EPA

Best Practices for Solid Waste Management
A Guide for Decision-Makers in Developing Countries

Addressing Plastic Waste

July 2023
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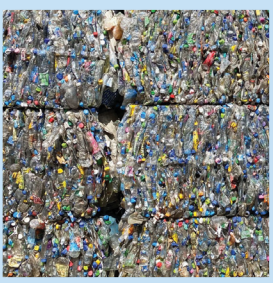




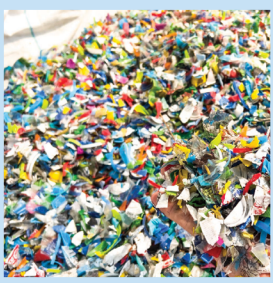

Best Practices for Solid Waste Management:
A Guide for Decision-Makers in Developing Countries

Addressing Plastic Waste

United States Environmental Protection Agency
Office of Resource Conservation and Recovery

July 2023

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Acronyms and Abbreviations

ABS	Acrylonitrile Butadiene Styrene
ASEAN	Association of Southeast Asian Nations
BBPB	Bye Bye Plastic Bags
BPA	Bisphenol A
CCAC	Climate and Clean Air Coalition
CCBO	Clean Cities, Blue Ocean
CEBSE	*Conservación y Eco-Desarrollo de la Bahía de Samaná* (Center for Conservation and Eco-Development of the Bay of Samana)
DRCs	Dioxins and Related Compounds
EPR	Extended Producer Responsibility
FRP	Fiberglass-Reinforced Plastic
HDPE	High Density Polyethene
INC	Intergovernmental Negotiating Committee
IUCN	International Union for Conservation of Nature
KKPKP	Kagad Kach Patra Kashtakari Panchayat
LDPE	Low Density Polyethylene
MM	Millimeters
NGO	Non-Governmental Organization
NOAA	National Oceanic and Atmospheric Administration
OECD	Organisation for Economic Co-operation and Development
OIOV	One Island One Voice
PAHs	Polycyclic Aromatic Hydrocarbons
PAYT	Pay-As-You-Throw
PET	Polyethylene Terephthalate
PLA	Polylactic Acid
PM2.5	Particulate Matter
PP	Polypropylene
PPE	Personal Protective Equipment
PS	Polystyrene
PUR	Polyurethane
PVC	Polyvinyl Chloride
RAP	Regional Action Plan
SBC	Social and Behavior Change
UNEA	United Nations Environment Assembly
UNEP	United Nations Environment Programme
USAID	United States Agency for International Development
U.S. EPA	United States Environmental Protection Agency
VOC	Volatile Organic Compounds
WHO	World Health Organization
WIEGO	Women in Informal Employment Globalizing and Organizing
WWF	World Wildlife Foundation

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ADDRESSING PLASTIC WASTE

Key Resources

- Best Practices for Solid Waste Management: A Guide for Decision-Makers in Developing Countries (U.S. EPA 2020)
- Global Plastics Outlook: Economic Drivers, Environmental Impacts and Policy Options (OECD 2022a)
- Reducing Plastic Pollution: Campaigns that Work (One Planet Network 2021)
- Legal Limits on Single-Use Plastics and Microplastics: A Global Review of National Laws and Regulations (UNEP 2018)
- A Framework for Selecting and Designing Policies to Reduce Marine Plastic Pollution in Developing Countries (Alpizar et al. 2020)
- Plastic Waste Mitigation Strategies: A Review of Lessons from Developing Countries (Hira et al. 2022)
- Improving Markets for Recycled Plastics Trends, Prospects and Policy Responses (OECD 2018)

Section 1

Introduction

In 2022, an estimated 400 million tons of plastic waste were generated globally (World Economic Forum 2022). Plastic waste accounts for approximately 12 percent of the solid waste stream in middle and low-income countries (Kaza et al. 2018). This percentage increases as a country's economic situation improves due to rapid urbanization and economic growth. Plastic consumption and waste are expected to triple by 2060, while plastic leakage into the environment is expected to double (OECD 2022b). Awareness of the health and environmental impacts of plastic waste are the basis for the rising momentum around international, national, and local policies and programs to reduce plastic pollution and improve proper management of plastic waste.

Addressing Plastic Waste is part of the United States Environmental Protection Agency's **Best Practices for Solid Waste Management in Developing Countries Toolkit**. The Toolkit serves as a free resource for decision-makers implementing solid waste management programs. The Toolkit includes e-learning modules, communication materials, webinar materials, videos, and the **Best Practices Guide for Solid Waste Management in Developing Countries** (the Guide). The **Guide** describes key aspects of solid waste management and identifies best practices that can be implemented in medium and large cities in developing countries. **Addressing Plastic Waste** is a companion chapter to the **Guide**.

This companion chapter provides an overview of the impacts and challenges of plastic waste management, the benefits of properly managing plastic waste, and best practices for recovering and incorporating waste back into the value chain. This companion chapter will detail potential solutions to addressing plastic waste in the context of implementing policies and regulations, instituting behavioral changes through education, partnering with stakeholders, and developing locally appropriate technology solutions and infrastructure. Whereas this chapter is solely focused on plastic, improving management of plastic waste should be part of a holistic effort to address the entire solid waste stream.

Additional information and resources relevant to plastic recycling can be found in **Section 11 – Recycling** of the **Guide**, which provides an overview of best practices for implementing recycling programs. Another companion chapter, **Recycling Markets**, provides an overview of recycling end-markets.

This companion chapter is not intended to be a step-by-step implementation manual, but it highlights resources that local authorities and decision-makers can refer to for more detailed technical guidance. Approaches that may be successful in one city or region may not function everywhere, so the chapter presents decision-makers with the information and resources to improve equity in solid waste management within the context of their given situation.

Section 2

What Is Plastic Waste?

Plastic waste results from the production, use, and disposal of mono-material or multi-material plastic products. Mono-material products are made entirely from a single type of resin, whereas multi-material products include one or more resin types, paper, and/or metal. The United States Environmental Protection Agency classifies plastic into three categories for municipal solid waste purposes:

- **Containers and packaging.** Containers and packaging include products such as plastic bags, containers, and wrapping material used to wrap or contain many small and large consumer goods (e.g., food, beverages, medications, cosmetic products, mattresses) that are discarded in household waste (U.S. EPA 2020a).
- **Nondurable goods.** Nondurable goods include products with a lifespan less than three years such as plastic plates, cups, trash bags, disposable diapers, and clothing (U.S. EPA 2020a).
- **Durable goods**. Durable goods consist of products that last longer than three years such as appliances, furniture, carpet, and consumer electronics (U.S. EPA 2020a).

Plastic is primarily made from virgin fossil fuel feedstocks. The three types of plastics are further categorized into seven polymer types and resin codes, which are typically listed on materials using the icons seen in Exhibit 1 (Ellen MacArthur Foundation 2016; U.S. EPA Undated). Understanding the different polymers of plastic is important because some recycling systems only accept certain types, meaning some plastics may not be recyclable in all systems. Cities can develop polymer-specific solutions if certain products are commonly mismanaged or littered.

