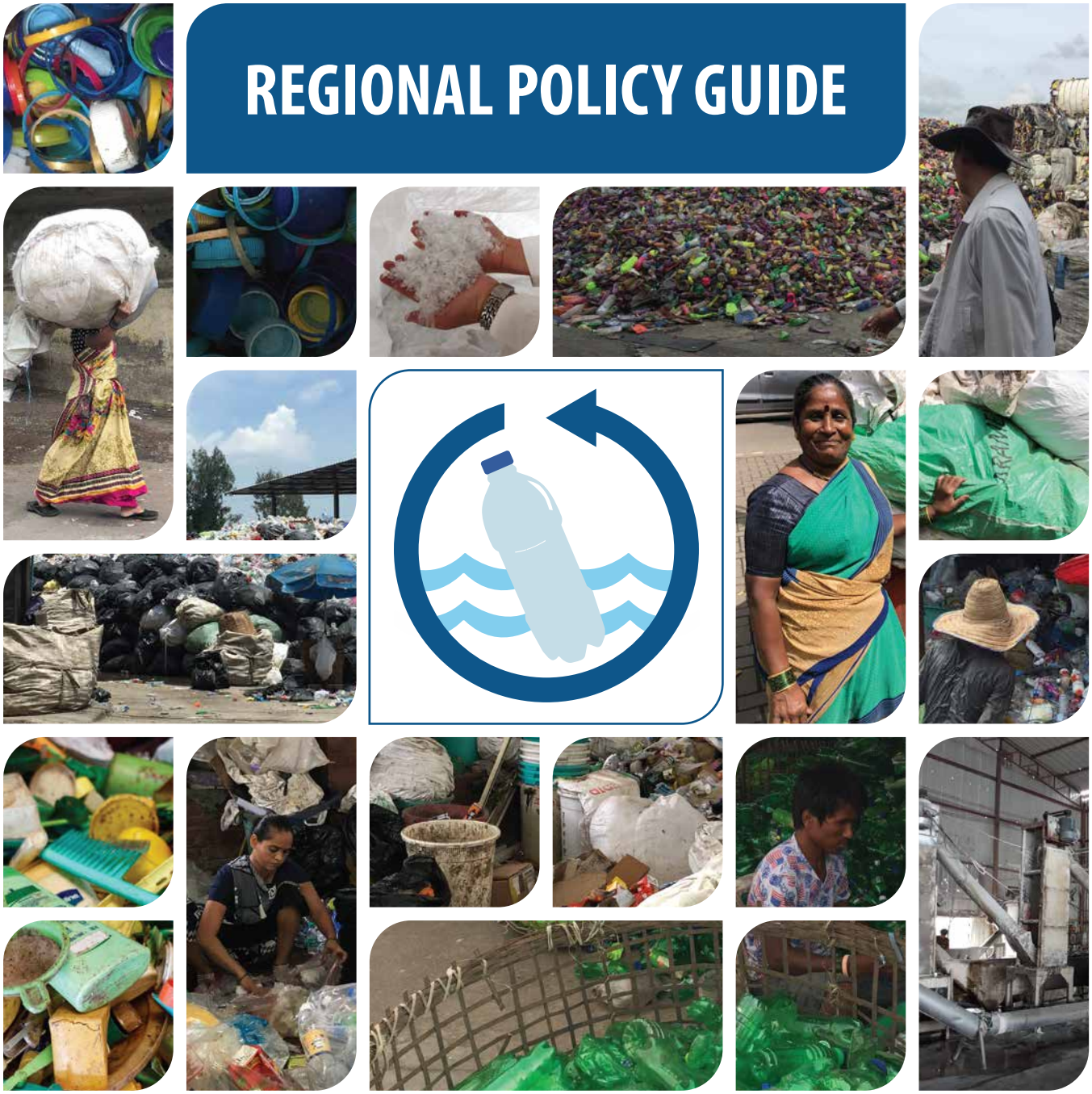
CLOSING THE LOOP

Innovative partnerships with informal workers to recover plastic waste, in an inclusive circular economy approach

REGIONAL POLICY GUIDE



UNITED NATIONS ESCAP
Economic and Social Commission for Asia and the Pacific

Kashtakari Panchayat

SWACH
A higher level of self-reliance

SEI

Acknowledgements

This regional guide is produced under the United Nations Economic and Social Commission for Asia and the Pacific (ESCAP) Closing the Loop initiative, which sought to gather evidence in cities in the Asia-Pacific region that could be used to identify opportunities to return plastic resources into the production cycle by linking informal and formal waste processes.

Lead authors: Diane Archer, Stockholm Environment Institute and Nguyen Trang, Asian Institute of Technology

Contributing authors and editors: Solene Le Doze, Natalie Harms, Omar Siddique and Alexander Vougioukas from ESCAP and Oliver Johnson from the Stockholm Environment Institute

External reviewers: Sonia Maria Dias and Taylor Cass Talbott, from Women in Informal Employment: Globalizing and Organizing

Copy editor: Karen Emmons

Design and layout: Jeff Williams
Infographics: Mallory Bellairs
Photos: Omar Siddique, Natalie Harms and Nguyen Trang

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Contents

Abbreviations

HDPE	high-density polyethylene
KKPKP	Kagad Kach Patra Kashtakari Panchayat trade union
MOU	memorandum of understanding
PET	polyethylene terephthalate
PMC	Pune Municipal Corporation
SWaCH	Solid Waste Collection and Handling cooperative

1. Introduction

This regional guide is an output of the Closing the Loop initiative, which targeted sustainable consumption and waste management in the Asia-Pacific region. The project was a partnership between the United Nations Economic and Social Commission for Asia and the Pacific (ESCAP), the Stockholm Environment Institute, Kagad Kach Patra Kashtakari Panchayat, Women in Informal Employment: Globalizing and Organizing and other stakeholders, including the municipal administrations in the two case study cities, Bangkok and Pune.

Arising from the increasing concern about plastic waste contaminating the natural environment in Asia and the Pacific, this initiative set out to foster a development pathway that integrates the economic, environmental and social dimensions of sustainability with the more efficient management of natural resources and a natural environment that supports human well-being and shared prosperity in Asian and Pacific urban areas. The goal was to identify a more inclusive circular economy approach to waste management. It fostered multi-stakeholder partnerships in workshops and gathered evidence in two cities – Bangkok, Thailand and Pune, India – to develop two case study reports.

This regional guide brings together the city-specific findings as well as experiences from the Asia-Pacific region to highlight associated opportunities for fostering a more inclusive, circular waste management system and the economic, social and environmental benefits.

The guide highlights implemented measures and their impact as well as areas needing further research and development. It focuses on the informal sector in waste management to understand the workforce-based infrastructure and thus find sustainable pathways that can support informal efforts where they are effective or improve conditions for the workers. Sustainable pathways thus include recognition of informal workers to future-proof their livelihoods and addressing plastic waste leakages to protect the environment. The guide explains why we looked only at waste management quite downstream in the circular economy and focus on the informal sector.

This guide will be useful to urban stakeholders wanting to develop an inclusive circular economy approach in their city: municipal administrators, waste management specialists, civil society actors active in the informal waste management sector and private sector waste managers.

2. Plastic waste management and the Sustainable Development Goals

Plastic waste management is one of the Asia-Pacific region's pressing challenges – with consequences for the environment and economies. Plastic waste presents a challenge to closing the loop for a circular economy. Globally, 90.5 per cent of plastics are never recycled.[1] According to the International Solid Waste Association, only 5 per cent of global plastic products consist of recycled content, compared with 58 per cent of paper and 37 per cent of steel products.[2] Ineffective and insufficient waste management practices result in leakages of plastic waste in to the wider environment.

Every year, 8 million tonnes of plastic materials enter our oceans, on top of the estimated 150 million tonnes that circulate in our marine environments.[3] McKinsey & Company and the Ocean Conservancy estimated in 2015 that five Asian countries – China, Indonesia, the Philippines, Thailand and Viet Nam – may account for up to 60 per cent of the plastic waste leaking into the Pacific Ocean, although these figures are being reviewed.[4] Nevertheless, this initial finding spurred the realization and urgency of the need to act on plastic waste in the Asia-Pacific region.

Mismanaged waste has impacts on natural resources, the natural environment, human lives and an economy. Plastic takes an extremely long time to decompose in the natural environment and is often the most visible component in waste dumps and open landfills. Plastic damages the environment, causes loss of coastal and marine biodiversity and has negative impacts on human health because its chemicals affect endocrine systems.

Better solid waste management systems offer the opportunity for not only environmental but also social and economic benefits.

Across Asia and the Pacific, the informal sector is vital for recycling and therefore should be recognized as part of the solution to plastic pollution. In many of the region's countries, waste management systems are underdeveloped, with the informal economy dominating the processes of waste collection and the sorting and recycling of plastic and other waste. Yet, waste pickers and their efforts remain unrecognized formally and are even stigmatized, despite their contribution to diverting plastic waste from landfill and from leaking into the environment.

There is vast untapped potential to scale up informal actors' contribution to effective waste management, to address the challenges they face that might cause waste leakage (such as lack of sorting or storage space for waste materials), to build a system that is more effective and efficient and to improve conditions for informal workers and future-proof their livelihood in a rapidly evolving landscape.

This guide considers how more extensive and effective waste management and better links between informal and formal waste processes can:

- encourage more sustainable consumption practices as well as help return plastic resources to the production cycle (closing the loop in a circular economy);
- reduce plastic waste leakage into the environment and the oceans; and
- help contribute to achievement of the Sustainable Development Goals, including SDG 11 for safe, resilient, inclusive and sustainable cities.

It is important to bear in mind that the local context – for example, waste collection rates and procedures – will differ from country to country and internally within countries as well as between rural and urban areas. Levels of urbanization will affect not only the amount of waste generated per household but also the proportion of plastic waste within that.[5] The type of plastic waste found locally will also differ, depending on whether the country is an importer of end-of-life plastic waste or only deals with locally generated plastic waste. Informal waste pickers may also have access to waste material at different stages in different settings – from the source to the landfill, depending on the formal waste management systems in play. These factors need to be taken into account when devising interventions to address the three objectives.

2.1 Plastic waste – A significant challenge

Urban areas produce more waste than rural areas, and Asian cities are forecasted to generate 1.8 billion tonnes of waste in 2025 (a massive increase from the 0.28 billion tonnes in 2012).[6] Using World Bank country groupings, the East Asia and Pacific region is generating 23 per cent of the world's waste, at an average of 0.56 kg per capita per day.[7] Meanwhile, waste production in South Asia is an average of 0.52 kg per capita daily, but this is expected to double by 2050.[8] Some 53 per cent of waste in East Asia and the Pacific and 57 per cent in South Asia are composed of food and green waste, with dry recyclable material comprising about one third of the waste.[9]

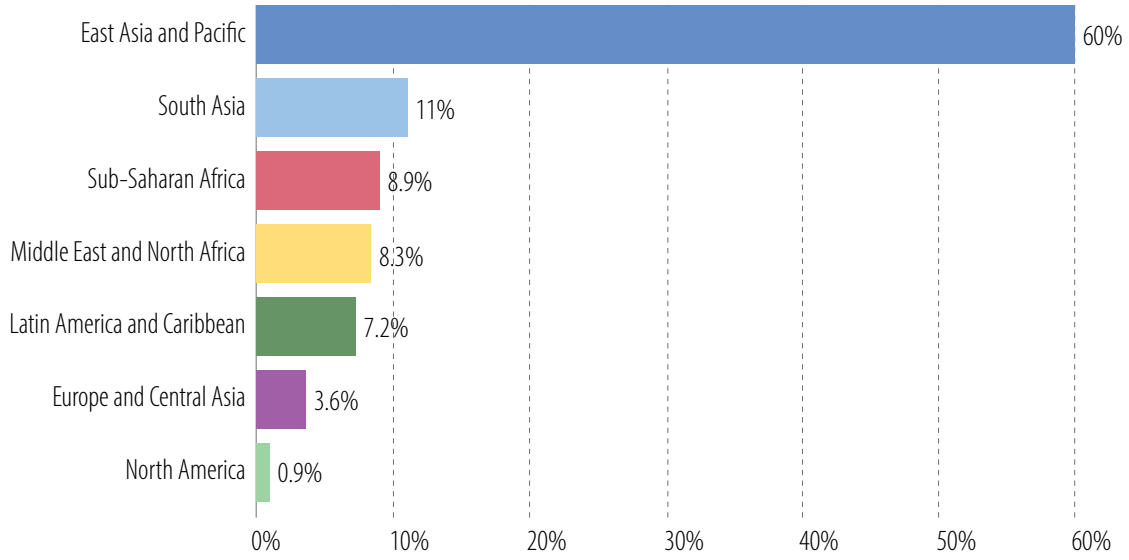
By 2015, the world had produced a cumulative total of 7.8 billion tonnes of plastic. The recycling and incineration of plastic before 1980 was rare. As waste management processes evolved, an estimated 55 per cent of plastic globally was discarded, 25 per cent incinerated and 20 per cent recycled by 2015.[10]

The amount of plastic waste humans generate is rising around the world. In the Asian-Pacific economies, more and more plastic waste will be generated from industry, manufacturing processes and agricultural activities.

