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Waste Management in the Middle East and North Africa

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Acknowledgments

This report was prepared by a World Bank team led by Frank van Woerden (Lead Environmental Engineer), Haji Huseynov (Senior Infrastructure Specialist), and Delphine Arri (Senior Environment Engineer) under the leadership of Maria Sarraf (Regional Manager for Environment, Social and Climate in MENAAP region). Meskerem Brhane (Planet Regional Practice Director for the MENAAP region) and Catherine Signe Tovey (Regional Manager for Urban in MENAAP region) provided strategic guidance throughout the development of the report prepared as a collaboration between the Environment and Urban teams.

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The analytical findings and conclusions presented in this study are the professional opinion of the World Bank Group team, based solely upon data obtained during this assignment and the interpretation of available studies, historical information, and documents.

This report acknowledges the limited nature of certain data. This data is expected to be reassessed and reiterated where necessary through follow-up assignments. Unless the team has knowledge to the contrary, information obtained from desktop research, secondary sources, client countries, or World Bank consultants has been assumed to be correct and complete.

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Abbreviations and Acronyms

COED	Cost of environmental degradation
DB	Development band
EPR	Extended Producer Responsibility
ESM	Environmentally sound management
EU	European Union
GDP	Gross Domestic Product
GHG	Greenhouse Gas
FCV	Fragility, conflict, and violence
HIC	High-income country
kg	Kilogram
kg/person/day	Kilograms per person per day
LIC	Low-income country
LMIC	Lower-middle-income country
MENA	Middle East and North Africa
MIC	Middle-income country
NGO	Non-governmental organization
NDC	Nationally Determined Contribution
PPP	Public-private partnership
PRO	Producer responsibility organization
SDG	Sustainable Development Goal
SSP	Shared Socioeconomic Pathway
SWM	Solid waste management
Ton	Metric ton (1 ton = 1,000 kg)
UAE	United Arabic Emirates
UMIC	Upper-middle-income country
UN	United Nations

From Waste **to Value**

An opportunity for the Middle East and North Africa region

THE CHALLENGE

The Middle East and North Africa (MENA) region generates more waste per capita than the global average.

MENA generates more waste per capita than East Asia, South Asia, and Sub-Saharan Africa. The MENA region's GDP is equivalent to 22 percent of the European Union's GDP, yet in 2016, it generated 69 percent of the EU's waste volume.

MENA
0.9 kg
/capita/day

GLOBAL
0.79 kg
/capita/day

$7.2 billion
per year

COST OF ENVIRONMENTAL DAMAGE

The region is facing a waste crisis causing environmental damage of US$7.2 billion each year.

Currently in MENA

67% of waste is left uncollected, openly dumped, burned, or not properly tracked.

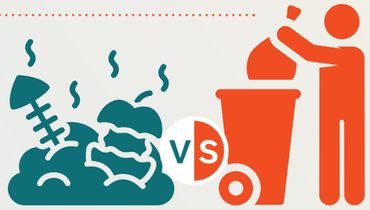
57% of municipal waste is organic.

83% of collected waste has potential for reuse, recycling or energy recovery.

ONLY 10% of waste is recycled, reused or composted—a missed opportunity to reduce waste and make economic gains.

Proper waste management offers benefits that far outweigh the associated costs.

Waste management costs in MENA range between US$50 and US$100 per ton, while the economic cost of unmanaged waste is significantly higher, estimated at US$375 per ton of uncollected waste.



UNMANAGED WASTE GLOBALLY
US$375
per ton

MANAGED WASTE IN MENA
US$50-100
per ton

FOOD WASTE

US$60 billion
per year

Food waste is also a major concern in MENA, causing economic losses as high as US$60 billion each year.

WASTE VOLUMES

TODAY
155 million tons
per year

IN 2050
294 million tons
per year

By 2050, waste is expected to nearly double—from 155 million tons to 294 million tons—if no action is taken.

This surge threatens public health, the environment, and the tourism sector.

MENA countries collectively spend US$7.7 billion per year on waste management—but not always in the most efficient way.

Compared to global benchmarks, collection performance aligns with spending levels. However, treatment and disposal outcomes lag behind what the current investments could achieve.

There is no simple, universal solution. Countries in the MENA region have different circumstances, income levels, and entry points for change. Waste management is a responsibility shared by all.