Exhibit 1. Plastic Polymer Types, Resin Codes, and Product Examples

Plastic Polymer Types and Resin Codes						
1 PETE 01 PET Polyethylene Terephthalate	2 HDPE 02 PE-HD High Density Polythene	3 V 03 PVC Polyvinyl Chloride	4 LDPE 04 PE-LD Low Density Polythene	5 5 PP Polypropylene	6 6 PS Polystyrene and Expanded Polystyrene	7 7 OTHER Other, such as: - Acrylic polycarbonate - Acrylonitrile butadiene styrene (ABS) - Bisphenol A (BPA) - Fiberglass-reinforced plastic (FRP) - Nylon - Polylactic acid (PLA)
Sample Products						
Water bottles, dispensing containers, food-grade containers and bakery trays	Shampoo bottles, milk bottles, freezer bags, ice cream containers	Cosmetic container, plumbing pipes and fittings, electrical conduct, blister packs, wall cladding, roof sheeting, bottles, garden hose, shoe soles, cable sheathing, blood bags and tubing	Bags, trays, containers, food packaging film	Potato chip bags, microwave dishes, ice cream tubs, bottle caps, single-use face masks	Cutlery, plates, cups, protective packaging, hot drink cups	Automotive and appliance components, computers, electronics, cooler bottles, packaging
						

Section 3

Why Address Plastic Waste?

Plastic waste can intentionally or unintentionally leak into the environment during production, consumption, and disposal phases of the product lifecycle, though leakage is most common at the end of its useful life. Leakage contributes to more than 165 million tons of plastic that are found in oceans (World Economic Forum et al. 2016). By 2050, the weight of plastics could outweigh the weight of fish in the oceans (World Economic Forum et al. 2016). Leakage can also clog sewers and drainage systems, resulting in flooding and breeding grounds for disease [UNEP Undated].

Once in the environment, "plastic waste" becomes "plastic pollution." Plastic waste is disposed of at a facility or waste receptacle, whereas plastic pollution is intentionally or unintentionally disposed of into the environment. Once in the environment, plastics are persistent and may take between 100 to over 1,000 years to decompose, depending on environmental conditions (Babaremu et al. 2022). Impacts of plastic in the environment are addressed in more detail in the *Plastic Waste Impacts section*.

Plastic pollution can originate from:

- Leakage of resin pellets during production
- Mismanaged waste (e.g., waste collected but improperly or illegally disposed of or waste that is not collected in areas where solid waste management services exist)
- Litter (e.g., items discarded in the environment)
- Abrasion (e.g., "wear-and-tear") and losses of microplastics
- Industrial and marine activities
- Catastrophic events
- Urban and stormwater runoff
- Washing machine wastewater

High-density polyethylene (HDPE), low-density polyethylene (LDPE), polyethylene terephthalate (PET), polypropylene (PP), and polystyrene (PS) collectively account for 92 to 96 percent of the types of plastic found in the environment (Hahladakis 2020). Examples of common plastic product categories found in the coastal environment include (Alpizar et al. 2020; Ocean Conservancy 2021b, 2022; Pew 2020):

- **Beverage and food packaging**, such as bottles, bottle caps, food wrappers, straws and stirrers, and take out/takeaway containers.
- **Carrier bags**, such as grocery bags and shopping bags.
- **Packets and multilayer films**, such as single-portion condiment and shampoo packets and sachets, and coffee, chip, crisp, candy, and sweets bags and packets.
- **Mono-material films**, such as cling film, flow wrap, and pallet wraps.
- **Household goods and cleaning products**, such as bottles, and mono-material and multi-material plastic objects such as pens, toys, combs, toothbrushes, durable goods, and buckets.
- **Marine-based goods**, such as derelict fishing gear including lines, nets, and pots or leakage from commercial fishing and recreational fishers. Offshore oil and gas platforms are not considered solid waste but may contribute to marine litter and have tourism impacts in coastal cities.
- **Miscellaneous products**, such as cigarette butts and personal protective equipment (PPE), including face masks and gloves.

3.1. Plastic Waste Impacts

Unmanaged plastic waste can cause serious human health, environmental, and economic impacts, described below:

- **Human health**, including:
  - ***Fragmentation into microplastics***. Once in the environment, plastic pollution can fragment into smaller pieces of plastic. Plastic particles less than five millimeters (mm) in size in one dimension are called "microplastics." Microplastics have been found in human livers, kidneys, and placentas; however, more research is needed to understand the human health impacts of microplastics (UNEP 2021; Potter 2021).
  - ***Exposure to chemical additives***. Carcinogenic chemicals found in plastics leach into tap water, which may cause developmental, reproductive, neurological, and immune disorders (IUCN 2021a).
  - ***Spread of infectious diseases***. Plastic pollution, such as single-use plastic bags, can clog sewers, providing a breeding ground for mosquitoes and pests and increasing the risk of malaria [UNEP Undated]. Malaria disproportionately impacts the World Health Organization (WHO) African Region, where over 95 percent of malaria cases and deaths occur (WHO 2022).
  - ***Air pollution from waste burning***. Open burning or uncontrolled incineration of waste emits carcinogens such as dioxins, furans, and black carbon [CCAC Undated], which pose health risks to humans, animals, and the environment. According to R20 Regions of Climate Action (2016), "global yearly emissions of CO_2 due to open burning are estimated [sic] to be 1.4 billion tons per year." Plastic and waste burning account for 13.5 percent of fine particulate matter ($PM_{2.5}$) emissions (Royal Academy of Engineering 2021). Other pollutants such as polycyclic aromatic hydrocarbons (PAHs), dioxins, and a range of volatile organic compounds (VOCs) are released when plastic is burned (Royal Academy of Engineering 2021).
- **Environment**. Plastics pose a threat to the marine environment by increasing the risk of ingestion, suffocation, and entanglement of marine species (IUCN 2021a). Research has indicated that more than 1,500 species in marine and terrestrial environments are known to ingest plastics (Santos et al. 2021). Microplastics may reduce the ability of animals to digest food, leading to intestinal blockage, starvation, and internal injury [NOAA Undated].
- **Economic**. Plastic pollution can be costly to the global economy. According to one estimate, plastic pollution accounts for more than $2.2 trillion in damages (e.g., damage to infrastructure) per year, including $1,500 billion in ocean damage, $695 billion in greenhouse gases, and approximately $25 billion in land pollutants (Hira et al. 2022).

KEY POINT

Benefits of Addressing Plastic Waste

1. **Reduced health impacts**: Limiting the volume of plastic waste that enters the environment decreases human and environmental health risks from plastic pollution.
2. **Increased recycling rates**: Recycling rates increase as strategies aim to increase recycling of plastics and reduce contamination in the recycling system.
3. **Reduced consumption**: Plastic consumption decreases as strategies discourage or ban the use of plastics.
4. **Reduced contamination**: Contamination of plastics (biodegradable plastics mixing with other plastics, plastics contaminated with other materials) decreases as strategies streamline plastic consumption and disposal, and manufacturers simplify design with fewer harmful contaminants.
5. **Reduced leakage**: Litter and other mismanaged waste decreases as strategies are implemented to collect and capture more plastics before entering the environment or waterways.
6. **Enhanced collaboration**: Partnerships among stakeholders grow as strategies encourage collaboration.
7. **Enhanced markets**: Market values of plastic increase as the quality of end-use plastic increases from improved recycling rates and decreased contamination. For more information, see the **Recycling Markets** chapter.

