities in middle income countries where the collection of waste is already high but where the effort of the government is focused on improving the financial and environmental sustainability of the sector. The RBF model to strengthen waste collection and transport in under-served communities is applicable to both low and middle-income cities but is most relevant where the focus is to improve solid waste services in under-served and low-income communities and could be part of community and slum upgrading projects

[To be reviewed in the context of: http://www.resol.com.br/textos/results-based_financing_for_municipal_solid_waste_-_world_bank_-_2014_-_executive_summary.pdf]

2.6.2 Framework conditions

Actors in the field of municipal waste management have different access to finance and influence on the (full) cost recovery mechanisms. Therefore, framework conditions for each actor are of importance for their ability to perform.

Waste services are usually tasks assigned to Municipalities by law and they require funds to provide these services. Some municipalities can be:

- fully dependent on budget transfers from a regional or central administrative level;
- have the right to levy specific taxes and/or service/tourist/product related charges; which then are administered in the municipal budget;
- Have the authority to raise service fees to cover the running costs;
- raise their own additional funds for investment purposes, e.g. by issuing (city) bonds.

Due to legal restrictions, municipalities in some countries cannot engage in public-private partnerships or are not in the position to form a municipal-owned company or form municipal waste service unions. Others require tenders to outsource public services to the private sector.

In addition to municipal laws, other conditions defined at the regional or central level may be equally important in the financing of waste management. For example, access to the grid or a network and the energy tariffs set for fuel or electricity generated by waste management facilities provide an incentive or disincentive to develop advanced waste management. The tariffs are a factor that defines the operation costs of waste management plants and consequently the service fees paid by waste generators. General subsidies for example on fuel, electricity, artificial fertilizer or specific goods may hamper the development of advanced waste management solutions.

It is important that policy-makers at the central level set the right incentives and the enabling framework conditions for municipalities to perform their duties. The extent to which the instruments discussed in the following chapter can be employed is largely defined at the national level.

2.7 Economic instruments

Economic instruments in solid waste management have two major objectives: to cover costs and thus improve service delivery; to influence behaviour by means of the pricing mechanism in order

to minimise waste, avoid negative impacts (e.g. from landfill) or to strengthen resource recovery and recycling.

Economic instruments do not substitute but complement and strengthen regulatory and other approaches in the respective policy area. From a public administrator's perspective, a differentiation can be made into revenue-generating, revenue-providing, and non-revenue (guidance) instruments:

- **Revenue-generating instruments** are for example taxes, charges, fees, royalty payments, concessions, permit levies etc.;

- **Revenue-providing instruments** are subsidies, bonuses, tax rebates, tax exemptions, licence waivers etc.;

- **Non-revenue (guidance) instruments** are deposit-refund systems, take-back solutions, Extended Producer Responsibility, performance bonds/ sureties, permit trading schemes etc.

At each stage of the waste management process, different economic instruments may be appropriate.

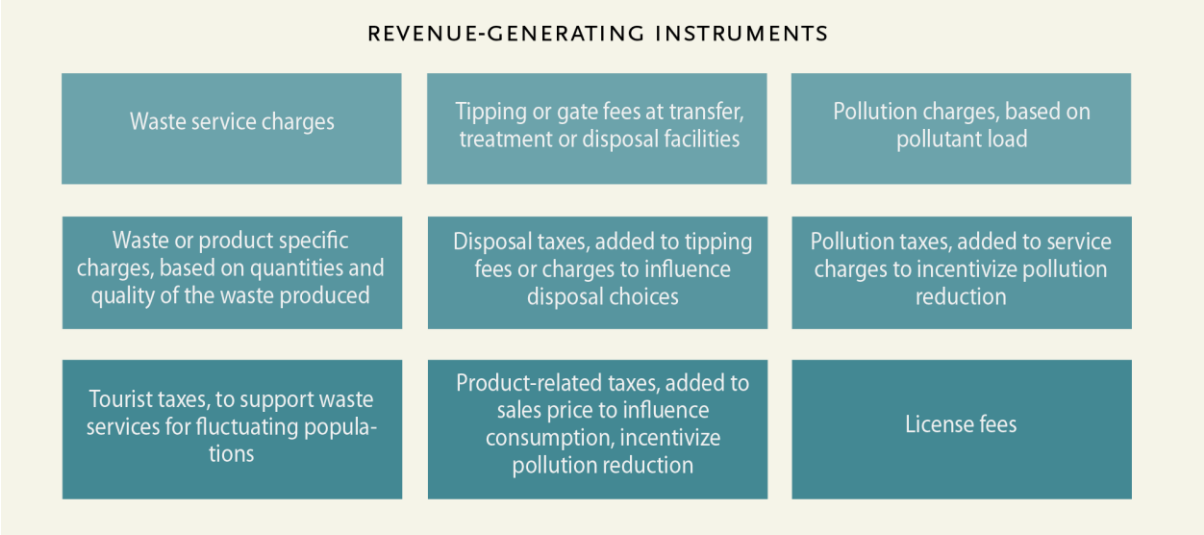
- Waste charges may create incentives for improved separation and reduce waste generation. Deposit-refund systems may improve waste separation;
- Advanced recycling fees can provide the revenue from such activities so that the share of the recycling of certain materials increases;
- Landfill taxes can generate both positive and negative impacts. They may provide a disincentive to take rubbish to landfill and increase illegal dumping. On the other hand, they may divert waste to other waste management methods (e.g. recycling or incineration);
- Feed-in tariffs may support the development of waste-to-energy solutions.