Waste collection coverage in urban Asia is about 77 per cent – with significant variation between rural and urban areas and between countries. For example, the Philippines averages around 85 per cent waste collection, compared with 40 per cent in China (although in urban China, this is closer to 65 per cent).[11] Taken together, the Asia-Pacific region accounts for the largest share of mismanaged plastic (see figure 1), with consequences for leakages into the natural environment, including oceans. Plastic waste consistently accounts for 60–80 per cent of the total debris recorded in marine surveys.[12]

Figure 1: Global mismanaged plastic, by World Bank regional classifications, 2010

Share of global mismanaged plastic waste by region in 2010. This is measured as the total mismanaged waste by populations within 50km of the coastline, and therefore defined as high risk of entering the oceans. Mismanaged plastic waste is defined as "plastic that is either littered or inadequately disposed. Inadequately disposed waste is not formally managed and includes disposal in dumps or open, uncontrolled landfills, where it is not fully contained. Mismanaged waste could eventually enter the ocean the ocean via inland waterways, wastewater outflows, and transport by winds or tides."



Source: https://ourworldindata.org/plastic-pollution.

2.2 The Sustainable Development Goals and plastic waste

2.2.1 The ocean and life below water

SDG 14 addresses the conservation and sustainable use of oceans, with target 14.1 specifying the prevention and reduction of marine pollution of all kinds. Approximately 8 million tonnes of plastic leaks out of the global economy and into the oceans each year. Without action, the world's oceans will contain nearly 250 million tonnes of plastic by 2025.[13] Plastics in the marine environment are a conduit for a wide range of toxins, which have now been found in deep ocean channels.[14]

Microplastics have been found in the marine food chain and can have a multiplier effect through bioaccumulation in the food chain. Additionally, the small size of microplastic makes it difficult to remove from the ocean, and therefore interventions should concentrate on reducing the input of plastic waste into the seas.[15] Achieving a reduction in waste-stream leakage will also benefit SDG 6 and SDG 15 by reducing water pollution and protecting ecosystems, both in riverine and marine ecosystems and on land.

The plastic waste most likely to enter the oceans is generated by populations living within 50 km of the coast – and countries with a long coastline are more likely contributors.[16] Rivers are a common source of plastic into the ocean, with Asian rivers contributing 86 per cent of plastic input. An estimated 80 per cent of ocean plastic material derives from land-based sources, with the rest from marine sources.[17] Of the land-based leakages, 75 per cent derive from uncollected waste, and the remainder from leaks within the waste management systems.[18]

Implementing interventions to reduce plastic waste leakage in the top-five ocean-polluting Asian countries could reduce global plastic leakage by up to 45 per cent over the next ten years.[19] Much of the plastic that

leaks into oceans are low-value plastics, such as plastic bags and other plastic wrappers, are less likely to be targeted for recycling by informal waste pickers. Interventions to reduce plastic leakages should bear this in mind.

Figure 2: Plastic waste leakage into oceans

Source: https://jambeck.engr.uga.edu/landplasticinput.

2.2.2 Livelihoods

More than 15 million people globally earn their income informally in the waste sector.[20] A UN-Habitat study found that in low-income countries, informal waste pickers often collect 50–100 per cent of waste, at no cost to a municipality.[21] A single waste picker can collect, sort and transport between 10 kg and 15 kg of waste a day in Delhi, while the pickers with a tri-cycle can collect up to 50 kg a day.[22] A study by the Women in Informal Employment: Globalizing and Organizing (WIEGO) network of informal waste pickers across ten cities, including Pune in India, found that 76 per cent of waste pickers said that formal businesses are the main buyers of recyclable waste – with the informal waste pickers being instrumental to the supply of secondary raw material.[23]

The waste sector presents opportunity to help achieve several of the SDG targets. Waste pickers – often women, children, older persons, unemployed persons and migrants – are a vulnerable demographic. For many informal waste pickers, their health and well-being (SDG 3) is directly affected by their poor working conditions. Many of them work without the necessary protective equipment or knowledge of the potential hazards presented by exposure to different types of waste. A study of waste pickers in five areas of Delhi found that awareness of various occupational and environmental health hazards was low – with more than 50 per cent of them suffering from diseases due to the hazards of the occupation and exacerbated by poverty.[24] Risks range from landslides and trucks at dump sites to exposure to chemicals, medical waste, fumes and chemicals. Collected materials may be stored within the home, further increasing exposure.

Informal waste pickers are often from disadvantaged communities, with low levels of education, and include migrants with few other income-earning possibilities. The work suits many women due to the flexibility it offers, although in many cases, whole families are involved. The WIEGO study found that men consistently earn more than women as waste pickers, with 80 per cent of people sampled in the informal economy monitoring study reporting large variations in income, little profit and too many competitors.[25]

A growing number of examples of membership-based organizations of informal waste pickers and of non-government organizations working with informal waste pickers are demonstrating how to achieve greater efficiency in waste collection with better working conditions and pay and formal recognition for the workers. Waste picking can thus be a route out of poverty (SDG 1). By re-thinking approaches to waste collection and integrating informal services directly into the waste management process, there is scope to address poverty as well as SDG 5 (on gender equality), SDG 8 (on decent work) and SDG 10 (on reduced inequalities).

Figure 3: Contributions of the informal waste recycling sector to achieving the Sustainable Development Goals

Source: Adapted from World Business Council on Sustainable Development, n.d., p.15.

2.2.3 Sustainable consumption and production

SDG 12 highlights the need for reducing waste generation through prevention, reduction, reuse and recycling to limit the release of waste products into the environment. The circular economy concept offers an opportunity to achieve this because it focuses on minimizing resource use and keeping the resources that enter the economy in productive use for as long as possible to maximize value, thus reducing pressure on finite natural resources and enabling environmentally sound end-of-life solutions. This represents a shift away from the linear, extractive model of resource use that has come to dominate global economies.

The circular economy presents a huge economic opportunity, with benefits for preserving natural capital, reducing waste and maximizing the value we get from resources already in use. In the United States, the

Ellen MacArthur Foundation estimates that $80 billion to $120 billion are lost annually to the economy due to the material value of plastic packaging alone.[26] But it could be economically attractive to recycle 50 per cent of plastic packaging and to reuse another 20 per cent.[27]

Sustainable consumption requires producers of goods reduce their use of natural resources and take ownership of the waste they produce, and it requires consumers to demand fewer resource-intensive products while changing their behaviours towards waste reduction and material reuse and recycling.

2.2.4 Sustainable cities

Currently, 50 per cent of Asia's population lives in urban areas, and this proportion is increasing.[28] While urban populations generate more waste per capita, urban areas also have higher coverage of waste collection through municipal waste services, private sector services, informal waste pickers or a combination of them. SDG 11 aims to achieve resilient, safe, inclusive and sustainable cities, and addressing waste management can help achieve this goal.

Mismanaged solid waste is a major cause of localized flooding in many cities due to blocked drains as well as a cause of water contamination and disease. Improving solid waste management can therefore have positive health impacts on urban populations and contribute to urban resilience.

Urban residents who work as informal waste pickers are often marginalized – however, recognizing their significant contribution to the waste management sector by integrating their activities into formal waste management processes can lead to more inclusive cities.

2.3 Towards inclusive plastic waste management

Given the important role that informal workers already have in waste management in many Asian cities, a re-conceptualization of solid waste management systems that integrate waste pickers as partners would facilitate the achievement of just, inclusive and liveable cities, in line with SDG 11. The private recycling sector relies on materials sourced and sorted by informal waste pickers in many cases. Yet, there is still a need to ensure that informal waste workers are adequately recognized, compensated and protected, given their difficult working environments and low social status, despite the contribution they make to public health and the environment. This regional guide offers recommendations for instituting more circular waste management systems, which also offer the opportunity to be more inclusive, thus bringing about environmental, social and economic benefits.

CLOSING THE LOOP

Unlocking an Inclusive Circular Economy Approach for Plastic Waste Management

+5 million people

2000 tonnes of municipal waste daily

Only 8.3% of municipal waste is **PLASTIC** but this is still equivalent to **166 tonnes per day**.

Plastic waste, including microplastics, are pervasive in the organic waste that accounts for almost 3/4 of all waste.

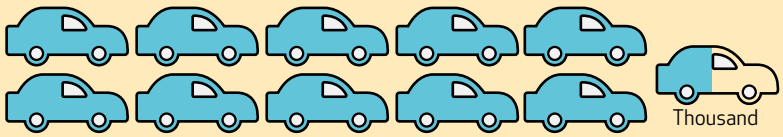
87.5% of Pune's total municipal waste is collected, with **informal workers,** working under contract from the municipality, **gathering over 50%**.

Informal workers remove enough plastic waste from Pune to account for nearly

50,000

TONNES OF ANNUAL CO_2 EMISSIONS

This is the equivalent to CO_2 emissions...



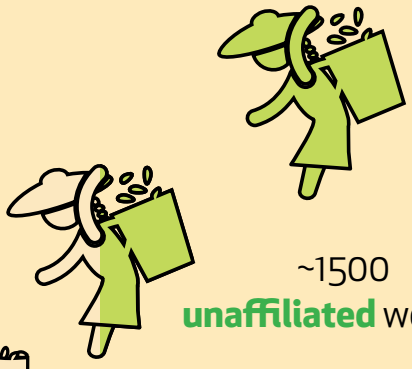
...from **10,423 passenger cars**...

...burning **20,611,991 litres** of petrol.

Some organization amongst the informal workers is already established.

KKPKP trade union has **~7000** members,
including **~3000** who are also members of **SWaCH** co-op

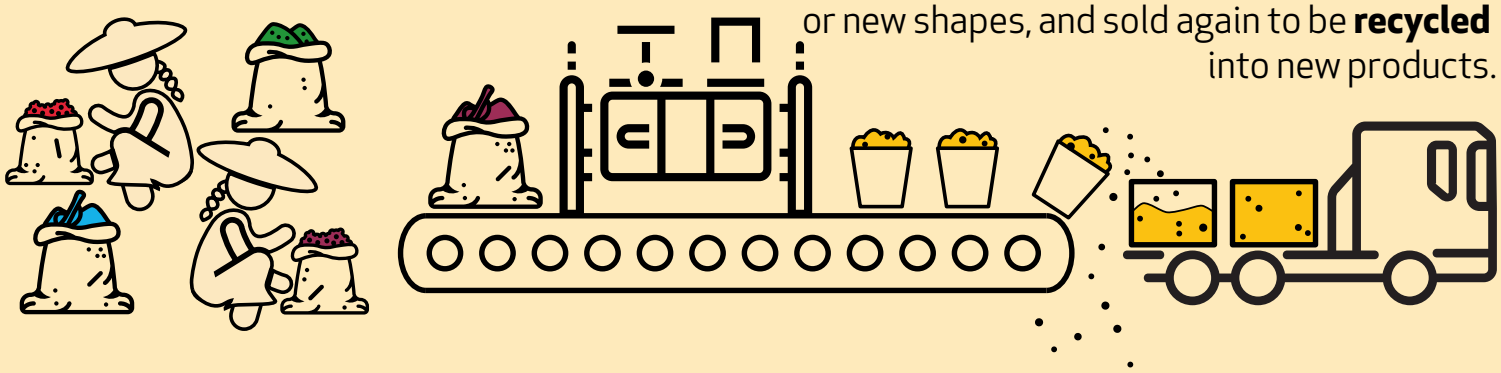
Waste pickers sell their recyclable materials to any one of **600 small and medium scrap shops**.