Section 4

Challenges

Exhibit 2. Challenges to Managing Plastic Waste

Cities face many challenges when managing plastic waste (Exhibit 2). Common challenges include:

- **Weak strategic planning**. A strategic plan for a solid waste management program outlines the strategy and goals of the program, identifying key projects, policies, costs, and the timeline necessary to reach such goals. A weak strategic plan can limit the effectiveness of solid waste management efforts. For example, weak strategic planning may result in a lack of skilled managers and operators necessary to perform tasks in the solid waste management system (UN Habitat 2011).
- **Lack of solid waste management systems and infrastructure**. Cities around the world may struggle to manage plastic waste due to the limited availability of waste collection, treatment, and disposal options. Furthermore, infrastructure for solid waste management has not kept up with the growing manufacturing and usage of single-use plastics (Hira et al. 2022).
- **High cost of collection and transportation**. The high cost of transportation can present a barrier for some solid waste management providers as well as customers (McKinsey and Company 2016, OECD 2018). This barrier is even more prevalent in small jurisdictions where recycling rates range from 0 to 5 percent (Hira et al. 2022). In some countries, waste collection services are privately owned utilities with high operational costs and service fees. To avoid paying expensive fees, residents opt to illegally dump or burn their waste instead.
- **Shortage of funding**. In the current plastics market, the cost for recycled plastics – including additional costs for sorting, cleaning, and disassembly – is far higher than the cost of virgin plastics (McKinsey and Company 2016). Stakeholders often find it is more economical to use virgin plastics, which results in landfilling, burning, or dumping of used plastic products. Lack of funding can pose a key obstacle for cities to purchase or maintain large-scale, locally appropriate technology that can prevent or capture plastics from entering waterways (Hira et al. 2022). For more information on recycling markets, see the **Recycling Markets** companion chapter.
- **Legal constraints and limited enforcement**. Global efforts to address plastic waste and pollution are underway (Exhibit 4), but policymakers must consider unintended consequences and loopholes of policies and agreements. Additionally, setting aside resources and oversight for enforcement is critical to meeting the targets and goals of national and local plastic waste and pollution efforts.

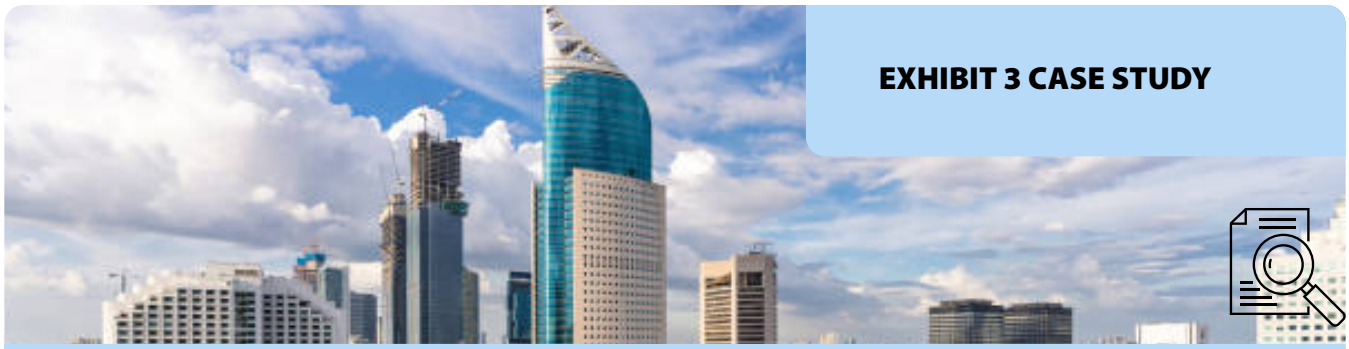


EXHIBIT 3 CASE STUDY

Combining Policy with Infrastructure in Asia

Waste banks are a market-based strategy that local governments can implement to increase collection of recyclables including plastic, paper, metal, and glass. Indonesia, Thailand, and the Philippines have all supported waste banks.

In Indonesia, an online platform of up to 70 types of recyclables is available to attract local households to sell their segregated recyclables. The Guidelines for the Implementation of Reduce, Reuse, Recycle through Waste Banks in Indonesia has helped waste banks gain popularity. The number of waste banks in the country has increased by up to 50 percent each year.

Thailand introduced "zero-baht[1]" (cashless) shops, which allow customers to exchange recyclables for consumer goods. Zero-baht shops also offer a savings plan for customers that bring in recyclables. Informal sector workers are eligible for the savings plan by completing one of the following:

1. Crediting recyclables at zero-baht shops
2. Depositing two glass bottles per day or
3. Depositing one baht per day, continuously for two months

These savings plans contribute to medical insurance, educational loans, and rice provisions for older people.

In Marikina City, Philippines, a similar scheme exists where recyclables are collected at junk shops under the Eco-Savers Programme. The Eco-Savers Programme educates households on proper solid waste management practices and rewards students with credits that can be used for educational supplies.

[1]Baht is the currency of Thailand

For more information about market-based collection systems and other solutions, see Applying the extended producer responsibility toward plastic waste in Asian developing countries for reducing marine plastic debris.

EXHIBIT 4 CASE STUDY

Global Plastics Action

In March 2022, the United Nations Environment Assembly (UNEA) of the United Nations Environment Programme (UNEP) adopted a resolution to develop a legally binding instrument to end plastic pollution during the fifth session of UNEA in Nairobi.

The UNEA has requested the Executive Director of UNEP to convene an intergovernmental negotiating committee (INC) to begin drafting the instrument during the second half of 2022, with the ambition of completing the legally binding instrument by 2024. With this timeline, cities may take this resolution into consideration to begin planning for what may be required by an official treaty.

The resolution calls upon the INC to consider provisions for inclusion in the instrument to: (1) promote national action plans to work toward prevention, reduction, and elimination of plastic pollution; (2) support regional and international cooperation; (3) encourage action by all stakeholders, including the private sector; and (4) promote cooperation at the local, national, regional, and global levels.

Key questions that decision-makers can consider when drafting an Action Plan (AP) include:

1. What is the scope and how do we set targets?
2. What is the geographic boundary encompassed by the AP?
3. What are the existing laws/regulations on the issue?
4. What are the short-term and long-term goals of the AP?
5. Are the goals broad enough to encompass the entire geographic boundary in the AP?
6. What is the timeline for the AP?
7. Who are the key stakeholders within the region that are currently engaged in the topic, and who else could be included?
8. What actions will be taken to meet goals?
9. Who will oversee implementation?
10. How will progress be monitored throughout the implementation of the AP?
11. How will results be evaluated?
12. What plans or actions worked? What did not work? How can improvements be made for the future?

National/Regional Action Plan examples by topic area:

Marine Waste: **NOAA**, **Great Lakes**, **Vietnam**, **Baltic Seas**, **South Asia Seas**, **Malaysia**, **Belize**, **Flanders Region**, **Northeast Atlantic**, **Black Seas**, **G20**, **African Atlantic Coast and Island Countries**

Planning Templates/Guidelines: **WWF/Plastic Smartcities**, **UNEP/GPML**, **G20**

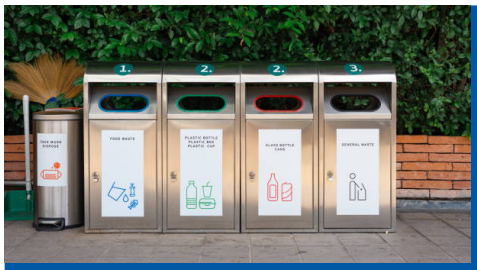
Circular Economy: **Flanders Region**, **Vietnam**

Land Waste Reuse/Recycling: **ASEAN**, **Sri Lanka**

Section 5

Best Practices

This section describes best practices for addressing plastic waste, including regulatory and policy interventions, behavioral and educational campaigns, partnerships, and locally appropriate technologies. Exhibit 12 provides information on the various challenges cities encounter when managing plastic waste and offers solutions that address such challenges.



KEY POINT

No One Solution Can Solve the Global Plastic Waste Issue

It is important to consider all stages of the recycling system including collection, management, and disposal. Further, it is critical for cities to increase collection and separation of materials. Strengthening provision of collection services, especially in rural areas, can help cities collect waste, and prevent leakage into the environment. Enhancing separation efforts can help cities recycle more plastic waste and increase the value of recycled plastics.