2.7.1 Revenue-generating instruments

Revenue-generating instruments make up the largest proportion of instruments used to implement a certain economic policy and get waste management financed. According to their principal policy objectives, revenue-generating instruments are often classified in three main categories:

- Cost-covering, earmarked and service-related charges or fees, like user charges, gate fees
- Incentive-related taxes or charges levied on pollution or consumption, with the objective of changing the behaviour of producers and/or consumers;
- Fiscal environmental taxes levied on pollution or resource consumption with the primary objective to raise revenues.

Revenue-generating instruments are:



The idea scenario would be to charge the entire waste service in the form of cost-covering fees to each individual user. That would represent a truly fair allocation of the financial burdens for collection, treatment, disposal as well as the aftercare of waste and for the prevention or restoration of the environmental damage done by the waste generator.

Costs for waste management are in general related to the following:

- the disposal of the various types of collected waste and recyclables - includes waste collection, transport, treatment and/or the safe storage or depositing of the waste;
- the operation of special recycling programs (e.g. take back schemes, etc.);
- the provision of waste consultation and public information;
- the corresponding administration.

A waste charging scheme should ensure there is full coverage of the waste management related costs (fixed and variable) and there is fair allocation of these costs to the population as beneficiaries of the services. The fee calculations may also consider socio-economic aspects and ability to pay.

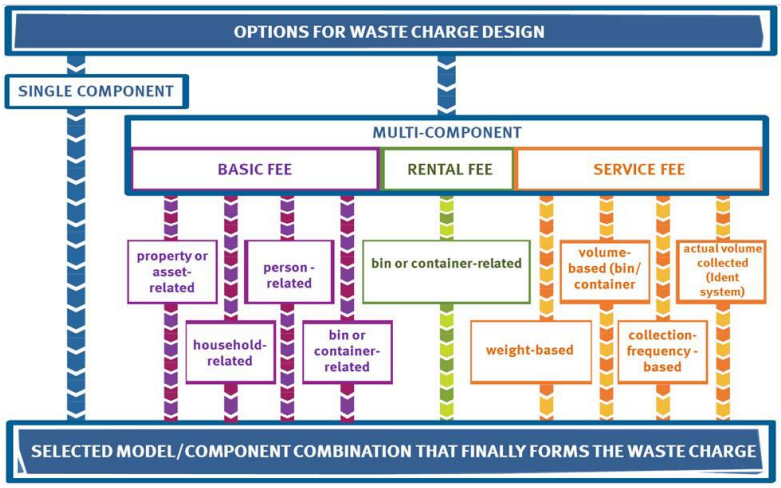
2.7.2 Common waste service charging schemes

1. Single flat rate

This scheme consists of a single flat fee for all households. The fee covers the fixed and variable portions of the waste service and is independent of the amount of waste collected. The single flat fee provides no incentive to reduce waste but is transparent and simple to operate. Changes in the cost of the service may have little impact on disposal volumes (

2. Multiple component fee

The multi-component fee can be made up of a basic fee plus additional fee for service. The basic fee represents the fixed component and is independent of the service provided. It can be charged per person, household, property and or bin/s provided. The variable charges depend on the service and can relate to waste volume or weight, collection frequency, bin rental etc. Because multi-component fees include a fixed charge, plus a fee for service they can be complex to administer but are more likely to encourage waste reduction.



- **<u>Volume-based (bin volume):</u>**
  Charging for a fixed frequency of collection based on the volume of the bin. To aid revenue security a minimum chargeable volume may be applicable.

- **<u>Pickup frequency based:</u>**
  Charging based on the frequency of emptying of a provided bin. To aid revenue security a minimum number of pickups may be applicable.

- **<u>Weight-based:</u>**
  Charging per unit weight of collected waste (typically applying to residual and bio-waste collection). A weight-based service fee can be charged in combination with a fee per emptying.

- **<u>Volume-based (waste volume collected):</u>**
  Charging based on the waste volume. This requires knowing the volume, either by measuring or schemes like the prepaid sack or tag-a-bag.

From Bilitewski et al 2018

Revenues generated from waste services may be earmarked and/or collected, administered and dispersed from separate budget positions, specific funds or alike to allow transparent and purposed-oriented revenue raising and disbursement. Spending policy and mechanisms are therefore an integral part of the functioning of revenue generating instruments.