OPPORTUNITIES
TO TURN THE TIDE

MENA countries would benefit from focusing on three priorities: securing financing, reducing waste, and improving institutional accountability and coordination. These measures would help manage rising waste volumes, improve solid waste management performance, and lay the foundations for a more circular economy.

1 Secure more financing for waste management

To deliver better service and address the growing waste challenge, MENA countries need to become more efficient while increasing spending threefold, from US$7.7 billion to US$23 billion per year in 2050. This is an attainable level of spending, given the region's projected GDP growth, but better cost recovery is critical.

For **high- and middle- income countries**, increased revenues could help carry the cost of solid waste management investments and complement public funding sources.

Potential revenue sources

- User fees
- Public-private partnerships to attract private investments and technical expertise
- Extended producer responsibility mechanisms.

Fragility, conflict- and violence-affected countries and economies require different financing approaches and the support of international assistance because conventional revenue models like user fees are often unworkable.

2 Reduce waste, especially food and packaging waste

Minimizing waste would save money

Each **1%** reduction in waste would save MENA up to **US$150 million per year**

while also keeping waste volumes manageable.

MENA countries can implement various measures to minimize waste, from complex to simpler ones, to ease the fiscal burden and save resources. Raising awareness, engaging communities, and integrating the informal sector are essential for achieving effective waste reduction.

3 Improve institutional accountability and coordination

Successful waste management depends on clear roles and strong collaboration between citizens, national and local authorities, and the private sector, supported by effective accountability mechanisms.

BETTER WASTE MANAGEMENT
IS WITHIN REACH ACROSS THE MENA REGION

Economies affected by fragility, conflict, and violence

can prioritize reliable waste collection and building capacity for better disposal control. Initiatives suited to local contexts offer the best path forward.

Achievable outcome by 2050

70% of total waste is collected and disposed of in sanitary landfills and 20% is collected and diverted away from landfills, leaving 10% of waste uncollected.

70%
20%
10%

Middle-income countries

can extend collection services, ensure safe disposal, and promote recycling and other waste-reduction solutions beyond current low levels. Appropriate circular economy opportunities can be seized or scaled up.

Achievable outcome by 2050

Universal collection with 40% of waste is diverted away from landfills.

60%
40%

High-income countries

are well positioned to pursue advanced circular economy approaches and maximize benefits.

Achievable outcome by 2050

Waste disposal is reduced from 87% to less than 30%.

20%
80%

ABOUT THIS REPORT

This report provides a high-level overview of the key findings and insights contained in the report, "Waste Management in the Middle East and North Africa".

The report draws on new data from the 19 MENA countries and 26 cities, and analyzes the performance of, and challenges in, solid waste management (SWM) systems across the region. It also proposes improvements to avoid the costs associated with poor management while realizing efficiency gains and seizing circular economy opportunities.

Chapter 1 of the main report introduces the study's context, objectives, approaches, and scope, and explains how the countries and economies were grouped for analysis.

Chapter 2 examines SWM performance across these groups.