Several factors impact successful implementation of plastic waste strategies, including geography, financial, and political constraints. Many cities find that a combination of strategies is most beneficial to address plastic waste, including:

- **Regulation and policy**. Cities can set targets or laws to limit plastic usage, encourage proper disposal of plastic waste, and phase out the most problematic plastic. Mandates to require data reporting are examples of mechanisms cities can use to manage plastic waste.
- **Behavioral change and educational campaigns**. Changing consumer behaviors and educating people about the negative impacts of plastic pollution can lower plastic consumption, lower contamination in the recycling stream, and lead to enhanced management of plastic waste.
- **Partnerships**. Non-governmental organizations (NGOs), local governments, the informal waste sector, businesses, and other societal stakeholders can work together to maximize public awareness and execution of policies or educational campaigns focused on plastic waste. These stakeholders can also partner to fund and manage new infrastructure and technology. Partnerships are also critical to developing and expanding markets for plastic waste. For more information on recycling markets, see the **Recycling Markets** companion chapter.
- **Technology and infrastructure**. Access to and investment in locally appropriate technology and infrastructure can help cities better manage plastic waste and increase the value of recycled plastics. Innovation of new environmentally sound technologies can help prevent, collect, reuse, and recycle more plastic waste through machine learning to sort plastic waste, blockchain tools to foster recycling, washing bags to filter microplastics, and autonomous leakage removal systems (OECD 2022a). Investing in locally appropriate technology can aid in the development of sanitary landfills and increase closure of open dumpsites.

5.1. Cross-Cutting Best Practices

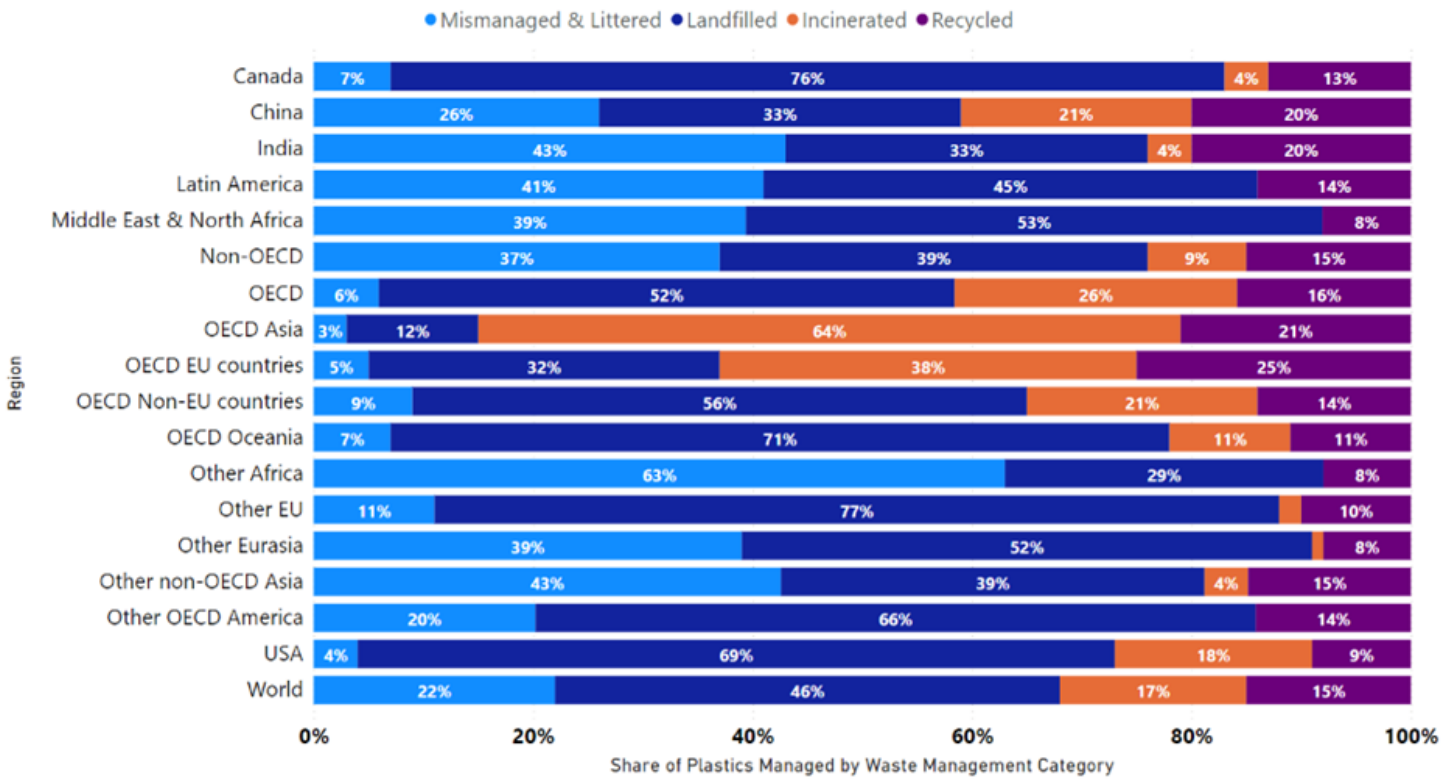
According to the solid waste management hierarchy developed by the United States Environmental Protection Agency, the most preferred way to manage plastic waste is by source reduction and reuse. Recycling is the next most preferred way to manage plastic waste. See **Section 3 – Approaches** of the Guide for more information about the solid waste management hierarchy.

Though recycling is the second most preferred solution, estimates vary on the total percentage of plastic recovered and recycled globally. According to the OECD (Exhibit 5), only 15 percent of plastics were collected for recycling in 2019. The other 85 percent of plastic waste was landfilled, incinerated, or mismanaged as uncollected litter (e.g., waste that is not collected or is disposed of in the environment) (OECD 2022a).

Cities can consider the following when developing and implementing plastic waste reduction and management strategies:

- **Baseline assessment**. Baseline information helps cities develop effective strategies. Cities can conduct a baseline assessment to understand the types and applications of plastic in the waste stream, monitor the flow of plastic waste, and identify potential leakage points. Cities can also use a baseline assessment to identify areas of concern, including products, businesses, sectors, and challenges with the current recycling system, before deciding which strategies to implement. For more information, see **Section 7 – Waste Characterization** of the Guide.
- **Continued measurement and reporting**. Measuring and tracking data, including the volume of plastic waste collected, sorted, recycled, or properly disposed of, is an effective way to understand and communicate whether a strategy is successful or if additional strategies need to be implemented.

Exhibit 5. Management of plastic waste by category before recycling losses, 2019 (OECD, 2022a)



- **Financing**. Assessing existing financial resources and identifying any additional funding that may be required for implementation is a key step to take when deciding which strategies are best. Cities can engage with other stakeholders, partners, and the private sector to potentially increase funding opportunities for new, locally appropriate strategies and technologies to collect plastic waste; educational campaigns to prevent plastic pollution; and establishment of takeback programs or deposit-refund schemes. Examples of financing mechanisms include (Ocean Conservancy 2021a):
  - ***Revenue-based finance***. Debt repaid as a percentage of revenue with caps on the amount repaid or limit on repayment period.
  - ***Cashflow-based finance***. Financing repaid by reference to investee cashflows.
  - ***Equity redemptions***. Ability of funders to repurchase equity at a predetermined price.
  - ***Forgivable loans***. Debt that converts to a grant subject to pre-agreed conditions.
  - ***Convertible grant***. Grant that converts into equity.
  - ***Recoverable grant***. Grant that converts to debt.
- **Stakeholder engagement.** Engaging with all stakeholders of the waste stream including local and national governments, private industry, NGOs, residents, and the informal sector is an important step when designing effective strategies (Exhibit 6). This ensures that all stakeholders are consistent in their own practices when strategizing ways to collect, sort, and manage plastic waste. For more information, see **Section 4 – Stakeholder Engagement** of the Guide.