2.7.3 Challenges and capacity barriers to waste service charging

Covering the full-service costs solely through user charges may result in user charges that are not affordable for the majority of the population. Therefore, the full range of economic instruments need to be considered, including other taxes, user charges, landfill fees or taxes, product taxes and deposit-refund systems, as well as economic incentives for improved solid waste management like subsidies, tax exemptions or feed-in tariffs for energy from waste (GIZ 2015).

As it is hard to change behaviours, there is a recognised potential for unauthorised disposal (e.g. roadside dumping) as a result of increased disposal costs.

Guidance how to calculate costs and expenditures for waste management and how to transfer this into waste service fees (TBD)

Best practice example:
How to design an appropriate waste fee - Principles, Practices and Applications of Waste Management Fees published by ISWA

CCAC has a cost estimating tool available for organic waste management on its website. The OrganEcs tool helps estimate the costs associated with constructing and operating an organic waste management project.
http://ccacoalition.org/en/news/new-cost-estimating-tool-available-organic-waste-management

Guidance how to calculate gate fees based on actual costs (TBD)

Best practice example:
The Turkish Ministry for Environment and urbanization has published a guidance on cost and fee calculation for operators of waste facilities „Evsel Katı Atık Tarifelerinin Belirlenmesine Yönelik Kılavuz"
http://www.cygm.gov.tr/CYGM/Files/yayinlar/kilavuz/Evsel%20Kat%C4%B1%20At%C4%B1k%20Tarifelerinin%20Belirlenmesine%20Y%C3%B6nelik%20K%C4%B1lavuz%20ve%20Ekleri.pdf

Best practice example:
Does a levy work? New Zealand waste disposal levy.

The New Zealand Government introduced a disposal levy in 2009 on household waste sent to land fill. Currently the levy is NZ $10.00 tonne. Half of the levy money goes to territorial authorities (city and district councils) to spend on promoting or achieving the waste minimisation activities set out in their waste management and minimisation plans. The other half is put into a Waste Minimisation Fund. Despite the efforts of the Government, the amount of waste sent to landfill is increasing. The levy scheme was

reviewed in 2017 and recommendations were made to improve the operation and outcomes of the scheme with the view decreasing the flow of waste to landfill.

Best practice example:

Toronto's plastic bag levy.

In 2009 the Toronto City Council introduced a requirement that retailers impose a $0.05 levy on each disposable bag given to customers. This is called a nudging policy - a policy that seeks to encourage behavioural change through small measures. A study by Rivers et al 2017 into the effectiveness of the policy, found that the levy increased the use of reusable shopping bags by a small amount (3.4 %) However this increase was mostly seen in people who already used reusable bags and were encouraged to use them more frequently, while there was no effect on infrequent users. The reusable bags users were from households with high socio-economic status (as measured by income, educational attainment, and housing situation). This suggests important limitations for nudging policy more generally, as people with lower socio-economic status appear to have been unaffected by this behavioural prompt.

Best practice example:

Waste levies including charges on individual products (Covec 2005)

Best practice example:

The landfill tax in Catalonia/Spain[1]

Spain does not apply a landfill tax at national scale but the country's Waste Act incorporates the right that economic incentives can applied by the waste authorities in different regions in order to promote a more environmentally benign waste disposal performance. The national legislation on taxation moreover defines the circumstances when regions can create their own taxes. Several places used that possibility to levy a special tax on the landfilling of certain wastes but the tax scheme on landfill disposal (and meanwhile also on incineration) in Catalonia is the only one that targets on municipal solid waste. In addition, this tax scheme also allows the return of the revenue to the payers of the tax according to their waste performance. Introduction of that scheme took place in 2004 and 2008 respectively, and was reinforced by investments made in parallel into waste infrastructure and separate collection programs. The applied tax rate initially was EUR 10 per ton of municipal waste landfilled and brought over EUR 32 million in revenues in its first year.

Catalan Law 8/2008 on financing infrastructure and waste management established additionally a tax of EUR 5 per ton of municipal waste incinerated. Beginning from 2010 an incremented rate of EUR 20 for landfilling was charged to those delivering municipalities that had not initiated separate collection schemes for biowaste. Tax earnings are earmarked for the Waste Management Fund (Fons de Gestió de Residus) with the stipulation that at least 50% of the revenue generated serve the financing of waste pre-treatment. The Catalan Waste Management Fund is the most important instrument for the financing of waste management strategic goals and infrastructure development in the region.

Best practice example:

Example for a disposal tax, added to tipping fees or charges to influence waste management:

The UK landfill tax was introduced in 1996 in order to better reflect the environmental costs of landfilling. The aim was therefore both to reduce the overall levels of waste produced and to send less waste to landfill. The Landfill Tax is an environmental tax paid on top of normal landfill rates by any company, local authority or other organisation that wishes to dispose of waste in landfill. It is landfill operators who are liable for the tax - the costs are passed on to users as higher prices. Landfill Tax is collected from operators by HM Customs and Excise.