~1500 **unaffiliated** workers

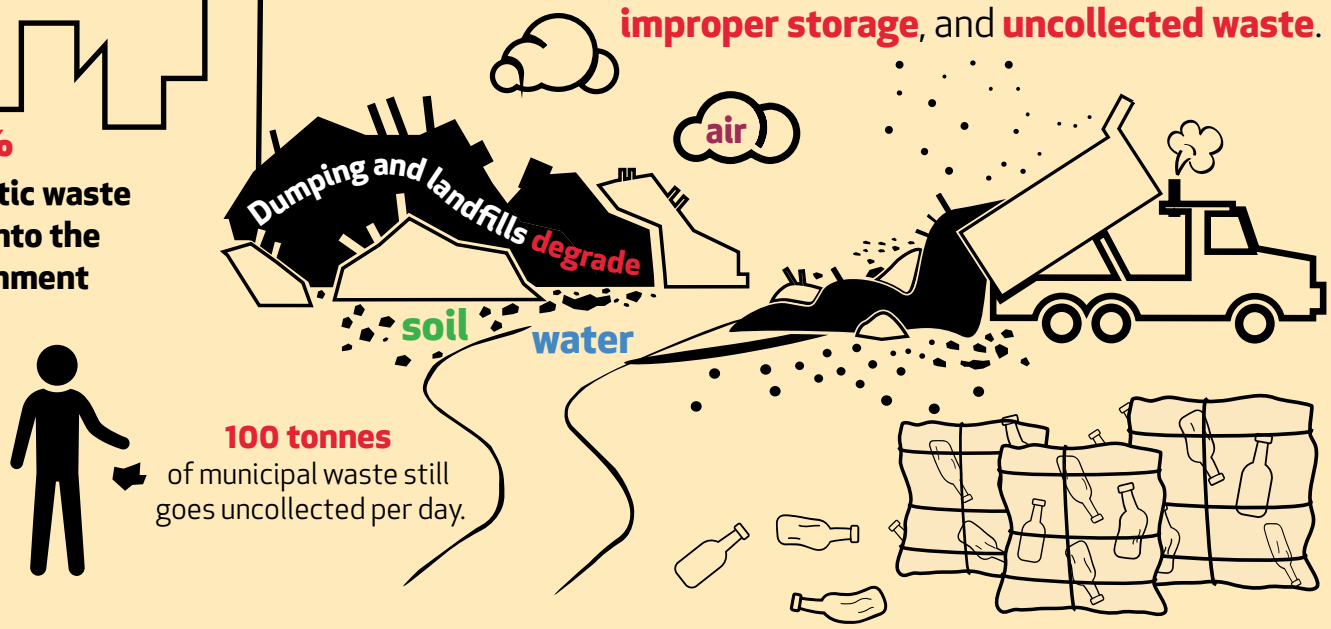
Each type of plastic waste has an individual market value.

The materials are **sorted** further,
sold on to be **processed** into flakes, pellets,
or new shapes, and sold again to be **recycled** into new products.



However, **leakages** in the plastic recycling value chain still exist in multiple forms including **illegal dumping**, **improper storage**, and **uncollected waste**.

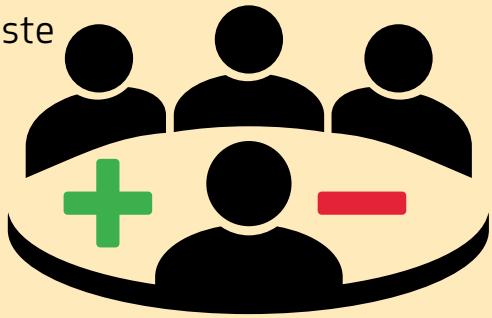
12.5%
of plastic waste leaks into the environment

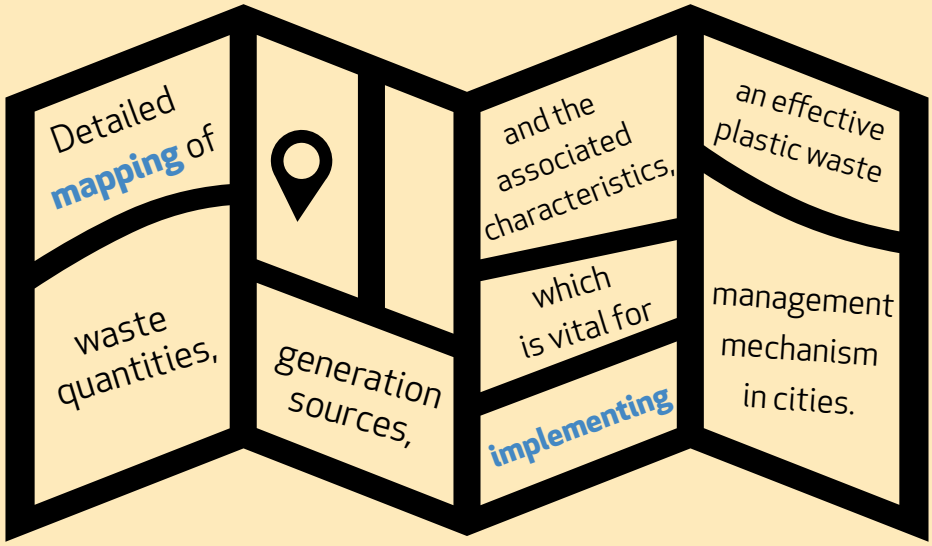


100 tonnes
of municipal waste still goes uncollected per day.

Key actions to address plastic waste leakages into our environment include...

Increasing awareness and **education** about the **benefits** of waste segregation and the **harms** of dumping and littering.





3. Plastic waste management approaches and technologies

3.1 Plastic waste types

Plastics are polymers, which are large molecules composed of smaller units called monomers, joined together in a chain. Polymers are synthesized via a process called polymerization. Polymers generally contain carbon and hydrogen elements and may contain others, such as oxygen, nitrogen, chlorine or fluorine.

The wide variety of polymers is one of the difficulties hampering plastic recycling. In developing countries, the volume and waste management options of commonly used polymer types is not as extensive as in more industrialized countries. Table 1 provides an overview of the six main types of polymers (all thermoplastics) and their respective applications. They are all available in a variety of grades resulting in specific properties. To manufacture plastic products, plastics are moulded or extruded into the desired shapes.

Table 1: Description of the six main types of thermoplastics

Type	Characteristics	Applications
High-density polyethylene (HDPE)	Stiffness, strength, toughness, resistance to moisture, permeability to gas	Piping Automotive fuel tanks Bottles Toys
Low-density polyethylene (LDPE)	Ease of processing, strength, toughness, flexibility, ease of sealing, barrier to moisture	Plastic bags Cling film Flexible containers
Polyethylene terephthalate (PET)	Clarity, strength, toughness, barrier to gas and moisture	Bottles Carpets Food packaging
Polypropylene (PP)	Strength, toughness, resistance to heat, chemicals, grease and oil, versatile, barrier to moisture	Food containers Battery cases Bottle crates Automotive parts Fibres
Polystyrene (PS)	Versatility, clarity, easily formed	Dairy product containers Tape and video cassettes and cases Cups, plates and utensils Protective packaging, food containers and packaging, bottles, desk accessories, canteen trays, toys, clamshell containers
Polyvinyl chloride (PVC)	Versatility, ease of blending, strength, toughness	Window frames Flooring Bottles Packaging film Cable insulation Credit cards Medical products

Source: Authors.

The wide variety of plastic types has implications for the management of plastic waste because different types have different secondary values and therefore need to be sorted according to their category. Where there is money to be made from recyclable plastic is with high-value plastic, such as polyethylene

terephthalate (PET) and high-density polyethylene (HDPE) items. Not all plastic waste is suitable for recycling nor would the recycling always be profitable – for example, certain plastics and thin carrier bags have little value and are therefore are less likely to be collected – with increased likelihood of leakage into the environment. The degree to which plastic waste is collected and recycled depends on many aspects, such as the existence of a market, the price of virgin materials and the potential profit margin, the supply and demand for secondary plastic materials, the level of accessibility and quality of collected plastics, seasonal variations, collection and segregation conditions and the convenience of processing the collected plastic materials.[29] In addition, an impediment to recycling is that often in products different types of plastics are being used together or with other materials, making it hard to separate and recycle. These factors vary across countries and over time.

3.2 Technical solutions to managing plastic waste

3.2.1 Plastic waste recycling methods

Recycling plastic has clear environmental benefits. Recycling contributes to reducing the amount of plastic waste going to landfill or open landfill sites, thus helping to minimize the leaching of chemicals into the environment. Using recycled materials, including plastic, enables energy savings of 20–90 per cent, compared to the energy needed to produce virgin materials.[30] Because plastic is made from crude oil, recycling leads to savings of non-renewable fossil fuel resources. The plastic recycling industry can contribute considerably towards reducing greenhouse gas and other hazardous substance emissions into the atmosphere (such as nitrogen oxide and sulphur dioxide).

It is important to bear in mind, though, that plastic is a particularly challenging material to recycle because it degrades each time it is processed and can generally only be recycled into products of a lower grade. Thus, a plastic bottle can be recycled into clothing fibres, for example, which may then become road filler, at which point it is no longer recyclable.[31] In addition plastic products are often composed of different types of plastic or plastic combined with other materials, from which they are hard to separate and thus harder to recycle.

Mechanical recycling

Mechanical recycling is a way of making new products out of unmodified plastic waste. It refers to the processing of plastic waste into secondary raw material or products without significantly changing the chemical structure of the material. In principle, all types of thermoplastics can be mechanically recycled with little or no quality impairment. However, current conventional mechanical recycling techniques, such as sorting, grinding, washing and extrusion, can recycle only 15–20 per cent of all plastic waste types.[32] Plastic waste generated from domestic uses are mainly turned into textile products, packaging materials, bottles, stationery and similar products.

Waste streams that can easily provide clean plastic of a single type in large quantities are ideal for mechanical recycling and represent a win-win situation from an environmental and economic perspective. Environmental benefits from substituting virgin material generally exceed the environmental burden from collection, sorting, transport and recycling operations, while the costs of such operations can be outweighed by potential revenues from selling recyclable material on the market.

Chemical recycling

Chemical recycling, or feedstock recycling, refers to techniques used to break down plastic polymers into their constituent monomers, which in turn can be used in refineries or petrochemical and chemical production. There are currently several methods of feedstock recycling of plastic waste, such as monomerization, blast furnace feedstock recycling, coke-oven chemical feedstock recycling, gasification and liquefaction process. Feedstock recycling is also a complementary technology that can help divert from landfills certain plastic waste that cannot be sustainably recycled by mechanical processes. Examples

of suitable streams for feedstock recycling include laminated and composite plastics, low-quality mixed plastic streams and contaminated plastics.

3.2.2 Waste to energy

Energy recovery is an alternative for plastic-rich waste that cannot be sustainably recycled, although it remains environmentally contentious. Some plastic material cannot be recycled in an eco-efficient manner because of such factors as (i) the amount, cleanliness and composition of the collected waste streams; (ii) the available technologies for sorting; and (iii) the market-driven requirements for quality and standards for recycled material that may limit the appropriateness of plastic recycling. For these types of plastic, energy recovery can be a resource-efficient option available, at least when compared to landfilling or enforced recycling.

In an ideal world, most plastic waste would be recycled and the remainder would be converted into building materials, fuel, gases or other useful commodities. For example, waste-to-energy technologies currently are widely applied for recycling and treatment of waste in the Philippines, including gasification, pyrolysis, chemical recycling and plastic repurposing. Gasification is a process whereby the partial oxidation of plastic waste produces a type of gas that can be used for electricity generation or fuel and could increase the value of plastic and add an incentive to efficient collection. Treating waste through incineration, that is, burning plastic to generate electricity, is particularly viable in Thailand and Viet Nam; the Philippines bans incineration due to air pollution – gasification is now a popular option there.

Incinerating plastic, however, can be highly problematic. Without adequate financial investment, education and capacity building, there is a risk that the use of incinerators to generate energy in some countries will produce serious human health consequences and environmental damage. Concerns include the high cost of a facility that meets modern emission standards; a lack of transparency and oversight to ensure that standards are met in some countries; and the risk of the lock-in effect reducing the drive for alternative strategies to minimize single-use plastic and promote the philosophy of redesign, reduce, reuse and recycle.

3.2.3 Producing plastic from alternative feedstocks

Plastic can be made from alternative feedstocks to fossil fuels, including such greenhouse gases as carbon dioxide (CO_2) and methane; bio-based sources, such as oils, starch and cellulose; naturally occurring biopolymers; sewage sludge; and food products. Recent technological developments have also proven that it is now possible to utilize organic waste material and PET to produce synthetic bio-based plastics (such as polyhydroxyalkanoates, or PHAs). Most (around 80 per cent) bio-based plastics are manufactured using starch as feedstock. The major sources of this starch are maize, potato and cassava. Other potential sources include arrowroot, barley, some varieties of liana, millet, oats, rice, sago, sorghum, sweet potato, taro and wheat. There are several methods for extracting starches, depending on the source crop.