EXHIBIT 6 CASE STUDY

Role of the Informal Sector in Addressing Plastic Waste

Informal sector workers play a critical role in collecting and sorting plastic waste. Informal sector workers recover materials for recycling, reduce municipal solid waste handling costs, generate employment opportunities, and contribute to public and environmental health. In Pune, India, the Kagad Kach Patra Kashtakari Panchayat (KKPKP) was formed to unionize informal sector workers. In Pune, there are about 8,000 waste sector workers, of which 90 percent are women, 50 percent are under the age of 35, and 45 percent contribute to more than half of their household income. In 2006, informal sector workers recovered approximately 130,000 tons of materials, 37,000 tons of which was plastic (WIEGO 2012).

Informal sector workers focus primarily on collecting materials with high economic value that can easily be sold, including PET bottles, paper, and metal. Lower valued plastic products such as single-use bags, films, straws, and food containers may not be prioritized without incentives to collect. In Vietnam, the Thanh Vinh Cooperative pays informal waste collectors $10.92 daily, over $2.00 more than the minimum wage. Earning a fair wage incentivizes informal waste collectors to collect all types of waste, regardless of value (Ocean Conservancy 2020).

For more information about the informal waste sector, see the flyer on Informal Sector Recycling, and the Equity and Recycling Markets companion chapters as part of the Best Practices for Solid Waste Management Toolkit.

5.2. Regulation and Policy

Cities can use a variety of regulation and policy mechanisms to minimize or eliminate plastic production, consumption, and disposal.

Product Bans

Many cities have found it helpful to address plastic waste by banning certain products such as plastic bags, straws, and cutlery. For example, 127 countries have enacted some form of legislation to address plastic bags, including 37 countries in Africa, 27 countries in Asia and the Pacific, 14 countries in Latin America and the Caribbean, and five countries in West Asia (UNEP 2018). To be effective, it is important that cities not only enforce product bans, but also provide complementary educational resources on the need for the product ban and offer alternative product suggestions.

Benefits Associated with Instituting Product Bans

Product bans address plastic before it becomes waste and can remove highly problematic or difficult-to-recycle plastic products from the waste stream. By banning certain plastic products, the amount of plastic found in a waste stream decreases, lowering the probability of mismanaged waste and plastic pollution. Bans can also reduce the need to collect some low-value products, which can lower the overall collection costs for cities.

Aspects to Consider Instituting Product Bans

Cities face several challenges when instituting product bans, including:

- **Lack of enforcement**. Product bans are less effective without proper enforcement (OECD 2021). However, a penalty that is too harsh may not be as effective in changing behaviors or may lead to lack of enforcement (Adam et al. 2020).
- **Timing**. It is important to allow enough time between announcement and implementation of a product ban. Without enough lag time, plastic manufacturers, retail businesses, and consumers may struggle to adapt to the new policy (OECD 2021). For example, if a plastic bag ban is announced and implementation of the ban is too soon after the announcement, small businesses and consumers may not have enough time to adjust to alternatives (Exhibit 7) (Adam et al. 2020).
- **Economic factors**. Job loss, business closures, loss of export revenue, and higher operational costs for local manufacturers are all potential challenges cities may face when instituting a product ban (OECD 2021; Hira et al. 2022; Godfrey 2019).
- **Unintended consequences**. Bans on single-use plastics may have unintended consequences for neighboring cities. Increased plastic consumption may redirect to nearby cities without bans, or export of plastic waste may shift to less regulated cities (Alpizar et al. 2020). Illegal importation of plastic items into places where bans are present is also an unintended consequence of bans (OECD 2021).

Extended Producer Responsibility

Extended producer responsibility (EPR) is "an environmental policy approach that gives producers financial or physical responsibility for a product's entire lifecycle, including the management or disposal of post-consumer products" (OECD 2022a).

Benefits of Extended Producer Responsibility

Through properly designed EPR schemes, cities can reduce the amount of plastic in the waste stream by ensuring reduction or recyclability of plastic products. EPR schemes can help reduce the costs of collection and final disposal, depending on the type of scheme implemented. EPR schemes, which are typically adopted at the national level, establish a legal requirement that producers assume responsibility for the goods that have reached the end of their useful life. Cities can apply EPR schemes to plastic producers, targeting plastic products such as packaging and containers.

Successful implementation of EPR can decrease contamination in the waste stream because products are required to be recyclable at the end of their useful life. This results in fewer non-recyclable or harder-to-recycle products in the waste stream. Reducing contamination may also decrease the cost of collection, sorting, and processing of waste. Common elements of EPR programs that address plastic include:

- **Taxes**. Cities can set taxes on plastics manufacturers or offer subsidies for manufacturers that meet specific criteria to reduce plastic pollution. Taxes are most effective when they are high enough to discourage consumption (OECD 2022a).

- **Recycled content standards**. Recycled content standards require producers to ensure that a certain percentage of their products or packaging are made from recycled content (OECD 2022a). For example, a developing country may set a target requiring manufacturers to use at least 50 percent recycled plastic. Cities can also align their own procurement policies for government purchases with recycled content requirements.

Aspects to Consider for Extended Producer Responsibility

EPR schemes are not as effective a solution if the solid waste management system is not well-established.

- **Lack of infrastructure**. Many cities do not have a solid waste management system set up to handle the impacts of an EPR scheme. Waste that does not have economic value will end up improperly disposed. EPR schemes may result in increased competition among informal sector workers to collect the most valuable materials.
- **Lack of enforcement**. Lack of enforcement of EPR schemes limits the effectiveness of the policy (OECD 2022a). Loopholes or disregard of the EPR policy may result from poor enforcement, allowing manufacturers to avoid responsibility. Free-riders and small-scale industries may be exempt from an EPR scheme or may not be required to participate due to competitive disadvantages. This limits the effectiveness of the EPR policy (Johannes et al. 2021). For more information about EPR as it relates to solid waste more broadly, see **Section 6 - Economic Considerations** of the Guide.

Recycling Laws and Incentives

Recycling laws can either be laws that directly require certain materials (e.g., plastic), and products (e.g., plastic containers and packaging) to be recycled, or laws that are directed at limiting the material disposal volume. Incentives can be policies or schemes to encourage recycling or discourage producing waste.

Benefits of Recycling Laws and Incentives

Cities can increase recycling through recycling laws and incentives, and in some cases, double recycling rates. These laws and incentives can decrease consumption of certain materials, reduce contamination of the recycling stream, and increase the economic value of certain materials. A successful approach to ensure effectiveness is to provide information and education about the law and incentives (Alpizar et al. 2020).

Examples include:

- **Pay-as-you-throw (PAYT)**. A PAYT policy requires people to pay a fee to dispose of waste (OECD 2022a). Cities can institute a PAYT policy to reduce consumption of plastic and assist with waste management costs.
- **Landfill bans**. Cities can ban certain materials, such as plastic, from entering a landfill. Landfill bans can increase the amount of plastic that is collected and recycled, and also reduce the amount of waste generated. Although landfill bans can help to bolster recycling markets, there are also potential risks (e.g., risk of open dumping or other improper disposal) if the proper conditions and recycling outlets are not in place. Decision-makers should fully assess and evaluate the suitability of this approach before implementing it.
- **Deposit-refund schemes**. Deposit-refund schemes offer incentives, such as payments or credits, to encourage proper disposal of plastic products such as bottles or bags (Exhibit 3). This scheme often increases the value of the plastic waste and may decrease mismanagement or littering of waste (OECD 2022a).