Landfill Tax in the United Kingdom by Tim Elliott (Eunomia) https://ieep.eu/uploads/articles/attachments/e48ad1c2-dfe4-42a9-b51c-8fa8f6c30b1e/UK%20Landfill%20Tax%20final.pdf?v=63680923242

And

Landfill tax, https://www.politics.co.uk/reference/landfill-tax

Best practice example:

Example for a disposal tax, added to tipping fees or charges to influence waste management

Best practice example:

Example for spending policy in special (revolving) funds

The Polish environmental fund system[1]

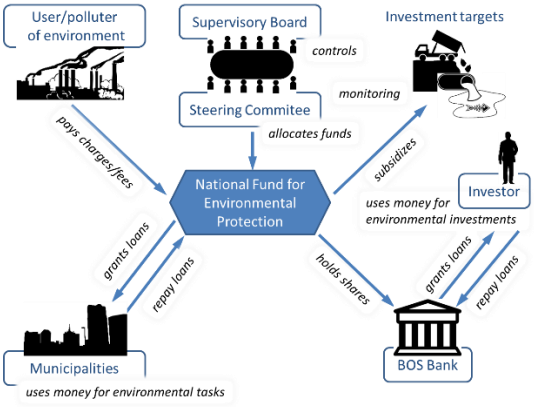
The system of environmental funds in Poland is showing the greatest degree of independence from state institutions whereas in many other countries these funds are administered from the environmental ministries. Different type charges, royalties and various penalties and fees[1], including product fees represent the main income flows into the funds operated in Poland. These sources supply over 40% of the financing for environmental protection in the country. Whilst at the beginning significant contributions to the funds came from EU-structural programs this has now changed and loan paybacks and interest take up quite an important position in the money inflow. Poland is meanwhile employing a multiple split of the fund solution, with funds created at the national, the voivodeship (regional), the poviat (district) and gmina (municipal) level. These funds are independently managed and provide financing at exactly the respective territorial level for which they were established but can nevertheless work complementary in certain fields. Payments which need to be made under the uniform rules to the fund are distributed in a split of 50:40:10 to the voivodeship, national and municipal fund respectively in order to facilitate this.

The National Fund for Environmental Protection and Water Management (Narodowy Fundusz Ochrony Środowiska i Gospodarki Wodnej - NFOŚiGW), was established as the first fund in 1989 to help executing tasks of strategic importance at the national level. The creation of the Voivodeship Funds (Wojewódzki Fundusz Ochrony Środowiska i Gospodarki Wodnej - WFOŚiGW) in 1993 and establishment of Communal Funds was an acknowledgment of the organizational success made with the system of financing

environmental protection. This system was supplemented with District Funds for Environmental Protection in 1999. As a result of the reform of the public finance system in 2010 the Communal and District Funds became directly controlled by the budgets of individual local government units, however, subject to the requirement to transfer proceeds from environmental charges and fines for activities related to environmental protection.

The divided system of environmental funds provides a great leverage for real and more rapid progress in environmental protection across the different territorial structures of the country. In the financing system based on environmental funds an important role is served by the Bank for Environmental Protection (Bank Ochrony Środowiska S.A.) that co-finances and co-operates with the funds.

The structures and main principles for operating the funds are governed by diverse legal acts with the Environmental Protection and Management Act being the main one. The necessary programmatic framework and orientation is provided by three main columns, these are a National strategy, an Action Strategy and a Joint Action Strategy. In the common action strategy for the National Fund and Voivodeship Funds have been formulated four primary directions for financing environmental protection in Poland, with one of these objectives being a sustainable waste management and protection of land. Funding outlayed from the National and Voivodeship Funds on pro-environmental tasks throughout the country exceeds an average of 7 billion Polish Zloty (approx. TL 2 billion) per annum, and has contributed significantly to create the country's present system for waste management.



The main administrative structures for fund management comprise a supervisory board and a steering or management board. Principal responsibility of the management board is the general management tasks, which on the operational level involves, among others, to elaborate work plans, the preparation of funding decisions, taking orders for loan repayments and the suspension of payments, and to undertake decisions to fine and collect these fines in case of breach of fund rules. The supervisory board is the superior control organ for the fund and the management board. It does determine criteria for the selection of priority activities and sets up the lists of priority activities, develops the plan of operations, approves loan and investment decisions, monitors the capital operations and verifies the reports.

A separate and independent structure to govern the financial assets of the local environmental fund does not anymore apply at the level of the municipalities who administer the respective funds and money flows at their own discretion over municipal council decisions and budgets.