The Indian start-up EnviGreen has come up with a combination of natural starch and vegetable oils that looks and feels just like plastic but is 100 per cent organic, biodegradable and eco-friendly. The cost of an EnviGreen bag is about 35 per cent higher than that of a plastic bag, however. EnviGreen bags biodegrade naturally in fewer than 180 days; if placed in water at room temperature, they dissolve within a day. The Karnataka State Pollution Control Board has approved EnviGreen bags for commercial use.

Bio-based plastics tend to be more expensive than their fossil-based counterparts, especially given the current low prices of fossil resources. Therefore, their success depends on obtaining additional benefits, such as environmental benefits like reduced carbon footprint, social value or product performance through eco-design. They also create a risk of contaminating segregated waste because it can be hard

to tell bioplastics and plastics apart when waste is being sorted, hence reducing the value of fossil-fuel plastic separated for recycling. Clear labelling of bioplastics and training in identification methods for waste sorters would help reduce contamination.

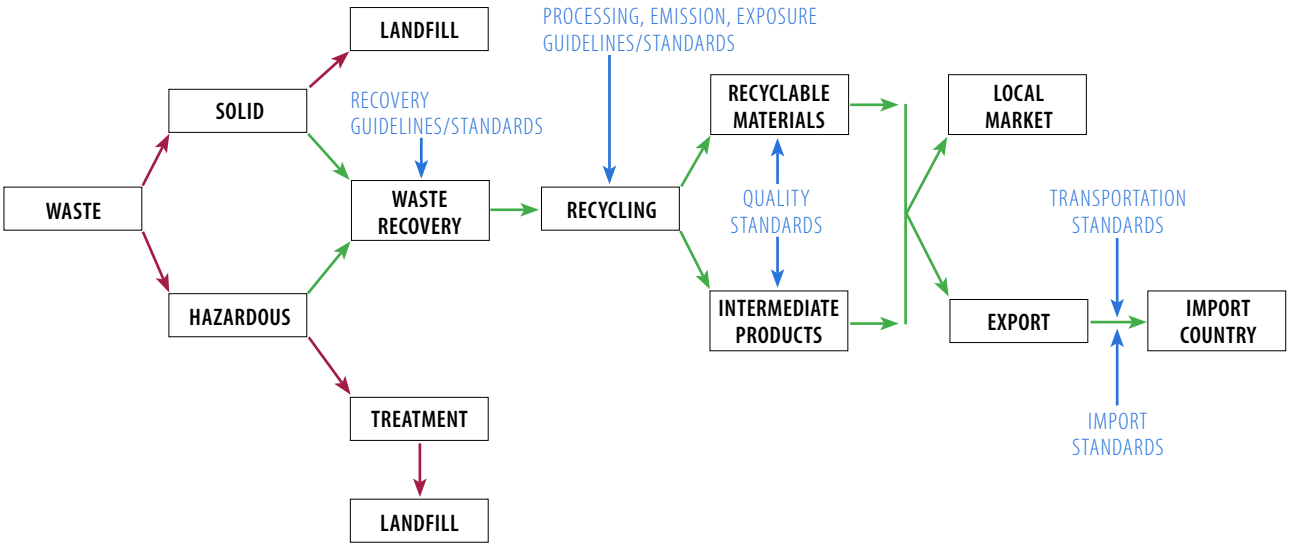
From plastics to new products

The capture and recovery of plastic waste for remanufacturing into new products has been widely demonstrated, for example, for making bricks and composites, in road construction and for furniture as well as for clothes and footwear. Through chemical recycling, the petrochemical components of plastic polymers can be recovered for use in producing new plastic or to produce other chemicals or as an alternative fuel.

3.2.4 Quality standards

The availability of standards for the waste-recycling industry is important to ensure the sustainability of the industry and minimize impacts to the environment and human health. They can be mandatory or voluntary and can deal with different steps of the recycling chain (see figure 4): for example, for material at the waste-recovery stage, for recycling processes, for the secondary raw material and for imports and exports of waste or plastic materials. Standards can also ensure that common definitions of recyclable material and intermediate products are agreed upon and used.

Figure 4: Role of standards in the waste-recycling industry in Malaysia



Source: Kojima, 2010.

3.2.5 Design measures

Eco-design is a common term for measures applied in the design phase of a product to reduce the environmental impact at any point of the product's life cycle, from the extraction of raw materials to the final disposal of the product. Eco-design can promote waste prevention and will often also result in several other environmental benefits being simultaneously achieved. Thus, it contributes to achieving a circular economy approach. Waste management plans often include promotion of eco-design as a waste-prevention initiative, although eco-design projects are, in many cases, initiated by sectors outside of waste management.

An extension of this approach aims to improve product longevity, reusability and waste prevention by incorporating after-use, asset recovery and waste and pollution prevention into its design from the outset. This means adopting a life-cycle approach, including: cleaner production; discouraging single and other avoidable plastic use; designing products for appropriate lifetimes, extended use and for ease of separation, repair, upgrade and recycling; eliminating toxic substances; and preventing the release of microplastics into the environment by redesigning products. Examples include designing clothes and tires to reduce wear and tear and eliminating or using alternatives to microplastics in personal care products, such as facewash, or supplying cleaning products in refillable plastic containers or drinks in reusable beverage bottles and thus eliminating single-use bottles.

As the case study of waste management in Pune[33] revealed, 87 per cent of the plastic waste in the research area was attributable to Indian brand owners (local and national), with only 13 per cent associated with international brand owners. This means that there is ample opportunity for national policies to be implemented to change how domestic companies use limited resources in the packaging and production of goods, with potential to significantly impact the amount of waste generated.

4. Current policies and other measures to close the loop

A circular economy approach requires not only measures to better manage waste to ensure that resources re-enter the economy but also measures to reduce the amount of resources consumed and waste generated in the first place. There are a number of ways these approaches are being applied in the Asia-Pacific region, both through government policies and other targets and through initiatives by private sector actors that can be scaled up. To best ensure achievement of a circular economy and the SDGs, all of these approaches need to bear in mind the potential impact on the informal waste sector and how informal actors can be integrated.

4.1 Bans and other legislation

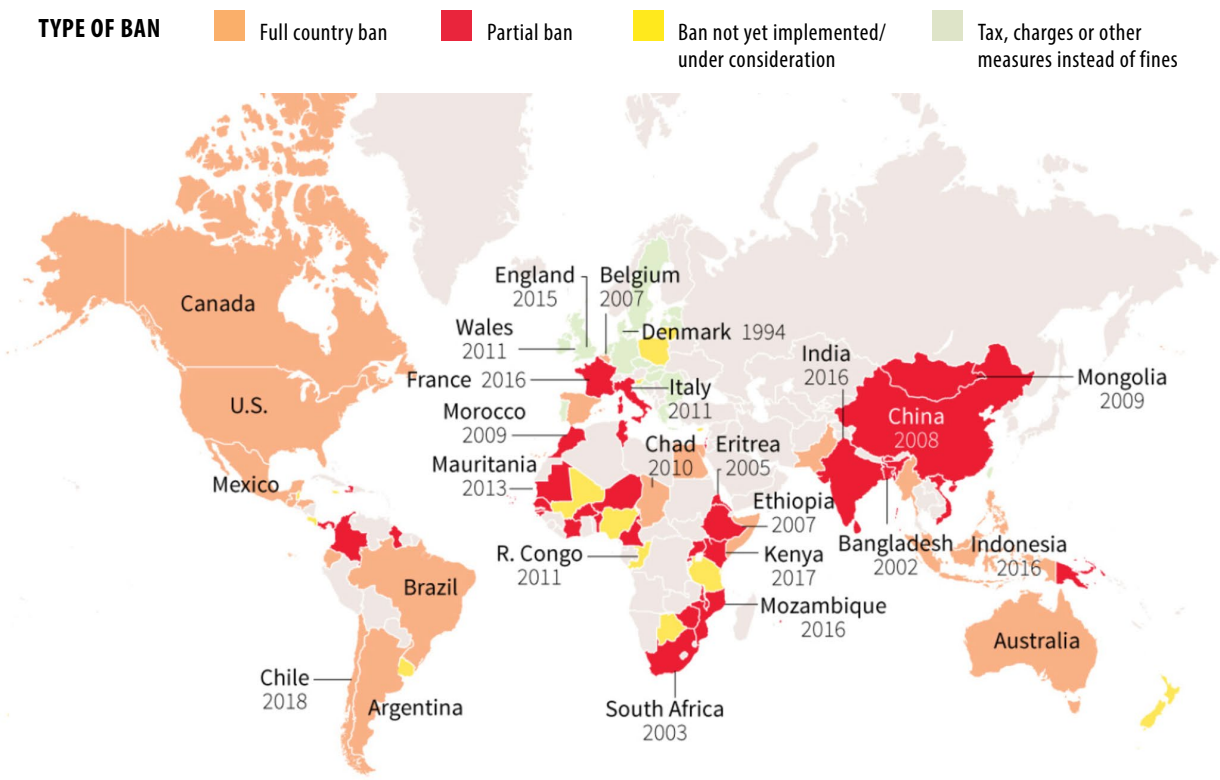
A survey by the Thai Government in 2017 found that, on average, Thais use eight plastic bags a day, equating to around 198 billion bags a year.[34] In Japan, 45 billion plastic bags are handed out yearly, 30 per cent of which are given by convenience stores. Plastic bag bans are increasingly becoming a popular policy measure to control single-use plastic around the world, but enforcement can be challenging (see figure 5). In other contexts, taxes or charges on plastic bags have been implemented as a way to reduce plastic bag use while changing consumer behaviour. Where plastic bag bans are not a policy measure, a growing number of private sector companies are imposing their own restrictions on plastic bag use, having a bag-free day each month, for instance, in line with increasing consumer awareness of plastic pollution. In Japan, whether to charge for plastic bags is left up to retailers to decide, although the Government plans to introduce legislation on this practice.[35]

Bangladesh implemented a full plastic bag ban in 2002, becoming the first country in the world to do so – including the manufacture, import, sale, distribution or commercial use of plastic bags. But due to lack of enforcement and the high cost of jute bags as an alternative, plastic bags were making a comeback by the 2010s. The resulting plastic waste is blocking drains and rivers, contributing to the country's already bad flooding. The Government is now piloting biodegradable bags made of polymex and licencing for businesses to use certain types of plastic bags, at risk of being banned from trading if they are found using the wrong kind.

In comparison, the Indian State of Maharashtra's and Mumbai's plastic bag bans, introduced in June 2018, carried a hefty fine, ranging from 5,000 rupees to 25,000 rupees for repeat offenders and up to three months in jail for persons found distributing or using plastic bags – including consumers. Teams of enforcers patrol markets and shops to fine retailers still supplying plastic bags to customers. This ban is part of India's pledge to be free of single-use plastic by 2022, with most of the country's 29 states already implementing a full or partial ban.[36]

In the Maldives, the Government imposed a tax on the import of plastic bags in 2015, resulting in a drastic decrease in non-biodegradable bag use and a growth in the use of biodegradable alternatives. In all cases, restrictions on plastic bag use should be accompanied by awareness raising to explain the importance of reducing plastic bag use by consumers and retailers. Viable alternatives should be offered – for example, if jute bags are to be used, they should be made available at an affordable price.