Aspects to Consider for Recycling Laws and Incentives

Cities may not have adequate infrastructure to handle a sudden increase in recycling volume due to implementation of a mandatory recycling law or landfill ban. For example, deposit-refund schemes may increase the volume of plastic entering the solid waste management system, overwhelming the system. All stages of the recycling system could become overwhelmed by the influx of recyclables collected, sorted, and processed. A PAYT policy may increase illegal dumping or mismanagement of waste if people are unwilling to pay the fee. Due to lower costs of other disposal methods, such as landfilling or incineration, illegal dumping may be encouraged.

EXHIBIT 7 CASE STUDY

Single-Use Plastic Bans and Effective Lag Times in Latin American Countries

In Costa Rica, the import, marketing, and distribution of polystyrene containers was banned in 2019. The ban officially went into effect starting in 2021. This two-year lag time between the announcement of the ban and the official launch date provided businesses enough time to adapt to the rule change. The Costa Rican government also helped cities identify and transition to environmentally friendly alternative packaging materials. The ban was part of a broader national strategy to reduce consumption and disposal plastics. Violations of the ban result in fines of $763 to $7,629 (Global Citizen 2019).

Similarly, Chile banned the commercial use of plastic bags in 2018. The Chilean government provided large retailers with six months to phase out single-use plastic bags and offered small businesses up to two years to implement the ban.

For more information about key policy measures for Latin American and Caribbean countries, see The Circular Economy in Latin America and the Caribbean.

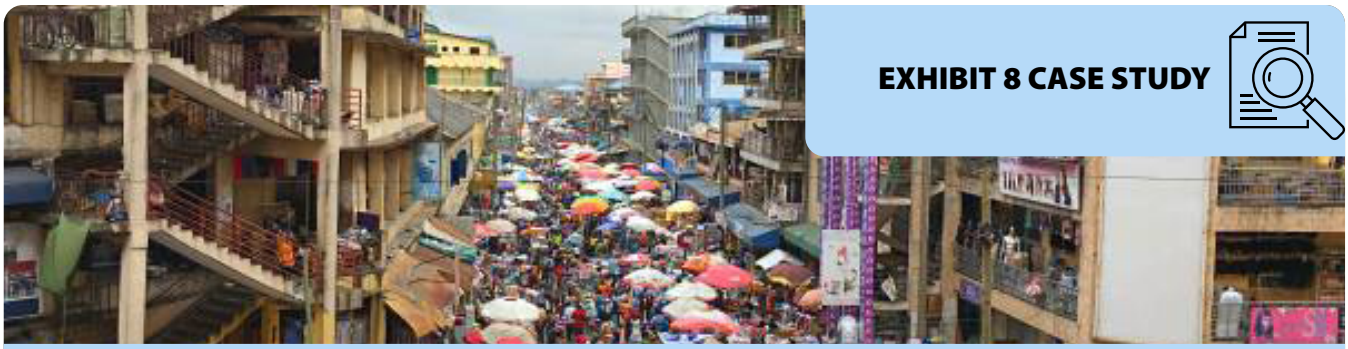


EXHIBIT 8 CASE STUDY

NGO Partners with Informal Waste Sector in Ghana

In Ghana, over 76 percent of plastic waste is mismanaged. This plastic waste is either dumped on land, burned, or leaked into bodies of water. Only 9.5 percent of plastic waste is recycled in Ghana, all of which is recovered through informal collection.

Starting in 2015, rePATRN Limited partnered with informal sector workers to address mismanaged plastic waste and to enhance collection of plastic waste. Almost no recycling of PET plastics took place in Ghana before rePATRN. At a global market level, PET is a valuable plastic that could now be collected and sold to end markets for profit. From 2015 to 2020 rePATRN helped collect over 900 metric tons of PET each month. rePATRN extended its partnership to Veolia Ghana Limited to establish Ghana's first bottle-to-bottle recycling plant. By leveraging the informal sector, rePATRN Limited has recovered over 6,000 tons of PET bottles, engaged with over 5,000 people, created 150 direct jobs, and generated over $6.5 million USD in revenue.

For more information, visit the rePATRN website, Veolia website and A Roadmap for Radical Reduction of Plastic Pollution in Ghana.

5.3. Behavior Change and Educational Campaigns

Raising awareness about the negative ecological, social, and economic impacts of plastics is necessary to address plastic waste and encourage action among residents, businesses, and local officials. Cities use a variety of behavioral change strategies and educational campaigns that can be conducted through social media, normative messaging, formative research, and the education system.

Benefits of Behavior Change and Educational Campaigns

Raising awareness is an effective strategy to improve the management of plastic waste, reduce contamination, prevent its leakage into the environment, help to reduce plastic consumption, and strengthen understanding of current and future policies. Common strategies include (Akenji et al. 2020):

- **Influencing social or cultural norms**. Shifting social or cultural norms to consider the negative impacts of plastic waste may discourage plastic consumption and encourage proper recycling habits. Encouraging the use of plastic-free or reusable products and organizing environmental cleanups are effective ways to influence a given population (Exhibit 7). Religious leaders have also been effective in raising local communities' awareness of the issues of plastic waste. For example, prominent Muslim groups in Indonesia have raised awareness about plastic waste among millions of religious followers (Garcia et al. 2019).
- **Increasing education in schools**. Including information about the negative impacts of plastic waste in school curricula can encourage students to consider the global plastic waste issue starting at a young age.
- **Targeted media initiatives**. Media initiatives can reach large audiences. Social media (e.g., WhatsApp and YouTube), television, and radio are all means of effective media campaigns (Oguge et al. 2021). Consider a "plastic-free" or "say no to plastics" campaign to discourage the use of plastics. Targeted media initiatives can also help influence social or cultural norms.
- **Enhancing tourism branding**. The environment is a key asset of the tourism industry. If plastic pollution is visible, tourists may be less likely to visit. Tourism also significantly contributes to plastic pollution. Tourism companies play an important role in maintaining a clean environment. Engage with local stakeholders to promote a common plan that eliminates unnecessary plastic, promotes reuse and circularity of plastics, and raises awareness of the impact of plastic among staff and guests (Global Tourism Plastics Initiative 2020).
- **Increasing data collection**. Data on current consumption behaviors; current collection, sorting, and disposal patterns; and products and brands that end up polluting rivers and beaches are key to effective educational campaigns. This information allows cities to provide targeted educational and communication efforts to specific areas, populations, or industries.

Aspects to Consider for Behavioral Change and Educational Campaigns

Getting people to change their behavior is a significant challenge for educational campaigns. Limited understanding or knowledge of the negative impacts of plastic waste limits behavior change. Consumers may be unwilling or unable to change habits around using plastic waste if there are not adequate and affordable alternatives such as reusable products.

Determining the most effective approach for an educational campaign is crucial (e.g., formative research could be conducted to inform the educational campaign). Inclusivity of all populations, including vulnerable communities, women, and informal sector workers, is necessary for effective educational campaigns. A negative stigma surrounding the informal waste sector may also present challenges in changing behaviors.

CASE IN POINT

Educating Youth Worldwide and Empowering Women in Bali, Indonesia

Bye Bye Plastic Bags (BBPB) is an international NGO that works to educate and raise awareness about the impacts of plastic on the environment. BBPB representatives have spoken to more than one million youth, and BBPB has leaders in more than 50 locations worldwide.

BBPB has led multiple campaigns and initiatives including One Island One Voice (OIOV), a program for businesses and organizations to share best practices in Bali, KOMITMEN, an initiative to eliminate plastics; and Mountain Mamas, a project empowering women in Bali to make handmade bags as alternatives to plastic bags. BBPB also developed an educational booklet intended to educate young students about waste.

For more information visit Bye Bye Plastic Bags' website.