Best practice example:

Waste service charges, based on services received

Revenue-providing instruments [TBD]

Examples needed

Subsidies

Bonuses

tax rebates

tax exemptions

license waivers

Favourable energy tariffs

Non-revenue (guidance) instruments [TBD]

Deposit / refund

Best practice example:

Batteries

Deposits on car starting lighting and ignition batteries, or other batteries, ensure at end-of-life they are returned through a garage or retailer or recycler and at that point the deposit refunded to the person returning the battery.

Reference: https://batterycouncil.org/page/State_Recycling_Laws

Best practice example:

Cans and bottles

Deposit system is a collection system of the valuable materials. Deposit systems for packaging containers such as cans and bottles are built on a principle where the purchasing price of a product includes a deposit amount that is paid back to the consumer when the container is returned after use. If well managed, the deposit system proves very high recycling rates. It is built on a scheme where beverage producers domestically or internationally are working with a system operator who provide with special barcodes. The barcodes permit to return the containers and recycled them. Several examples reveal that the deposit system can have very innovate approach moving away from a traditional money deposit. The reimbursements can be return awards by assets.

Example: The deposit system in Norway is up and running since 1999 and as of today shows efficiency of 97 per cent. The collection systems are established in retailers' shops or petrol stations where consumers can return their containers. Similar system are

established in number of countries such as Canada, Estonia, Finland, Germany, Lithuania among others.

Incentives to deposit

Other incentives than a refund of part of the original purchase price may be used to encourage citizens to deposit used and end-of-life goods at collection points.

Best practice example:
Plastic bottles

Citizens get awarded for recycling efforts by receiving a "free" metro ride. Beijing has introduced a collection system at source by giving a possibility to pay for subway ride by recycling a plastic bottle. This case study can provide lessons learned.
Deposits on car starting lighting and ignition batteries, or other batteries, ensure at end-of-life they are returned through a garage or retailer or recycler and at that point the deposit refunded to the person returning the battery.

Best practice example:
Recycling rewards

Citizens get rewarded for recycling and ultimately waste collection becomes a community effort. Citizens in city of Ethereum in Netherlands, are rewarded for recycling with tokens (a digital asset). They can exchange that asset for another public service (e.g., transportation). Source: Agora Tech Lab.

Tradable permit systems, including cap and trade schemes (e.g. for landfilling biodegradable waste) in which the total quantity that can be landfilled is capped nationally and individual allowances to landfill tonnes of biodegradable waste are allocated and subsequently traded; credit-based schemes (for packaging waste) which allocate targets for recycling to industry and require proof of target achievement through holding of tradable certificates that are produced when a tonne of waste is recycled.

Best practice example:
Tradable permit systems

Reference: A Comparative Study on Economic Instruments Promoting Waste Prevention

Extended Producer responsibility for specific waste streams

Producer Responsibility has evolved into a proven concept in many countries as more than 400 schemes are in operation around the world in more than 30 countries. Extended Producer Responsibility schemes ensure the manufacturer/producer and or importer of certain goods take financial responsibility for the collection and recovery or disposal of those goods at their end-of-life, for example for: packaging and packaging waste, electrical and electronic equipment, used batteries and accumulators, discarded mercury containing lighting etc.

Reference: OECD E*xtended Producer Responsibility, Updated Guidance for Efficient Waste Management, Revised 20 September 2016*
https://www.oecd-ilibrary.org/environment/extended-producer-responsibility_9789264256385-en

Best practice example:

Extended Producer Responsibility – Packaging & Packaging Waste

Need good example from developing country

Reference: Expra (EXTENDED PRODUCER RESPONSIBILITY ALLIANCE), founded in 2013, is the alliance for 26 packaging and packaging waste recovery and recycling systems from 24 countries which are owned by obliged industry and work on a not-for-profit basis. EXPRA acts as the authoritative voice and common policy platform representing the interests of all its member packaging recovery and recycling organisations founded and run by or on behalf of obliged industry.

On street large containers, example of textiles and glass

Municipalities may provide containers on streets in order to organise collections of waste from citizens. Containers of different colours may be provided for different types of waste (for example: blue for plastic and metal packaging, yellow for paper-cardboard, green for bottles, jars and flasks in clear glass, grey/black for residual waste and brown for organic waste).

Private companies and charities may also provide containers on streets in order to organise collections of specific goods for reuse and wastes for example used clothing for reuse, where containers are on municipal land agreements with municipalities may be necessary,

Container parks, “Bring” centres

Local authorities may provide container parks where citizens can take their wastes and deposit them in the appropriate containers. Alternatively, the construction and day to day management of container parks can be carried out by waste management companies, or a combination of local authority and particular private enterprises providing the collection systems within the container park.

On street household waste separate collection containers

The provision and emptying of on on-street containers are provided by local authorities or private waste management companies.

Composting

Composting is a sustainable organics management solution that can potentially be low cost and require less technical capacity than alternative treatment methods. Composting is being adopted as an organic waste management strategy as well as a way to address climate change and agricultural needs.