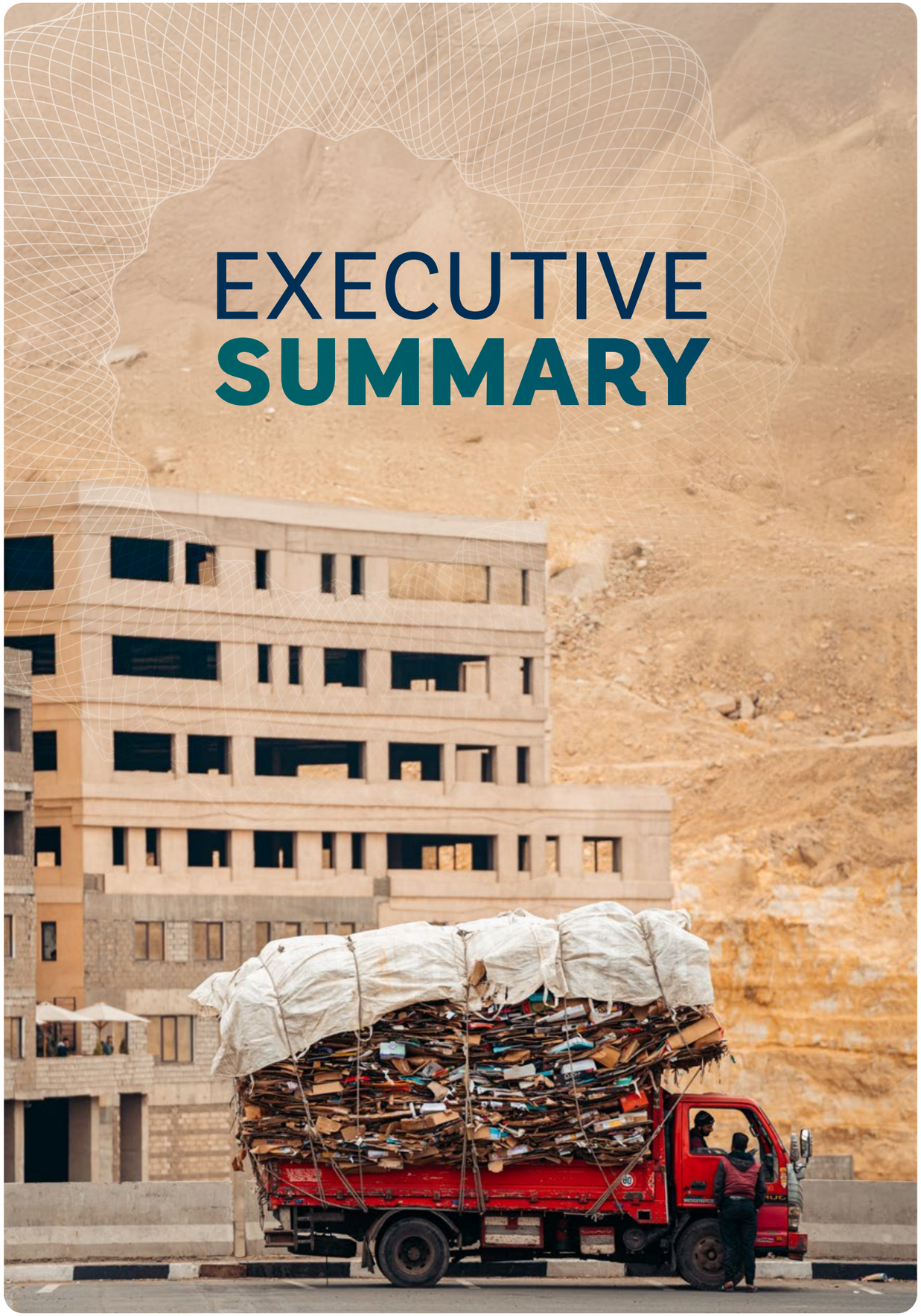
Chapter 3 analyzes how the SWM sector is organized, and reviews policy and regulatory frameworks, governance structures, financing mechanisms and efficiency, job creation, and private sector engagement.

Chapter 4 benchmarks MENA countries against global best practice and identifies possible goals for 2050.

Chapter 5 explores opportunities to embed circular economy principles in SWM systems.

Finally, Chapter 6 presents recommendations for each grouping to support improved SWM outcomes.

EXECUTIVE SUMMARY



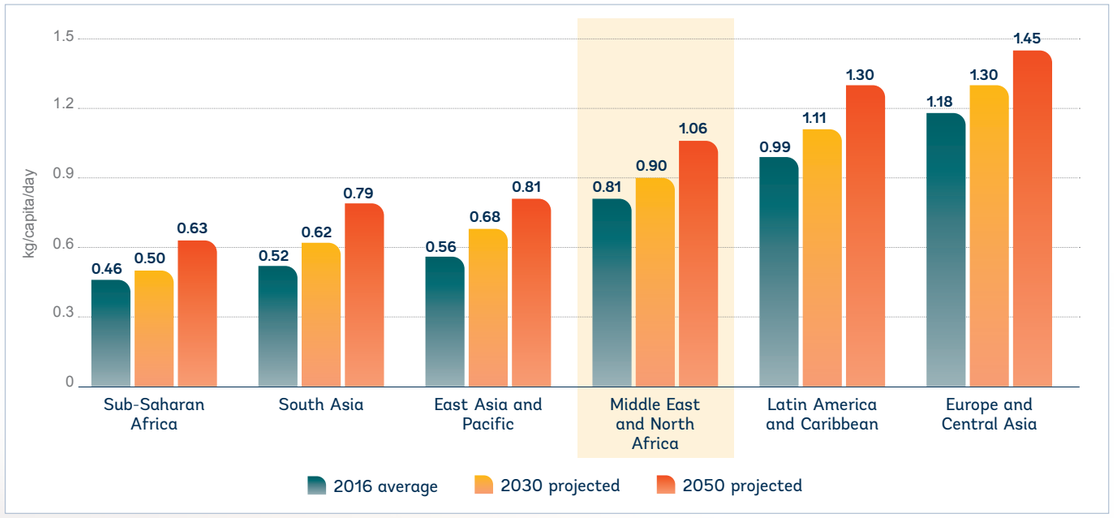
Why explore MENA's waste challenges now?