Figure 5: Countries with plastic bag bans, as of 2018



Source: http://fingfx.thomsonreuters.com/gfx/rngs/GLOBAL-PLASTIC/010050KC19P/PLASTIC-BAN-01.jpg

There are cases in which the bans need to be complemented by measures to mitigate potential unintended impacts they can have on people who rely on plastic goods for their livelihood. Many plastic bags are produced in small and medium-sized enterprises, which may not have the capacity or resources to switch to producing alternative products, thus leading to job losses. For example, in the weeks after the plastic bag ban in Maharashtra, India, more than 300 plastic bag manufacturers closed down.[37] Time needs to be allowed for small businesses, such as market traders, to source alternative carriers to plastic bags, at a price that will not negatively impact their earnings. The unintended consequences of the Maharashtra ban has led to some backtracking, such as allowing small retailers to use thicker plastic bags.[38]

National targets

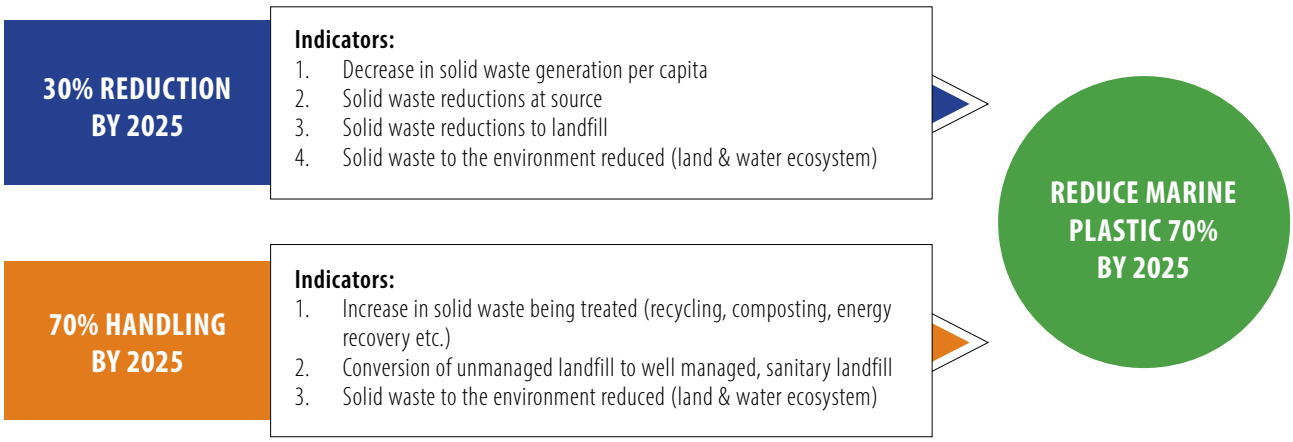
Setting specific quantitative and qualitative national targets of plastic waste management can substantially reduce plastic waste.

In Thailand, to deal with plastic waste pollution internally, the Government has three integrated goals in reducing plastic waste by 2021: (i) reduce the volume of plastic discarded; (ii) design and produce plastic products that are more environmentally friendly; and (iii) reuse 60 per cent of plastic after consumption. The Government will revisit the concept of collecting taxes or introducing fees associated with the use of plastic packaging, such as introducing a plastic bag or packaging tax. The Ministry of Natural Resources and Environment is implementing the National Solid Waste Management Master Plan (2016–2021). The policy includes the 3R measures (reduce, reuse and recycle) to promote the recycling of materials and increasing the waste collection and sanitary landfill rate by the Government. Government agencies are leading the way in cutting waste: the Department of Medical Services in the Ministry of Public Health stopped using plastic bags for storing medicines in every unit as of 1 October 2018. This measure will

reduce the use of plastic bags in hospitals under the Department's auspice by more than 9 million pieces per year. It also demonstrates the contribution that the public sector can make by implementing measures "in house".

Ranked as the second-biggest global polluter for dumping plastic into the sea, the Indonesian Government has pledged to devote $1 billion per year to reduce plastic and other marine waste. Indonesia has a strong commitment to reduce waste by up to 30 per cent by 2025 and targeting the reduction of marine plastic debris by 70 per cent by 2025 (see figure 6), through the 3R approach. The National Plan of Action on Combating Marine Plastic Debris (2017–2025) has five pillars: driving behavioural change, reducing both land-based and sea-based leakage of plastic waste, reducing plastic production and use, and policy reform alongside law enforcement. A critical strategy driving behaviour change among the general population is the deployment of waste banks. These are facilities located across Indonesia where communities can deposit organic and non-organic solid wastes and receive a sum of money for their contribution. There are more than 4,000 waste banks in Indonesia currently, run by a variety of operators, from schools to local communities, who compost the organic waste and sell the collected plastic material to waste dealers, thus increasing the potential to reduce plastic waste and bring about a more circular economy.

Figure 6: Indonesian national solid waste management target



Source: Indonesian Plan of Action on Combating Marine Plastic Debris, 2017–2025.

The success of waste banks can be context specific, however. A successful scheme in the low-income area of Klong Toey in Bangkok traded fresh eggs for rubbish, thus addressing waste management and nutrition concerns. But in India, waste banks have not been successful, largely due to the robust informal recycling sector, which perceives waste banks as diverting high-value recyclable items from the waste actors. Waste banks are generally run by formal entities and may benefit from facilities or subsidies from local government. This highlights the importance of considering the whole value chain when setting up waste management measures – because many schemes, such as waste banks and buy-back PET bottles, have a negative effect on another part of the chain, namely the informal actors. It is thus important to consider how to integrate formal and informal actors to maximize the efficiency and profitability for all waste actors.

4.2 Economic or market-based measures

Economic measures aim to regulate the behaviour of individual consumers or enterprises through economic incentives or disincentives. Economic instruments can include financial measures, such as subsidies and taxes, or measures to influence the market, such as by restricting the tradable quantity allowed on the market.

Following the Chinese Government's restriction on plastic imports, Japan's Ministry of Environment is drawing up plans to increase recycling of disposable plastic items, with one proposal for subsidizing waste management companies to help fund the construction of state-of-the-art recycling facilities. Japanese waste management firms do not have the specialist equipment to recycle these plastic items and, as many lack the space to store this waste, they no longer accept waste shipments. The Government plans to build the capacity of recycling facilities in Japan and will cover half the cost of introducing equipment to recycle plastic. The budget for the initiative for the 2018 financial year is 1.5 billion yen ($13.5 million).[39] The Ministry's proposals also call for setting a goal of reducing the volume of disposable plastic products, including drinking straws, plastic bottles and shopping bags, by 25 per cent by 2030.[40] The proposals seek to increase the percentage of plastic packaging products recycled to 60 per cent by 2030 and use all forms of plastic waste, including the heat emitted when it is burned, effectively by 2035.[41]

Deposit schemes can lead to a large increase in plastic waste collection, especially high-quality materials, as demonstrated in European countries. This is being considered in Asia. For example, in Beijing, the city has installed special ticket-vending machines at subway stations that access used plastic bottles as payment. Once entered into the recycling machine, the bottles are scanned so that their value is calculated, depending on the quality and number of items. In return, the machine issues a public transportation credit or extra mobile phone minutes. Most machines are located in high-traffic or tourist areas. Similarly, in Surabaya, an Indonesia city, buses accept plastic bottles instead of cash, providing two hours of free travel that not only reduces waste but also promotes public transportation. Such schemes can help address different environmental concerns in one step – although the impact on individuals who rely on collecting recyclable items for their income should be considered and integrated into the schemes.

4.3 Private sector initiatives

Proactive practices by the consumer goods industry through recycling, for example, could reduce the cost of marine littering by an estimated 30 per cent, particularly through action by the food and soft drinks sectors.[42] Many private sector companies are implementing measures to recycle the waste generated through the consumption of their products. For example, HP introduced recycling of its printer toner cartridges in 2000, which has since led to more than 197 million HP LaserJet and Inkjet printer cartridges being returned to the company for recycling worldwide.[43] In 2005, HP began recovering PET from its used cartridges to produce new cartridges, and now, more than 80 per cent of HP ink cartridges contain 45-70 per cent recycled content, and all of HP's toner cartridges contain 10-33 per cent recycled content.

Private sector companies are also joining global initiatives to reduce plastic waste. In May 2016, the Ellen MacArthur Foundation launched the New Plastics Economy Initiative – an ambitious global programme, with more than $10 million in funding and involving 40 stakeholders across the value chain, including a broad group of leading companies, cities, philanthropists, governments, academics, students, NGOs and citizens. The initiative aims to bring about a shift to a new plastics economy, particularly with plastic packaging. It provides a new way of thinking about plastic as an effective global material flow, aligned with the principles of the circular economy.

The initiative looks to: create an after-use plastic economy; reduce the leakage of plastic into natural systems and other negative externalities; and decouple plastic from fossil fuel feedstocks, thereby reducing natural resource use. It highlights the economic benefits of reusing up to 20 per cent of the packaging as well as recommending the recycling of 50 per cent of items. It seeks to capitalize on the fact that it could become economically attractive to reuse 20 per cent of the packaging, while 50 per cent could be recycled. However, the remaining 30 per cent, including small format and nutrient-contaminated packaging, would require a fundamental redesign and innovation in the sector for recycling to be economically feasible. Recycling largely remains economically costly for most private-sector companies, and hence there is a need for the feasibility and benefits to be demonstrated.

There remains scope for governments to incentivize such initiatives on a larger scale, whether through tax incentives or other measures, and consumers should demand this of producers. Producers could also be forced to act through extended producer responsibility approaches to improve environment-friendly product designs and support plastic recycling and reduction. In certain instances, government regulations may need to be relaxed or changed to encourage the use of "second-life" plastic material. For example, in Thailand, it is currently not possible to use recycled plastic packaging for food items, which thus restricts the market for recycled plastic.

Governments can enter into voluntary agreements with private sector actors. The Thai Pollution Control Department, for instance, made agreements with five major water bottlers to cease using plastic cap seals on their bottles as of 1 April 2018. A cap seal is the small plastic wrap moulded over the bottle cap that must be peeled off before the bottle can be opened. Studies had found that bottles without them pose no hygienic health risk. Thailand produces 4.4 billion plastic drinking water bottles per year, 60 per cent of which have cap seals – the weight of which alone amounts to 520 tonnes of plastic per year. This very targeted initiative can have tremendous impact, particularly because cap seals are low-value waste that can easily leak out of the waste management system.

Producers should also be encouraged to support the upgrading of the informal scrap and recycling trade as part of their extended producer responsibility obligations. However, this and other producer responsibility models that are often successful in high-income countries would need to be adjusted to the situation of Asian and Pacific cities to ensure that informal workers are integrated and not just replaced by conventional technologies or approaches or even cut out. For example, extended producer responsibility should focus on low- or no-value plastic materials because such obligation on high-value materials (such as PET bottles) can undermine waste pickers' livelihoods and won't necessarily increase diversion rates.

4.4 Engaging and educating the general population

Effective waste management towards achieving a circular economy requires that the general population be educated about the necessity of reducing waste generation and proper waste disposal and sorting to minimize leakages and increase recycling rates. There is also a need for changing public perceptions of informal waste pickers as essential contributors to the waste management sector. A large part of more effective waste management lies in awareness of the level of households and individuals of what actions they can take to reduce plastic waste and facilitate recycling. This entails a change in consumer behaviours, which can take time and concentrated efforts through awareness-raising campaigns and incentives. If recycling is difficult, or brings no visible, immediate benefit to an individual, it will be more challenging to implement.

Measures that can be taken by governments and the private sector to encourage a reduction in plastic waste and improve recycling include:

- Rewarding consumers for environment-friendly actions, such as by giving "loyalty points" to those who use their own shopping bags.
- Facilitating separation of waste at source, for example, by providing households with separate bins or bags for different types of waste or ensuring that bottle banks or similar collective waste bins are easily accessible, and clearly labelling products so that consumers know which bin they should go into.
- Households could also be charged for waste collection by weight or volume to encourage recycling and minimize landfill waste.
- Schemes such as waste banks can reward consumers for recycling. In low-income areas, waste can be exchanged for essential food items or for stationery products in schools, for example.

- Requiring larger producers of waste, such as schools or hotels, to comply with waste separation measures, and providing easy and quick entry points to help increase the amount of recycling that occurs. For example, in the Bangkok Metropolitan Administration, 400 schools are already obliged to segregate their waste.

It is widely recognized that engaging young people is a vital part of raising awareness of environmental issues to change behavioural practices. If children learn of the damage caused by plastic as part of the school curriculum and how to help reduce plastic waste production and leakage, they can help spread the message in their families. Curricula should be modified to ensure that lessons about waste management are provided in such subjects as biology, chemistry and technology. Good waste management can also be implemented in practice in school canteens and other facilities. Large institutions, such as schools and universities, can be good testing ground for zero-plastic campaigns to reduce the use of single-use plastic – for example, by requiring students to use their own cups and by segregating all the waste that is produced.

4.5 Data for monitoring waste management

Effective and inclusive plastic waste management requires comprehensive data to determine the quantities of plastic entering the economy, the amounts that are recycled, reused or end up in landfill and then to calculate the leakages in the sector and how they can be addressed. With this information at hand, it will be possible to pinpoint the specific actions that need to be taken to ensure that plastic waste is reduced. This data collection thus needs to be across levels (national to household), across sectors (from producers to consumers, including recyclers and waste managers) and across systems (government, private sector and informal).