5.4. Partnerships

Strengthening relationships among government, NGOs, private organizations, the informal waste sector, and others engaged in the waste stream is a crucial step that cities can take to manage plastic waste. Encouraging a multi-stakeholder approach ensures that all actors in the recycling system are working toward achieving common goals.

Benefits of Partnerships

There is value to plastic waste if the correct partnerships can form and work together. Increasing community behaviors, perception, and awareness toward plastic waste can be combined with local concepts, policies, and infrastructure efforts to reduce plastic waste (Omeyer et al. 2022). Common partnerships include (Garcia et al. 2019; Akenji et al. 2020):

- **Private sector and government**. Governments can incentivize private companies through fiscal policies to design products with recyclability in mind, substitute materials, or attract and build new recycling infrastructure or locally appropriate technology (Exhibit 8).
- **Civil society and government**. Governments can partner with local religious groups, schools, or other community groups to support initiatives that manage plastic waste.
- **NGOs and government**. Governments can partner with NGOs to support larger-scale initiatives that manage plastic waste such as eliminating plastic bags or implementing structures such as river booms to intercept plastic pollution before it reaches the ocean.
- **NGOs and academia**. NGOs can partner with academia to support research efforts related to plastic waste, such as the ones called "participatory science."
- **Informal waste sector and formal collection systems**. Linking informal sector workers with formal collection systems can address gaps in plastic collection (Exhibit 8).
- **Multiple companies**. Companies can partner together to improve packaging practices and move away from plastics.
- **Multiple cities**. Cites can partner to share governance best practices to address plastic waste. Partnerships among cities are crucial given that plastic pollution is a cross-border issue. Plastics may leak into the environment and pollute a neighboring city.

Aspects to Consider for Successful Partnerships

Identifying the right partner organization can be challenging due to limited financial resources available. Partnerships may not be as effective due to lack of enforcement of certain agreements. Both sides of the partnership must implement and uphold the agreement to ensure success. Cities may find it difficult to form partnerships if actors in the recycling system are not well connected.

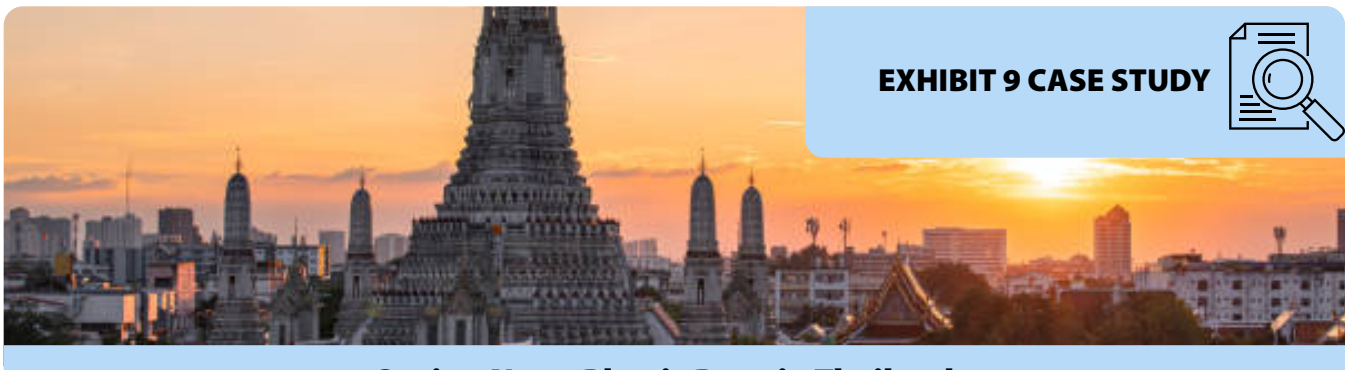


EXHIBIT 9 CASE STUDY

Saying No to Plastic Bags in Thailand

To combat heavy usage of plastic bags, the Thai Ministry of Natural Resources and the Environment (including the Department for Pollution Control and the Department for Environmental Quality) partnered with the Thai government to create the "Everyday Say No to Plastic Bags" campaign in 2019. The campaign focused on encouraging people to refuse single-use plastic products and packaging and support policy solutions.

The campaign has been effective in changing behaviors by using positive-feeling messages like "Love the Earth." Social media has been used to showcase large groups of people supporting the effort. This type of messaging taps into creating social norms around refusing single-use plastic products. The campaign also used a website and in-store displays to maximize the number of people the campaign could reach.

Overall, 75 retailers partnered during the first phase of the campaign and agreed to stop providing single-use plastic bags to their customers. The Thai government reported a reduction in plastic bag usage by approximately 6,350 tons during the first year.

For more information, see Reducing Plastic Pollution: Campaigns That Work and Thailand bans single-use plastic bags.

EXHIBIT 10 CASE STUDY

Private Industry Invests in the Recycled Plastic Supply Chain in India

Recykal is India's first waste-commerce company that provides end-to-end solutions connecting waste generators, processors, recyclers, and brand owners. In 2020, Circulate Capital, a market investment management firm, invested in Recykal to expand its efforts to recycle plastic waste. Recykal now focuses on managing plastic waste and e-waste. In 2021, Recykal facilitated the recycling of nearly 3,300 tons of plastic waste. Due to its success, Recykal has now raised an additional $22 million to further expand its recycling supply chain in India [Circulate Capital Undated].

In 2021, Circulate Capital invested more than $17 million in six new portfolio companies, and unlocked an additional $50 million into its strategies. Circulate Capital's investment into and partnerships with cities helped create 515 new jobs, supported thousands of informal sector workers, added approximately 38,100 tons of new infrastructure capacity, and prevented approximately 33,400 tons of plastic leakage into the environment.

For more information, visit the visit the Recykal website and the Circulate Capital website.

5.5. Technology and Infrastructure Investments

Locally appropriate technology and infrastructure are crucial to maintaining a successful recycling system and mitigating leakage of plastics. Collection, processing, sorting, and recycling of plastics are elements of the recycling system that can benefit from technology and infrastructure.

Benefits of Technology and Infrastructure

By investing in proper, locally appropriate technology and infrastructure, cities can address the following:

- **Detect and manage marine plastic pollution**. Manta trawls, boats, and other vessels can remove plastic pollution from oceans or rivers. Drones, sonic transmitters, remote sensing satellite imagery, and webcam monitoring can be used to identify plastic pollution or detect and monitor levels of contamination of waterways and beaches.
- **Address microplastics**. Installing stormwater and wastewater filters can prevent leakage of microplastics into oceans or rivers. Encouraging the use of washing bags and laundry balls also helps to capture and prevent leakage of microplastics.
- **Offer plastic alternatives**. Biobased plastics are derived from biomass such as corn, sugarcane, wheat, or residues of other products (OECD 2022a). Biobased plastics are commonly used for disposable consumer goods including cutlery, bowls, pots, crockery, straws, and packaging (Alabi et al. 2019). However, policy makers should consider the full lifecycle and waste stream of any alternative materials offered to avoid creating another unmanageable waste problem
- **Increase access to infrastructure**. Increasing access to recycling infrastructure encourages higher participation in recycling efforts (Exhibit 10). Access includes both infrastructure that enables more recycling as well as roads and trucks that can transport materials to be recycled or sold to end-markets. By increasing access, more plastic can be captured from being mismanaged, leaked into the environment, or landfilled.

EXHIBIT 11 CASE STUDY

Investing in Infrastructure and Education in Samaná Province, Dominican Republic

Approximately 2,000 to 2,500 tons of plastic are generated in the Dominican Republic each day. Prior to the presence of the USAID Clean Cities, Blue Ocean (CCBO) program, the waste was disposed of at open dumpsites. The CCBO program provided financial and technical assistance in Samaná Province to initiate a pilot program that established two sanitary engineered landfills and a comprehensive social and behavior change (SBC) strategy.