Best practice example:

Reference: Sustainable financing and policy : models for municipal composting

Module 3 - Actions for prevention and minimization of the generation of household waste (TBD)

NB. Reference is to be made to the Guidance document on waste prevention and minimization aims to assist parties to the Basel Convention in developing and implementing efficient strategies to minimize and prevent the generation of hazardous and other wastes as developed by the Expert Working Group on environmentally sound management.

- Eco-design, financial incentives, prohibition/voluntary [Note: e.g. to reduce quantity of household waste, to reduce hazardous content, to improve recyclability, taxation, prohibition is possible if there are alternatives, how to involve producer];
- Changing behaviour of retailers;
- Changing public behaviour to reduce consumption (How to stimulate household to reduce household waste) [Note: Choice of packaging and reduction of food waste can be addressed];
- Providing household waste community composting to reduce household waste that goes to landfill;
- Direct reuse.

Module 4 - Separation at source, collection and transport of household waste

1. Introduction

The volume of waste generation varies within and between countries and waste generation per capita is strongly correlated with national income. In high-income countries, waste generation rates are slowing, which may indicate the beginning of waste growth 'decoupling' from economic growth. However, as economies continue to grow rapidly in low- and middle-income, countries, one can expect waste generation to increase steadily.

1.1 Waste Fractions

Organic fractions comprise a greater percentage of waste in developing countries and small island developing States: usually in the range of 50 to 70% of all wastes. This is higher than in high-income countries, where organics account for typically 20 to 40%.

[Plastic fractions are generally high ranging from 8-12 %; Paper - 12 %]

['Dry recyclable' materials (metals, glass and textiles) range from 12% of MSW in high-income to 12% and 9% in middle-income and then 6% in low-income countries.]

[Need diagram to put the importance of source separation in context]

The Mare Chicose Landfill, the sole landfill site on the island of Mauritius, is expected to reach capacity in 2019. Unsorted municipal waste arrives at the sanitary landfill site from 5 transfer stations (Environment and Sustainable Development, Mauritius; Photo GRID Arendal 2018).

2. Separation

2.1 Introduction

The separation of waste at the source (households) is an essential step in a cost effective and environmentally sound waste management strategy. Sorting directly supports material recovery as it results in the production of a homogenous and ultimately higher value waste stream. Source separation can enable the processing of certain waste streams higher up the waste hierarchy than would otherwise be possible in a mixed waste stream. It is extremely important when high quality material is required such as organic wastes which can produce compost and mulch.

However, separating household waste is challenging in many countries due to several factors including rapid urbanisation, increased use of packaging materials and the absence of an enabling environment to facilitate sorting at the household level. Often waste is sent to landfill sites in a comingled manner, which makes it difficult and costly to separate and overall the waste stream has a lower value. In tropical countries, high temperatures and moist air are conducive to rapid decay, which further complicates any sorting.

2.2 Sorting at the source

Table 2.1. Example of household sorting instructions for non-organic waste – Inner West Council NSW, Australia

What goes in the recycling bins?	**What does not go in the recycling bins?**
Bottles, containers and cans • Bottles, containers and cans • Glass bottles and jars • Aluminium and steel cans • Empty aerosol cans • Plastic bottles and containers • All plastic takeaway containers (no food scraps) • Aluminium foil trays (no food scraps) • Aluminium foil (scrunched up into a fist-size ball)	✕ Plastic bags and other soft plastics ✕ Polystyrene foam ✕ Nappies, used or unused ✕ CDs, DVDs and VCR tapes ✕ Flower pots, including plastic ones ✕ Photographs ✕ Clothing ✕ Mixed foil and plastic packaging ✕ Ceramics, porcelain and broken glass ✕ Light globes ✕ Syringes and sharps ✕ Medicines ✕ Green waste ✕ Mobile phones and electronic or computer parts ✕ Plastic toys and kitchen storage containers ✕ All waste that goes in the garbage bin
Clean paper and cardboard • Newspaper, cardboard and paper • Milk and juice cartons • Pizza boxes (no food scraps)	

Table 2.2. Example of sorting food waste in Oslo Norway

What goes in the green bag?
• Peelings/cores • Bread • Teabags/coffee filters/coffee grounds

- Seafood
- Leftovers meat/bones
- Eggshells
- Small amounts of soiled kitchen paper

Source
https://www.oslo.kommune.no/english/waste-and-recycling/recycling-in-oslo/

No need for municipal collection - home and community composting

Sorting organic waste for composting at or near the source, for example in backyards, on verandas or in community gardens eliminates large quantities of waste from entering the municipal waste management system. This reduces the cost to householders of collection and disposal and can also provide compost for a variety of soil applications.