Government actors may be seen as the primary source of data, but this can be challenging, given the multiplicity of actors in the sector and limitations in data collection. If waste services are managed by the municipality, they may collect data on quantities of waste collected or sent to landfill for the purposes of managing their services. However, if waste management is outsourced to the private sector, there may be limitations on what data are collected, if there are no requirements for such data imposed by government regulators, for example. Similarly, scrap dealers may not systematically keep data on how much they collect and what type. Where the informal sector is involved, they may have challenges in collecting and storing data, and if the informal waste pickers are not organized, data may not be available in any centralized form. Finally, given the multiplicity of plastic manufacturers, it can be very challenging to keep a record of the amount and types of plastic being introduced into an economy.

Data from manufacturers of plastic products should include not only the quantities of plastic produced and introduced into the market but the types of thermoplastics contained within them, including the combinations or layers of them. Importers and exporters of plastic goods should be included in inventories to obtain an accurate picture of the plastic flows within the national economy. In the absence of such data being collected by the manufacturers, retailers and import or export traders could help fill the gaps, although the onus should be placed on manufacturers to collect and collate this information.

Data can help to increase awareness of the need for, and benefits of, a shift from non-essential plastic use and a throw-away culture to encourage recycling and to increase the value of plastic products. Data on recycling could start with an inventory of landfill and recycling facilities available, what materials they recycle (in what quantity) and what outputs they produce. Again, this data may be challenging to obtain, depending on the extent to which the sector is regulated or whether recycling operators belong to any sort of trade association that may gather such data. Information on inputs and outputs and any waste residue would be essential to understanding leakages from the plastic sectors and thus to tailor policies and campaigns accordingly, including around the market for recycled products.

CLOSING THE LOOP

unlocking an inclusive circular economy approach

Sai Mai District Bangkok

Average amount of recyclable plastic waste collected daily

2.6 tons

Municipal garbage collection crews

2 tons

Informal waste pickers

The formal and informal sectors make similar contributions to recycling efforts in Sai Mai

Recovering plastic waste prevented

21,681 TONS OF CO_2

equivalent emissions per year from avoided fossil fuels

INFORMAL WASTE SECTOR

Plastic waste is gathered from communities, institutions, and businesses

Differences in sale value determine materials collected

INTERMEDIARY

Plastic waste is sorted by type and color and amassed at transfer centers

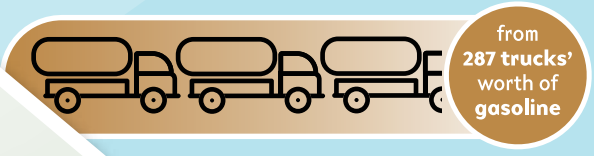
The plastic waste buyers demand certain kinds of plastic more than others

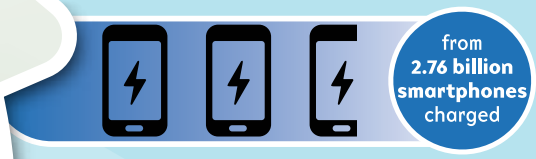
PRODUCTION SUPPLY CHAIN

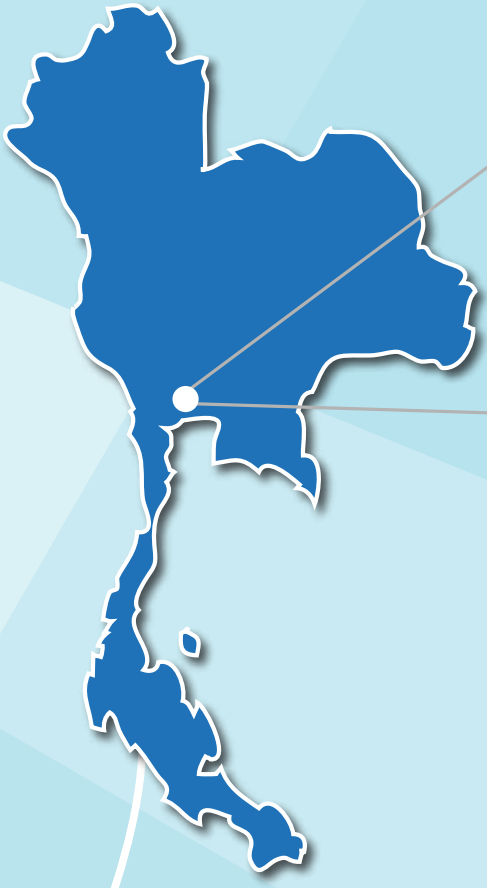
Recyclable plastics are broken down, cleaned wtih additives, and packaged

Plastic pellets and flakes are sold to manufacturers to be produced into new goods

AVOIDED EMISSIONS ARE EQUIVALENT TO THE ANNUAL CO_2 EMISSIONS...







10,130 TONS PER DAY
TOTAL MUNICIPAL WASTE COLLECTED IN BANGKOK

AN ADDITIONAL 1404 TONS GOES UNCOLLECTED DAILY

SAI MAI DISTRICT
1 OF 3 WASTE DISPOSAL STATIONS IN BANGKOK

THERE ARE AN ESTIMATED 250 SALENGS (INTERANT WASTE PICKERS) AND 100 STREET WASTE PICKERS

This is the only point in the value chain where mechanical technology is utilized

Pellets and flakes sell for **26-27 TBH/kg**

CHALLENGES AND ACTION POINTS

Lack of recognition

- Officially register informal waste workers, provide ID cards
- Provide health and safety equipment and welfare services to informal workers
- Leverage social media to promote positive public narratives

Limited separation at source and illegal dumping

- Household level education on waste separation before entering waste stream
- Provide environmentally friendly, safe sorting spaces
- Educate informal workers on impacts of illegal dumping

Lack of technical capacities and financial incentives

- Encourage workers to organize e.g. into cooperatives
- Expand innovation and experimentation with waste management technologies

5. Inclusive approaches to managing plastic waste

Despite the ongoing initiatives outlined in the previous chapter, it is clear that in Asia-Pacific cities, closing the loop in the circular economy requires the integration of informal waste actors into the formal waste management system. It is also important to recognize that in many Asian contexts, the infrastructure for waste management relies on human labour rather than high-tech solutions or hard infrastructure for sorting and recycling, as is now the case in most high-income countries. It is thus important to acknowledge and continue to research and develop ways of working effectively with the workforce behind waste management as well as increasing recognition of their contribution among the general population.

5.1 Plastic value chains, from consumer to disposal

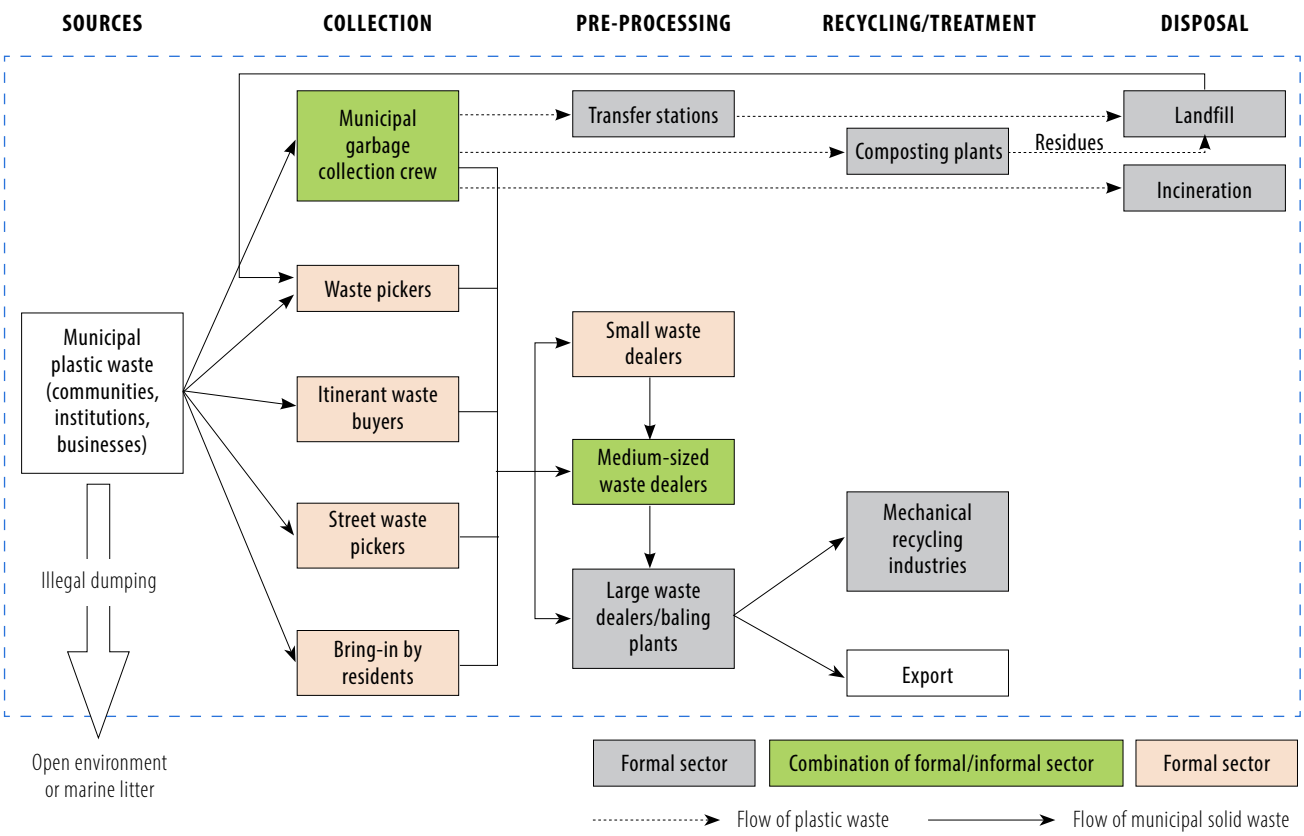
5.1.1 Local recycling actors

There are several actors, both formal and informal, private and public, involved in plastic waste collection for recycling in Asian and Pacific cities (see, for example, the case of Bangkok in figure 7). In cities where waste collection is not a formal service provided by the municipality or the service does not reach all parts of the city, the informal sector is the waste collector, often alongside private sector operators. In contexts in which household separation of waste is not the norm, waste separation is a task usually carried out by informal sector workers. Thus, in many Asian and Pacific countries, there is a variety of informal waste actors who earn income from collecting and sorting waste, including sorting plastic and other recyclable material. These informal actors are often not formally recognized or integrated into the formal waste management processes. Partnership are beginning to emerge, as in the case of Pune, where 3,000 waste pickers have been integrated into the city's door-to-door collection process and who segregate the waste. This practice remains relatively rare, and informal waste pickers usually still operate on the margins of society.

The individuals who have the most precarious livelihood are those who sort through waste directly on the street or in landfills. They collect all types of plastic waste that are available in the waste stream for resale to waste dealers, but they mostly focus on collecting the highest value of plastic waste, such as PET and HDPE bottles. They separate the different types of plastic waste because they fetch different prices. Low-value items, like most carrier bags, are ignored and therefore end up in landfills or risk leaking into the environment.

Another informal group are itinerant waste buyers who carry out door-to-door collection in a city. In Bangkok, they drive a four-wheel cart; in New Delhi, they use a tricycle. They buy plastic, paper and other waste from households, markets and local shops, which they then sell to waste dealers. As with other informal sector waste workers, a lack of storage space, combined with their precarious livelihood, means that they have to sell the materials they collect on a day-to-day basis and thus cannot wait for advantageous price fluctuations.

Figure 7: Actors involved in plastic waste management in Bangkok



Source: Authors, adapted from The Bangkok Post, 2012 and Sukholthaman and Shirahada, 2015.

Municipal garbage collection crews are also involved in the collection of waste. In the case of Bangkok, they are formal workers employed by local government, but they can also be considered informal actors because their waste separation activities for recycling are informal. The municipal workers carry out a rough sorting of plastic or other recyclable waste when they collect waste from households and commercial locations. The separated materials are sold to waste dealers and the income earned is shared equally among the workers. Although this sorting is not part of their formal work, it provides an additional income stream.

Waste dealer or junk shops can be both formal and informal and act as the middleman between those who collect the waste from waste producers and the recycling factories. Waste dealers usually operate from a storage yard and own vehicles for transporting the sorted waste and may hire informal workers to sort and separate waste on their premises. They will have contacts with informal waste pickers to supply them with waste material and with the recycling plants, which are the final actors in the chain, transforming plastic waste into new products, such as pellets.