Solid waste management (SWM) is a pressing issue in the Middle East and North Africa (MENA) region,[1] causing an estimated US$7.2 billion[2] in environmental damage each year. This is equivalent to losing the entire gross domestic product (GDP) of Jordan or Tunisia every six years. Poor SWM contributes to air, soil, and water pollution, and to public health issues. It can undermine tourism development, prevent cities from flourishing, lower property values, exacerbate food waste, and forego resource recovery from recycling and reuse. The impacts of such waste mismanagement disproportionately affect disadvantaged communities.

The benefits of proper waste management far exceed the related costs. Globally, the total cost of unmanaged waste—estimated at US$375 per ton for uncollected waste—far exceeds what proper waste management should cost. For MENA, a good benchmark value for waste management cost can be estimated as between US$50 and US$100 per ton.

The MENA region generates more waste than the global average. Currently, at 0.9 kg per capita per day, it produces more waste than East Asia and the Pacific, South Asia, or Sub-Saharan Africa (Kaza et al. 2018). The MENA region's GDP is 22 percent of the European Union's GDP (Figure ES.1), yet in 2016 it generated as much as 69 percent of the waste generated in the European Union.

Figure ES.1 Waste generation by region, 2016 and forecast for 2030 and 2050

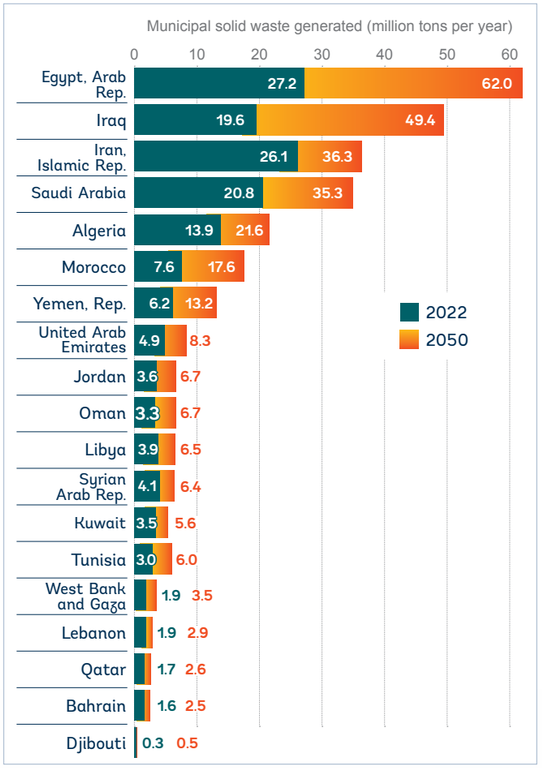


Source: Kaza et al. 2018.

The problem is growing, with waste generation in MENA projected to nearly double by 2050 unless policies change. Due to population growth, urbanization, and higher incomes, waste generation in the region is expected to climb from 155 million tons per year today to 294 million tons per year by 2050. MENA's generation will increase much faster than the global average (90 percent in MENA vs 70 percent globally between now and 2050). Most of the increase is expected to come in countries affected by fragility and conflict, which already struggle to provide effective SWM services, together with the Arab Republic of Egypt and Morocco.

Mismanaged waste and plastics pollution obstruct MENA's ambitions for tourism development. In the Middle East alone, the tourism sector contributed US$323.6 billion in 2019, accounting for 8.4% of regional GDP (WTTC, 2022). Tourism creates nearly 4.5 million jobs in the MENA region (McConaghy 2013). For MENA countries to further develop tourism, they would need to invest in SWM to keep their tourism areas clean. The Mediterranean is among the world's most plastic-polluted seas and MENA has the highest per-capita footprint of plastics entering the seas (World Bank 2022). Beach litter can substantially erode the number of visitors and revenue from tourism, with reductions of between 26 percent and 50 percent at severely polluted sites, as shown in Korea, South Africa, and the United States. In countries like Montenegro, the Maldives, and Bali in Indonesia, improving the attractiveness of tourist destinations has been an important driver for advancing investments into the waste sector.