Local composting can process any biodegradable material commonly available in households. Compost bins of varying sizes, that aerate the decaying material, can be purchased or built from simple materials (e.g. pallets or scrap wood). Small compost systems, often use a microbial inoculant in a sealed system (e.g. the Japanese Bokashi system[1]) or worm farms (vermicomposting[2]) to assist in the breakdown of organic material. These can be located on a veranda or small outdoor space. Community composting is also an option, especially for households with limited space. Communities can share a composter which can also support a communal garden or provide compost for home use.

Case study: Slovakian home composting of kitchen waste

Since 2017, towns and municipalities in Slovakia have been required by law to provide a system for the separate collection of biodegradable waste from kitchens (garden waste collection was already in place). Most municipalities have decided to provide households with home composters instead of collecting organic material. This initiative has decreased the demand for collection services and reduced the need for municipal composting. In some cases, over 50% less biodegradable waste has been sent from the municipality to landfill. An increase in landfill fees has helped drive the initiative (see ODPADY-PORTAL 2018).

2.3 Material Recovery and Sorting Facilities

Material recovery facilities (MRFs) are an essential part of waste management. The MRF receives, separates and prepares recyclable materials for marketing to end-user manufacturers. The main function of the MRF is to maximize the quantity of recyclables processed, while producing materials that will generate the highest possible revenues in the market. MRFs can also process wastes into a feedstock for biological conversion through composting and anaerobic digestion.

‘Clean’ MRFs. Clean material recovery facilities further separate clean, source-segregated dry materials for recycling and/or produce a prepared fuel. They may use either hand or automated sorting systems, or some combination of the two. They are used extensively in developed countries alongside source separation of mixed recyclables.

‘Dirty’ MRFs. Dirty material recovery facilities accept mixed waste from which dry recyclable materials are separated from the organic fraction. Cross contamination results in a lower quality output. This type of sorting facility is more common than clean MRFs in developing countries.

[1] https://www.the-compost-gardener.com/bokashicomposting.html
[2] https://www.planetnatural.com/composting-101/indoor-composting/vermicomposting/

Specific purpose MRFs. Specialized material recovery facilities focus on specific waste streams, such as e-waste, construction and demolition waste, or plastic waste.

Waste sorting centres. Waste sorting centre is the term used mainly in developing countries to cover a range of waste management operation. For example, the city of Pune city in India has set up a number of mainly manual waste sorting centres with the informal sector to integrate them into the mainstream waste management system. Centres which involve the informal sector, but use a mix of manual and mechanical sorting, are common in Brazil and some other countries. The United Nations Economic and Social Commission for Asia and the Pacific (ESCAP) has been promoting decentralized and Integrated Resource Recovery Centres (IRRC) in seven secondary cities across five countries in the Asia-Pacific region[3].

Case Study: Bangalore Clean Material Recovery Facility or Dry Waste Collection Centre

Dry Waste Collection Centres (DWCCs) are an important aspect of decentralized waste management. Bangalore became the first municipality in India to set up DWCCs. The concept, modelled around neighbourhood recycling centres, aims to facilitate the collection and buy back of all recyclable dry waste from local residents, contract workers, and waste workers or scrap dealers, including informal waste workers. The centres operate with zero subsidy from the municipality, so need to be financially viable. The operation prevents land filling of recyclable and other non-biodegradable material which can be alternatively processed. They integrate the many informal workers through employment opportunities in the DWCCs and provide a locality for recycling that serves as a dissemination point for information. The consolidation of recycling activity creates economies of scale and back-end integration, as well as providing an interface for engagement with industry. This engagement helps facilitate actions on extended product responsibility.

2.4 Collection

Case Study: SWaCH – A waste pickers' cooperative in Pune, India

Solid Waste Collection and Handling known as SWaCH is a wholly waste worker-owned cooperative, established to provide front-end waste management services to the city of Pune. In 2008, the cooperative entered into a formal memorandum of understanding with the municipal council to operate a door-to-door waste collection service. SWaCH currently provides waste management services to nearly half a million residents of the city. The Cooperative has 2300 members (and growing) who are engaged in door-step collection of waste.

Pairs of members of the cooperative are allocated 250- 350 households in designated localities. Households provide sorted waste - wet or organic waste and dry wastes such as plastics, glass, paper, etc.) to the collectors who in turn further sort the dry waste and sell the recyclables. Waste pickers drop off non-recyclable waste or residues at city-run feeder points.

The Pune municipality does not pay the waste workers for this work, instead they are authorized to collect a user fee directly from citizens and can sell anything of value that is discarded. The service provided is cost effective, as the Pune Municipal Corporation saves approximately Rs.102 million (almost US$ 1.5 million) per year in waste services.

2.4.1 Organic waste

Composition of municipal wastes is influenced by factors, such as culture, geographical location, economic development and climate. However, in most countries organic material tends to make

[3] https://www.unescap.org/sites/default/files/Paper_ESCAP%20paper%20on%20IRRC%20ISWA%20Congress.pdf

up the highest proportion. Organic waste comes from kitchen waste – fruit and vegetable peelings, food scraps and leftovers and garden waste – grass cuttings, hedge clippings, leaves and branches, flowers etc.