There remains a lack of data about the role of the informal sector in waste management. Brazil is the only country that systematically collects this data. Gathering this information could be vital to improve the waste management system of many cities and countries and securing recognition of the contribution of waste pickers, which in most countries, is not formally recognized. Governments can also carry out a social assessment to understand the impact of waste management systems on multiple stakeholders.[44] In doing so, several aspects of the waste management system can be assessed, including service quality, willingness to pay, risks arising from working conditions, gender issues and informal labour, and this information can be used to improve the waste management system. Governments and non-profit groups can also support waste pickers in forming cooperatives that provide a strong bargaining position with

stakeholders. Alternatively, a registration scheme for informal sector waste pickers and scrap dealers could be the basis for more regular data collection on types and volume of waste collected as well as the numbers of people involved.

5.2 Impacts of informal waste management

While the activities of informal waste workers often operate beyond the official channels and may be unlicensed, their contribution to the economy should be given due recognition. In Pune, the Solid Waste Collection and Handling Cooperative (SWaCH) of informal waste pickers is collecting approximately 52.5 per cent of the municipal solid waste (1,050 tonnes per day) in the city through its network that services 640,000 properties.[45] Without their entrepreneurship, valuable plastic goods would end up in landfill or leaking into the environment, with consequent negative impacts. The activities of the informal workers contribute to savings in terms of the use of raw materials and energy and to capital growth and investment in the recycling industry while reducing costs for solid waste management, which are borne by municipalities and households.

Informal workers can save municipalities a considerable amount of money by contributing to city waste management – they reduce the volume of waste that needs to be collected and disposed of in landfill. Beyond this, there are considerable labour cost savings for the services provided by informal workers as well as avoided costs of cleaning the environment had that plastic waste not been collected and recycled. For example, in Pune, SWaCH saves the municipality an estimated 740 million rupees ($10 million) each year in labour costs, at statutory wage rates, and 160 million rupees ($2 million) in reduced waste transportation and processing costs (3,000 rupees, or $37 per tonne waste treated).[46]

In Lima (Peru), Cairo (Egypt) and Quezon City (Philippines), Scheinberg and others estimated that informal waste pickers contributed to annual avoided waste collection and disposal costs of around $15.9 million, $13.7 million and $3.9 million, respectively.[47] Conservative estimates indicate that the informal collection, processing and recycling of plastic waste in Sai Mai District enables the Bangkok Metropolitan Administration to avoid an estimated 10 million baht ($316,000) per year in waste management costs. Across Bangkok's 50 districts, this could amount to 500 million baht ($15.8 million) per year, which is greater than the average of 437 million baht per year spent for waste collection between 2011 and 2013.[48]

The work of the informal sector in segregating and sorting waste also has a beneficial environmental impact because it avoids micro-plastic contamination of organic waste and leakages of plastic waste into the natural environment. It also contributes to a cleaner living environment. The waste pickers collection model is also non-energy intensive (in many contexts, primary collection and segregation of plastic waste involves little motorized transport beyond motorbikes) and has a small carbon footprint, compared with the formal and conventional technological approaches, such as mechanized and centralized waste collection schemes. In Pune, the contribution to annual greenhouse gas emissions reduction from plastic waste diversion and recycling is an estimated 50,000 tonnes of CO_2 equivalent.[49]

5.3 The informal sector still lacks recognition

In most countries of the Asia-Pacific region, the informal sector significantly expands the reach of solid waste management, supplementing the formal activities of municipal and private sector waste actors. However, in many contexts, these informal sector actors are not formally recognized for their work or are merely tolerated, with consequences both for the efficiency of the waste management process and for the workers, such as a lack of proper training and protective equipment. They may sometimes be viewed as working illegally and therefore persecuted. For example, in Thailand, the 1992 Public Health Act states that unlicensed collecting, transporting or disposal of solid waste is illegal, thus putting all informal waste workers in a precarious legal position. By giving formal recognition to the role of the informal waste sector, there is opportunity to achieve efficiencies in waste management with the integration of informal activities into formal waste management as well as better work and living conditions for the informal workers.

Networks, such as WIEGO, operate in urban areas to support informal sector workers to organize and achieve better working conditions, formal recognition and thus protection of their labour rights. The WIEGO Informal Economy Monitoring Study of Waste Pickers in five cities in Asia, Africa and Latin America found that for 65 per cent of those surveyed, waste picking was their main source of household income, with many waste pickers selling to buyers who work as resellers at a profit.[50] In these situations, waste pickers face barriers in negotiating better prices and may be exploited by buyers, who know that the waste pickers lack storage space and therefore need to sell their goods daily. In many cities, the waste pickers provide a service to the city at no cost to the municipality and are essentially subsidizing the solid waste management system.

The majority of workers in the informal recycling sector throughout the world are still not organized. There are increasing examples of waste picker membership organizations and cooperatives working to secure recognition for their members' work in their cities – including by contributing to the development of policies that integrate waste pickers into city-level waste management systems and recycling and enabling waste pickers to bid on contracts with the municipality. The Global Alliance of Waste Pickers[51] represents waste pickers on a global scale in such forums as the United Nations climate change negotiations and with the International Labour Organization. Where waste pickers are not recognized, policies and regulations can make life harder for them by, among other things, blocking off access to the waste that supports their livelihood.

5.3.1 Fostering informal–formal links

Local municipalities can be vital for ensuring formal recognition of waste pickers and for providing social benefits to them, such as through legal identification, housing, health care and education. A registration system for informal waste pickers, such as through an ID card (rather than a licensing system), can help municipalities keep track of who is active in the sector and therefore target them with the necessary support, such as provision of occupational safety gear. For example, in Quezon City, Philippines, the approximately 3,000 waste pickers working at the Payatas landfill site are provided with a formal identification document, and child labour is banned.[52]

Municipalities can help to highlight, among the general public, the contribution of informal workers to ensure that they are respected and supported in their work. Providing tangible figures, such as cost-benefit analysis of the avoided labour costs of having to clean up waste that had otherwise been mismanaged and leaked into the environment, can further demonstrate the added value of the informal sector in waste management. The saved costs could be re-invested in schemes to support informal workers, such as social protection.

In many cases, municipality officials need training and education on how the informal sector can be integrated into their waste management services. Capacity-building activities can help city waste managers see the value of an integrated approach with the informal sector and help them to think beyond the conventional approaches. Exchange visits to cities where this has been achieved can help demonstrate the value of implementing waste management in partnership with the informal sector.

On the side of the informal waste pickers, donor agencies, NGOs and civil society organizations should invest in helping informal waste pickers to organize themselves in order to improve their bargaining position. Where there are already waste pickers organizations, the professionalization of services that they provide can strengthen their position and keep them competitive. It may be of value for them to seek experts who have technical expertise to train them in the latest techniques as well as to highlight the importance of minimizing leakages of waste into the environment.

A challenge for integrating the work of informal waste pickers into the wider formal waste management system is to ensure that their role is future-proofed, for example, if new legislation on waste management is adopted or new service providers enter the sector. If informal workers are organized, they will be in

a better position to negotiate to have their rights recognized and to be engaged collectively as service providers on a larger scale, such as they have done in Pune, India. NGOs and civil society groups with long-term experience of working with these informal workers will be in a good position to support them through this process to ensure that they are fully recognized and consulted on any proposed changes to waste management processes.

Women are often important actors in the informal waste management sector because they carry out the role independently and as a side job to supplement their income. There is need for greater evidence of the particular challenges that women experience when working as informal waste pickers and the knock-on effects this may have on other members of their households. For example, certain women will have no alternative but to take their children with them when they go waste picking, thus exposing their children to contaminants as well as taking them out of school. Because many informal waste pickers store and sort the materials they collect in their home, this can also harm the environment in which children are living. Disaggregated data on the sex and age of informal waste pickers could also form the basis for targeted social support, such as education facilities for children of waste pickers.

6. Regional cooperation towards tackling plastic waste

6.1 Regional governance

While national agendas are slowly evolving to address the problem of plastic waste, much more effort needs to be directed towards regional cooperation and coordination of the sustainable management of plastic waste in our region. Recently, we have seen first-hand the impact of national policies that have transboundary or regional implications. China, which has imported almost half of the planet's plastic waste since 1988, recently banned such importation. This policy will displace an estimated 111 million tonnes of plastic waste by 2030,[53] forcing other countries to reconsider how they dispose of the material, with consequent impacts on the global waste supply chain. This creates opportunities to apply innovations for reductions in plastic consumption and improving recycling methods.

Regional cooperation is critical to implementing environment and development policies because neither the environment nor markets are confined to physical borders or boundaries. Countries in the region are closely linked in terms of transboundary resources. Therefore, improper waste management in one country has impacts on other countries, for example, through pollution of oceans and waterways, such as the Mekong River. Countries in the region can learn from each other's policy measures and thus reduce duplication and learn from failures. This can help to strengthen trade flows and build environmental awareness and shared cultural norms around waste management. Collective regulatory, capacity-building and integrative approaches to waste management can help to resolve transboundary pollution issues and contribute to political stability in the region.

For example, waste management in the South Asian Association for Regional Cooperation (SAARC) countries is often highlighted as an area in which better regional cooperation is needed. The Dhaka Declaration on Waste Management of 2004, for example, recognizes the need to promote more effective waste management systems, and the SAARC Action Plan on Climate Change of 2008 listed waste management as an area in which regional sharing of best practices would be useful. These commitments need to be turned into concerted action – there tends to be competing regional priorities at hand, such as food safety, power generation and poverty eradication. These could be resolved by integrating waste management concerns into the implementation of SDG action.

A number of regional platforms could be leveraged or re-invigorated to promote more effective transboundary waste management. These include ESCAP, which initiated this study and has provided capacity building for policymakers in Asia on finding solutions for the better management of plastic waste, including through engagement with the informal sector. ESCAP is particularly well placed, given its mandate to support the implementation of the SDGs in Asia and the Pacific and its convening power through intergovernmental and expert regional meetings. Existing platforms such as university cooperation platforms or the Association of South East Asian Nations platforms (such as the ASEAN Platform on Marine Pollution and research and educational networks) could be avenues for exchange and education programmes. City partnerships, such as CityNet, Cities Alliance, ICLEI, United Cities and Local Government and C40, could be valuable forums for knowledge exchange and support to municipalities wanting to take action relating to more effective plastic waste management.

NGO networks could also be useful actors, including those that support informal workers, such as WIEGO, StreetNet (working with informal street vendors) and the more local waste pickers associations that these organizations work with and support through exchanges and events. Networks dedicated to acting on waste, such as Break Free From Plastic, can work with both consumers and producers of plastic to raise awareness and push for policy changes at the national and global levels. The sharing of bottom-up experiences in the region can help to enable lesson learning towards scaling up approaches and solutions that work.

Many development partners are now becoming active in this field: the German Corporation for International Cooperation, the European Union, the Swedish International Development Cooperation Agency and the United Nations Environment Programme (UNEP) are all making progress in the field of marine pollution management. In 2018, for example, UNEP, the Coordinating Body on the Seas of East Asia (COBSEA) and the Government of Sweden jointly announced a four-year project to tackle marine litter and plastic pollution in South-East Asia, aimed at reducing the use of difficult-to-recycle plastic, increasing the collection and recycling of high-value plastic and boosting public support for improved plastic pollution policies. As far back as 2007, COBSEA began its marine litter initiative by conducting a review of national and regional institutional arrangements and by identifying the management gaps in marine litter. It found that coordination and cooperation at a regional scale are needed to align efforts, support partnerships and find regional solutions to addressing this cross-sector and cross-boundary issue.

At the same time, the Pacific-European Union Waste Management Programme has committed 17 million euros to waste management initiatives in the Pacific region, in partnership with the Secretariat of the Pacific Regional Environment Programme and other regional partner agencies. The Asia-Pacific Economic Coordination body is working to lower the financial barriers to sustainable waste management while simultaneously encouraging project investment, in close coordination with private sector stakeholders. It is setting up various "test sites" to find opportunities for reducing – if not eliminating – plastic waste leakage into oceans and waterways.

Finally, international conventions and protocols, including World Trade Organization agreements, and multilateral agencies, in particular the United Nations, can help to drive forward change in both the production and consumption of plastic and other aspects of environmental health. Regional dialogues on the issue can lead to shared declarations of commitment and agreements to put these into action. Global frameworks, such as the SDGs, commit national governments to tackling waste management and gathering data on their progress and can be supported in their endeavours by ESCAP and other United Nations agencies active in the region through financial and technical capacity as well as knowledge.

6.2 Regional business initiatives

From an economic perspective, there can be benefits for both consumers and suppliers from the adoption of similar standards for plastic products across the region, for example regulating product designs through regional legislation. Technological innovations to comply with these standards have the potential to be scaled up and replicated regionally, including those required for compliance to regulatory approaches, such as the polluter-pays principle or extended producer responsibility.