As a result, 31,345 tons of plastic were prevented from leaking into drainage canals, rivers, and streams. The pilot program improved solid waste management services for more than 85,000 residents. There are ongoing efforts to create new opportunities for informal sector waste collectors at the new landfills.

To create an effective SBC strategy, USAID partnered with Centro para la Conservación y Eco-Desarrollo de la Bahía de Samaná (CEBSE). This helped local decision-makers to better understand how residents and businesses think about solid waste and what policies could be promoted to achieve success. Research suggested that residents were aware of the plastic waste problem but frustrated by ineffective solid waste management projects in the Province. By combining newly engineered infrastructure with campaigns that raise awareness of the new infrastructure, USAID believes there will be measurable progress toward responsible solid waste management.

For more information, see Creating a Sustainable Waste Management Model in Samaná Province, Dominican Republic.

Aspects to Consider for Technology and Infrastructure

Technology and infrastructure cannot be the single solution. New technology and infrastructure may require additional funding and workers with advanced technical training to operate, maintain, and monitor equipment or transport materials. Specific and advanced technology may be necessary to recycle certain plastic resins or biobased plastics.

As cities work to capture more plastics, collecting and processing plastics will be a challenge. Many residents, especially in small jurisdictions, do not have access to regular recycling infrastructure. Without access to recycling infrastructure, plastic may be mismanaged, littered, or landfilled. Lack of access to roads and trucks to transport recycled materials also presents a challenge to collecting and recycling plastic. Funding for new, locally appropriate technologies and infrastructure is also a significant challenge that cities face when trying to address plastic waste. For more information about recycling infrastructure, see **Section 6 - Economic Considerations** and **Section 11 - Recycling** of the **Guide**.

Questions for Decision-Makers

- How does the city currently manage plastic waste?
- What are the major industries/sources of plastic waste in the community?
- Does the city have existing policies/laws addressing plastic waste? Are they enforced?
- Who are the key stakeholder groups involved in each stage of the plastic waste lifecycle, from generation to end-of-life?
- How has the city worked with the private sector? How can the city work in public-private partnerships for successful implementation of waste reduction strategies?
- Is the informal sector already engaged as a strategic partner? If yes, can the city leverage and improve its relationship with the informal sector?
- Does the city have data on how much waste is generated, how much is collected, what type of plastic is found in the environment, or what percentage of the waste stream is plastic?
- What are the local community attitudes or perceptions about plastic waste, recycling, and reuse?
- Does the city host beach and environment cleanups, which can provide beneficial data collected by residents?

Exhibit 12. Challenge and Solution Matrix

Regulation and Policy	Behavioral Change and Education	Partnerships	Technology and Infrastructure
Production			
Challenge: Pollution from pellets in plastic industry [3, 14, 15]			
• Standards to prevent and clean up pellet spills • Tax (e.g., on virgin plastic material; based on environmental performance of plastic product) • Recycled content mandates	• Campaigns to influence social norms and encourage "no plastic" behavior	• Programs for recycling content standards	
Consumption and Behavior			
Challenge: Littering [3, 7, 8, 9, 12]			
• Anti-littering laws and regulations	• Campaigns to influence social norms and discourage littering	• Host beach cleanups through the use of participatory science (NGOs) • Invest and maintain storm drains (Local municipal officials) • Participate in campaigns to educate consumers on proper disposal methods for its products (Private sector)	• Track marine litter (e.g., through the use of satellites, drones, and/or apps) • Remove marine litter (e.g., through the use of manta trawlers and vessels) • Invest in collection infrastructure
Challenge: High consumption of plastics [2, 3]			
	• Campaigns to influence social norms and encourage "no plastic" behavior	• Partnerships with companies (e.g., to shift from plastic to paper straws)	• Use technology to develop alternatives to plastics
Management of Plastic Waste			
Challenge: Cost of collecting, sorting, processing [2, 13, 14, 16]			
• Strengthen recycling markets (e.g., targets for recycling; standardized waste collection system; subsidize collection and recycling) • Landfill bans* • EPR	• Public education on material contamination • Share best practices	• Link informal sector workers with formal waste collection systems	• Invest in collection infrastructure • Develop alternate technologies that enable recyclers to process poor quality material
Management of Plastic Waste (continued)			
Challenge: Lack of infrastructure [2, 13]			
	• Share best practices • Create demand for recycling, contamination reduction, and littering and dumping reduction	• Invest in developing collection systems • Link informal sector workers with formal waste collection systems	• Develop low-tech plastics reprocessing technology

Regulation and Policy	Behavioral Change and Education	Partnerships	Technology and Infrastructure
Challenge: Poor data [4, 13, 14]			
• Mandatory data reporting mechanisms • Standardized terminology and tools • Set recycling targets	• Collect waste samples to generate evidence-based data	• Develop and share data sources with stakeholders	• Track proper disposal of waste (e.g., through the use of geotags)
Challenge: Limited participation or access to proper disposal methods for community members [15]			
• Establish sanitary landfills	• Campaigns to influence social norms and discourage littering	• Coordinate and educate stakeholders to increase participation	• Increase collection infrastructure
Challenge: Uncontrolled dumping or burning of waste [5, 13]			
• Enforcement to reduce illegal dumping	• Educate the public to reduce contamination and littering • Share best practices	• Enhance solid waste collection	• Strengthen collection systems and infrastructure
Challenge: Contamination of plastics (biodegradable plastics mixing with other plastics, plastics contaminated with other materials) [2, 3, 8, 10, 13, 16, 17]			
• Technical standards and guidelines for plastics recycling (e.g., standardized recycling collection) • Landfill bans* • Mandatory recycling laws • PAYT schemes • EPR • Design and labelling requirements (e.g., mandating labeling for biodegradable plastic)	• Educate the public to reduce contamination and littering • Share best practices	• Link informal sector workers with formal waste collection systems	• Support innovation for sorting, removing, and handling of contaminated plastics • Develop technology to identify biodegradable plastics
Plastics Secondary Material Market Development			
Challenge: Lack of demand for recycled plastics [1, 2, 13, 14]			
• Tax incentives • Recycled content mandates • Public procurement policies for manufacturers • Buyback programs • Deposit return schemes	• Encouragement to use and purchase products containing recycled content	• Private partnerships • Programs on post-consumer recycling content standards/ minimums	

Regulation and Policy	Behavioral Change and Education	Partnerships	Technology and Infrastructure
Challenge: Accessibility to global market [2, 13, 14]			
• Support for development of domestic reprocessing capacity • Stimulation of domestic demand for recycled plastic • Quality standards	• Consumer education to choose products that drive recycling markets	• Development and dissemination of market information for expansion into new recycling markets	• Create a database of information on the reuse of plastics
Challenge: Limited data [2, 6, 13, 14]			
• Mandatory data reporting • Standardized terminology, guidelines, and tools for plastic recycling		• Development and dissemination of market information	
**Although landfill bans can help to bolster recycling markets, there are also potential risks (e.g., risk of open dumping or other improper disposal) if the proper conditions and recycling outlets are not in place. Decision-makers should fully assess the suitability of this approach before implementing it.*			

Resources
1. Adidas (Undated)
2. Akenji et al. (2020)
3. Alpizar et al. (2020)
4. CITAG (2021)
5. Ciudad Saludable (Undated)
6. Ellen MacArthur Foundation (Undated)
7. Garcia et al. (2019)
8. Hahladakis (2020)
9. Hira et al. (2022)
10. Karasik et al. (2022)
11. Marine Debris Tracker (Undated)
12. Minderoo (2022)
13. OECD (2018)
14. OECD (2022a)
15. Omeyer et al. (2022)
16. Pew (2020)
17. Schröder et al. (2020)

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