Minimising the amount of food waste produced is important for food security. SDG target 12.3 aims to halve food waste per capita by 2030[4]. Consumers have an important role to play in reaching this target, as significant food waste occurs in the home, especially in developed countries.

While the focus should be on organic waste minimisation, the waste that is produced is a valuable resource, so should not be disposed of in landfill. Apart from losing potential revenue, there are many negative environmental and social impacts with landfill disposal, including the expense of acquiring land, potential for leachate and odour and greenhouse gasses produced by decomposing organic matter. Composting and anaerobic digestion represent much more effective ways of treating this valuable waste stream.

Home compost bin for municipal collection. Bin liner is composed of biodegradable corn-based plastic, 3nd Arrondissement Paris (Photo: GRID Arendal 2018).

In the absence of home composting, bins for storage and kerbside collection of separated organic wastes are often provided by the municipality, in an effort to divert organic material from going to landfilling as a component of mixed residual waste. Advanced systems provide also compostable bag liners, which increase ease of handling and are fully biodegradable.

The appropriate frequency of collection will depend on conditions. As biodegradable waste (especially food waste) decomposes much faster (and may potentially attract disease spreading insects) at higher temperatures and humidity, under these conditions more frequent collection may be required. In some cities such as Shanghai, multiple daily pickups are available.

[To insert graphic – frequency of collection]

[To explain user pays systems – weight, frequency, quality, etc.]

[4] https://sustainabledevelopment.un.org/sdg12

Case Study: Shanghai Food Waste

Xu et al (2016) document a successful food waste sorting programme that was trialled in an urban high-density development in Shanghai. The scheme, which included extensive consultation and awareness raising, resulted initially in 70% of food waste being correctly sorted. Even though a year later the rate had dropped to 45% (but had maintained low contamination levels), this was still considered very successful (sorting rates over 20% with contamination levels of less than 10% would have been considered very successful). The success was attributed to effective collaboration between a Community Committee, an NGO and residents, which resulted in a sense of civic duty amongst residents.

Food waste is considered a good source of nutrition for livestock, especially pigs who have a digestive system that is suited to mixed organics (Erasmus et al. 2015). However, some countries have banned or highly regulated the feeding of waste organics to animals (e.g. European Union) due to the possible transmission of disease such as foot-and-mouth disease and African swine fever. However, there are methods to process food waste, such as lactic fermentation and thermal treatment, which effectively eliminate pathogens and renders food waste safe for animal feed (Edwards, 2000, Garcıa et al., 2005, OIE, 2009). In parts of the world, food waste is commonly used as animal feed, including in modern systems of pig production. In countries such as Japan and South Korea 35.9% and 42.5% of food waste is recycled as feed, respectively. There, the use of food waste is closely regulated, with legislation governing the heat treatment, storage, and transport of food waste feed (Sugiura et al., 2009, Ermgassen et al., 2016).

2.4.1.1 Industrial composting and anaerobic digestion facilities

Anaerobic digesters are alternatives to managing organic residual materials with the benefit of energy recovery. This degradation process takes place in an oxygen-free environment with anaerobic bacteria (bacteria that don't require oxygen). The digestion process produces biogas (methane, carbon dioxide and water) which can be converted into energy and digestate - solid remnants of the original input material, which can be taken for composting or used as fertilizer. Rigorous source separation and an effective collection system is necessary in order to provide good quality source material.

Module 5. Preparing for Reuse of household waste

- Collection of household waste (e.g. textiles, furniture) with an intention of preparing for reuse (including for charity);
- Preparation for reuse through repair or refurbishment;

Module 6. Recycling of household waste

- Recycling processes for different waste streams;
- Quality/recycling standards, recycled content;
- Economic analysis of recycling [Note: Cost for processing, job creation].

Module 7. Recovery of household wastes

- Mechanical and biological treatment [Note: Composting, the organic component will be

recycled];

- Large scale composting;
- Waste to energy technologies;
    - Incineration for energy recovery - heating and cooling;
    - Biofuels [Note: Pyrolysis, gasification, slag management];
    - Anaerobic digestion [Note: Obtaining fuels through anaerobic digestion].

Module 8. Final disposal of household waste

- Incineration [Note: Safe handling of ash, energy recovery and coprocessing, in certain countries ash is again incinerated];
- Landfill of residual waste [Note: Including compacting];
- Permanent underground storage of hazardous materials in household waste).

Module 9. Awareness raising and communication

- Communication strategy, including to enhance stakeholder engagement;
- Education and two-way conversations;
- Changing behaviour;
- Communication, including through social media;
- Policy within government organizations and schools;
- Involving private sectors, including to conduct awareness campaign;
- Innovative approach to communication e.g. apps.

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