On the level of producers, packaging federations or recyclers' associations and other trade associations or chambers of commerce can keep private sector actors informed on the latest policies and innovations in the recycling sector. Plasticity is a global forum that brings together industry and business leaders to drive forward the circular economy and the technological innovations that can make this possible, building up momentum for change. These networks can share financing mechanisms and business models that work for the private sector, in addition to appropriate technologies.

6.3 Regional data and monitoring

To facilitate collaboration on a regional scale, better data collection and standardization would be valuable to all stakeholders involved in the plastic waste management sector. Tracking data on the composition of plastic products and the movement of plastic resources within an economy can support cross-value-chain dialogue and the exchange of knowledge and build on experiences gained through global institutional networks. An example of a global network is the Resource Efficient and Cleaner Production Network, which, in addition to promoting resource-efficient cleaner production, facilitates collaboration, including through the transfer of relevant knowledge, experiences and technologies.

From a regulatory perspective, databases could also be used to keep track of plastic manufacturers and commercial plastic flows in the region as well as to "name and shame" persons or businesses that fail to comply with environmental measures. Such information would help to improve social accountability, local implementation, monitoring capacity and the sharing of impacts.

7. Conclusions and recommendations

7.1 Summary

This guide has highlighted the necessity of taking more sustained and large-scale action in the countries of the Asia-Pacific region to manage waste, in particular plastic waste, more effectively. The scale of the plastic pollution problem in the region's seas as well as other negative impacts of mismanaged plastic waste, ranging from contamination of the food chain to blockage of drainage infrastructure, means that serious action needs to be taken now – not only to manage waste but to reduce the overall use of plastic, especially single-use plastic. The guide also highlighted what action is being taken, from regional and national down to local scales, through government and private-sector initiatives as well as the vital role that informal sector waste pickers contribute in cities across the region that enables the recycling of waste materials and reduces plastic waste leakage into the ecosystem. Their activities need to be supported to ensure better integration to formal waste management processes, safer working conditions and secure livelihoods in the face of a changing landscape.

There is still scope for much more extensive action by all stakeholders, from producers to consumers of plastic products and actors in the waste management sector. In table 2, we present recommendations for redesigning the waste management system to close the loop of the circular economy by focusing on greater efficiency of resource use and ensuring inclusivity in waste management as entry points for innovations in local waste management.

7.2 Recommendations for effective and inclusive waste management systems

Table 2: Summary of challenges, entry points for action and key actors

Challenges	Entry points for action	Key Actors
Towards efficient resource use and waste managment		
Production processes use excess natural resources, including plastics derived from fossil fuels	Extended producer responsibility and/or producer-pays principle Tax incentives for eco-design Voluntary agreements between government and producers to reduce plastic Global initiatives of companies to reduce plastic packaging	National governments Regional platforms Chambers of commerce Trade associations Ellen McArthur Foundation and similar organizations Plasticity and similar organizations Private sector companies
Retailers make use of excess plastic packaging and single-use plastic	Outright bans on single-use plastic Fees for plastic bag use Tax incentives to reduce plastic use Reward schemes for reusable bags	National governments Local governments Private sector companies NGOs and civil society
Consumers lack awareness of the need to reduce their use of plastic	Charge consumers per plastic bag Waste banks Educational campaigns in schools Information campaigns for the general public	Individuals Schools Local government National government NGOs and civil society

Lack of segregation of waste at source and leakages of waste into the natural environment	Mandate this as requirement for larger institutions, such as schools, hospitals, government offices and hotels Facilitate sorting by providing necessary bins Information campaigns about dangers of plastic waste leakage Training of waste sector workers on the need to properly dispose of unwanted waste materials	Individuals Schools Local government Waste management providers Informal waste workers National government NGOs and civil society
Towards inclusive waste management		
Lack of recognition of informal sector waste workers and their contribution to waste management	Develop clear vision of the role of informal sector within the formal waste management processes Raise awareness among general public of important contribution of informal sector	Local government Waste subcontractors Support NGOs Informal waste workers Households
Lack of integration of informal waste sector in formal waste management processes	Act towards formal integration of informal waste management sector: such as registering informal waste workers officially, providing them with ID cards, supporting creation of cooperatives Invest in capacity building to strengthen their ability to collect waste more efficiently Provide training to ensure non-valuable waste is properly disposed	Local government Waste subcontractors Waste middlemen (junk shops) NGOs Informal waste workers
Strengthening institutions for local, national and regional waste management		
Lack of data on waste generated, collected, recycled and leakages	Engage households and communities in record-keeping on waste generation Make use of new technologies to monitor waste generation and recycling Require manufacturers and retailers to record plastic use	Individuals NGOs Schools Manufacturers and retailers Local government National government Waste subcontractors
Need for more effective regional collaboration on transbounary waste management	Leverage existing regional platforms to address regional waste management challenges Integrate waste management objectives into the achievement of SDGs Make use of regional platforms to collect data for more effective decision-making	Bilateral bodies Multilateral bodies ESCAP ASEAN NGOs and civil society networks City networks Trade bodies

7.2.1 Towards efficient resource use and waste management

Regulatory approaches will be necessary to tackle the fundamental problem of plastic waste generation. Regulations should be targeted at producers, to scale down production of plastic, and at consumers, including retailers, to reduce demand for plastic and incentivize proper waste disposal and recycling.

On the side of manufacturers, regulations can require the implementation of extended producer responsibility or the polluter-pays principle and could be applied alongside incentives, such as tax cuts for companies that abide by the regulations and apply innovative approaches to develop goods from recycled plastics or requiring less plastic. The potential impact on smaller enterprises should be taken into account, for example, through the phased implementation of regulations to minimize the economic impact.

For retailers, regulations can require implementation of schemes to encourage recycling, such as refundable bottle deposits in stores (bearing in mind the potential impact on informal waste pickers who rely on these high-value plastic items and therefore potentially starting with lower-value plastics or integrating informal workers into the retailers' recycling processes) to rolling out bans on plastic bags and other single-use plastic. This should be accompanied by the development of appropriate alternatives to single-use plastic and awareness raising among consumers. Regulations also need to be fully enforced, with inspection teams to ensure that shops are not flouting bans, with appropriate fines or other measures.

On the part of consumers, for sustained results, concerted efforts to change the behaviours and practices of the citizenry are necessary. Collection and segregation at source should be improved through a combination of awareness initiatives, incentives, fines and enforcement measures to reduce contamination between plastic and organic waste (in both directions), increase recycling rates, eliminate chronic dumping spots and minimize plastic leakages into the environment.

Incentives might include financial rewards by shops for consumers using reusable bags or cups – and thus retailers need to be on board. Engaging with different population groups, especially youth, to highlight what they can do, can help to foster long-lasting changes in practice. Coastal populations need to be a targeted group to help to minimize leakage of plastic waste into oceans. There is a role here for government agencies and civil society to promote changes in practises.

With regards to waste management at the household level, awareness raising is also required to encourage separation and segregation of waste to facilitate recycling. Municipalities should enable this by providing the necessary facilities and information and can make it a requirement of larger institutions and organizations, such as schools, universities or hotels, as a starting point. Waste banks can be used to reward recycling and facilitate a centralized process, particularly in lower-income areas.

A general drive to improve data collection by all stakeholders, from government agencies to private sector manufacturers and retailers to household consumers, universities and NGOs, would provide more insight into the scale of plastic production and use, recycling potential and where leakages in the sector may be occurring. Local residents and communities can help to collect data, for example, through waste diaries to note their level of plastic consumption and waste generation, which could also help to raise their awareness of the need for behaviour change. There is often little data available on current levels of waste production, segregated by type, at a city-level, which makes it hard to plan for service provision and recycling facilities. Regional collaboration for streamlined data collection, aggregation and sharing would be valuable in light of the transboundary nature of waste, and existing regional networks could be leveraged to enable this. Finally, this data could be valuable for advocacy and awareness raising among stakeholders to lead to a long-term, sustainable and viable change in current practice to help ensure achievement of the SDGs and a reduction in plastic pollution in the oceans and other natural environments.

7.2.2 Towards inclusive waste management

The role of informal sector waste pickers for enabling better rates of recycling and reduced waste leakages needs full recognition and to be effectively integrated into waste management systems. This also means improving the working conditions for waste pickers while maximizing the benefits they offer to the waste management process. Data are usually lacking on the scale of their contribution, which creates challenges for integrating their services into waste management processes and to adequately support them in their work.

The informal sector often remains invisible in part due to informal workers' fear of persecution, and there may be challenges to organizing the work of informal waste pickers. A starting point may be concrete measures to reduce the stigma towards informal waste pickers and to build partnerships between informal workers and municipal waste managers. This may mean showing goodwill by providing safety equipment to the workers as well as worker IDs to recognize their contribution as actors in the waste management

process. The organization of the informal waste pickers as a cooperative (usually through the assistance of a civil society group) may be helpful for the waste pickers to negotiate more effectively, although the impetus should come from the waste pickers themselves to ensure that the action is appropriate.

The integration of informal workers can take place in stages, and a gradual shift through the stages may be most appropriate, in line with the level of readiness of local workers. WIEGO has developed categories of integration of the informal economy that can be used as a guide for policymakers and municipal waste managers in developing their relationships with informal waste pickers:

- No formal integration – a lack of support from the city and repressive policies.
- No formal integration but some tolerance and minimal support, for example, allowing waste pickers into dump sites to sort through waste.
- Transitioning to formal integration through the introduction of some measures to support informal waste pickers.
- Formal integration through a formal agreement as well as support mechanisms, such as provision of safety or other equipment, provision of infrastructure, provision of spaces to sort and store materials, legal recognition through legal reform, bylaws and registration systems and payment for collection.[54]

Where appropriate and in line with the desires of local informal waste pickers, achieving formal integration would help to ensure that the contributions of the informal sector to waste management is recognized and fully integrated into other systems and services to maximize efficiency. NGOs and civil society can support networks of informal workers in their negotiations with authorities, particularly as they can facilitate exchanges and dialogues with networks in other countries to encourage solidarity and the sharing of experiences towards achieving better working conditions and recognition.

City governments should be aware that the process of integrating waste pickers is a long-term commitment. Understanding the complexities of waste picking takes time, investment and a willingness to see waste management beyond conventional approaches. This might mean the city needs to have a vision of waste pickers as legitimate partners and how they fit within an integrated and sustainable waste management system. This should encompass consideration of how their roles will evolve as waste management technologies that are used in the city change and as competition increases from other actors entering the market as recycling technologies evolve and recyclable materials become more valuable. This may require helping municipal government officials and waste managers to understand how to work with informal waste pickers in respectful and empowering ways, which is training that could be provided by civil society or UN agencies, such as ESCAP.

The informal workers may require training to meet the necessary sanitation standards of the city and therefore be better qualified as service providers. For example, there may be a need to increase the awareness of informal workers about the harms of dumping plastic residue into the environment. This would help to foster an environmental identity within the sector to heighten their sense of responsibility. As technologies change, they may also need to be trained in new skills so as not to be left behind but, instead, integrated into new systems of waste management. For example, a group of entrepreneurs in Thailand is developing smartphone applications to improve community waste-collection processes, encouraging separation at source and allowing better planning of waste collection logistics. Including informal workers in these developments will ensure they benefit from innovations rather than get left behind.

7.2.3 Achieving the circular economy in the Asia-Pacific region

Closing the loop in the circular economy in the Asia-Pacific region will require regional collaboration and engagement. Successful policy development and implementation can come from learning from the experiences of other countries in the region and through good integration and collaboration between different ministries and departments, including central and local government. Bilateral and multilateral agencies and city networks can foster regional cooperation through targeted initiatives and capacity-building activities, assisting in the scaling up of projects and sharing lessons learned and good practices.

Existing regional platforms should be leveraged to address regional waste management challenges and can serve as platforms for negotiating and implementing regional commitments, conventions and protocols. Integrating waste management objectives into the achievement of the SDGs can help to ensure this issue can be addressed alongside other pressing development priorities of each country.

Taking an inclusive waste management approach can help to achieve a variety of SDGs, from socioeconomic goals, such as reducing inequalities, to achieving decent work, reduced poverty and gender equality as well as the environmental goals to reduce pollution while contributing to more inclusive cities in Asia and the Pacific.

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50. See www.wiego.org/informal-economy/occupational-groups/waste-pickers.
51. See http://globalrec.org/.
52. Gupta, 2014.
53. See www.ecowatch.com/plastic-waste-china-recycling-2580042463.html.
54. Dias and Samson, 2016.