Figure ES.2 Waste generation in the Middle East and North Africa, 2022 and forecast for 2050



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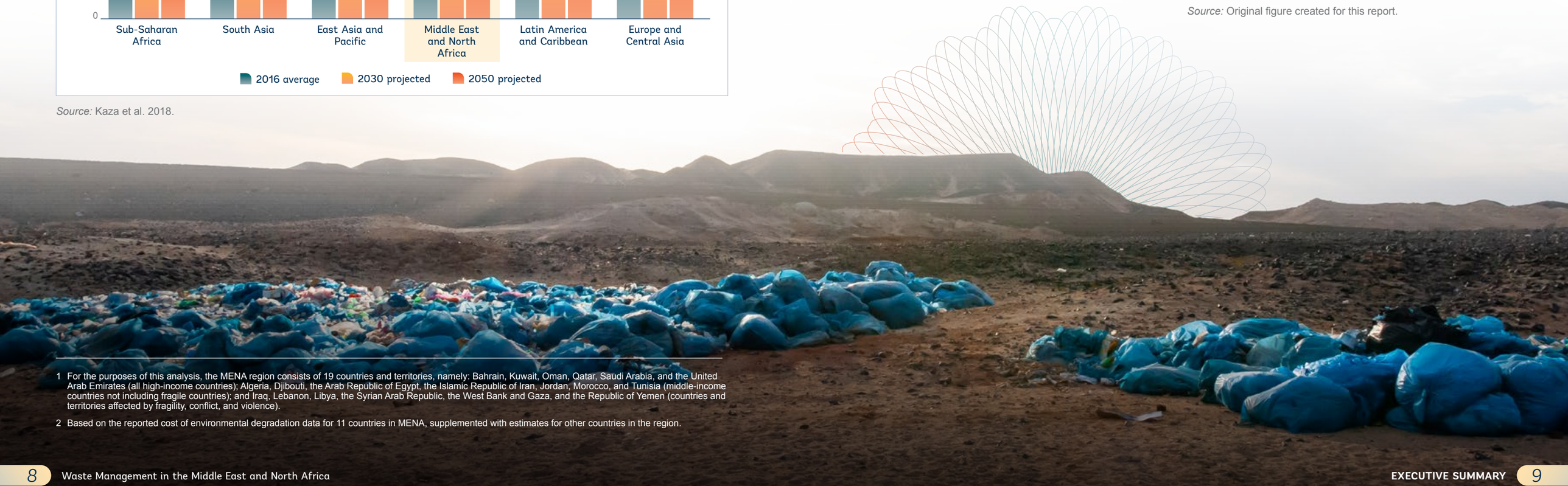


1 For the purposes of this analysis, the MENA region consists of 19 countries and territories, namely: Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and the United Arab Emirates (all high-income countries); Algeria, Djibouti, the Arab Republic of Egypt, the Islamic Republic of Iran, Jordan, Morocco, and Tunisia (middle-income countries not including fragile countries); and Iraq, Lebanon, Libya, the Syrian Arab Republic, the West Bank and Gaza, and the Republic of Yemen (countries and territories affected by fragility, conflict, and violence).

2 Based on the reported cost of environmental degradation data for 11 countries in MENA, supplemented with estimates for other countries in the region.

What are the solid waste management challenges in the region?

Food waste is a major concern in MENA, causing economic losses as high as US$60 billion each year. About 19 percent of all food is wasted in MENA. This is equivalent to losing between 75 and 130 kilograms (kg) of food per capita per year in a region where most countries rely on imports for staple foods, and one in six people experiences severe food insecurity. From an SWM perspective, wasted food contributes 11 percent of all municipal waste, raising the organic waste fraction in municipal solid waste to levels that are high compared to global benchmarks, exacerbating waste management challenges. This always peaks during certain seasons (for example, during the month of Ramadan), with the amount of food waste varying from country to country. In extreme cases, food waste can total 50 percent of total food.

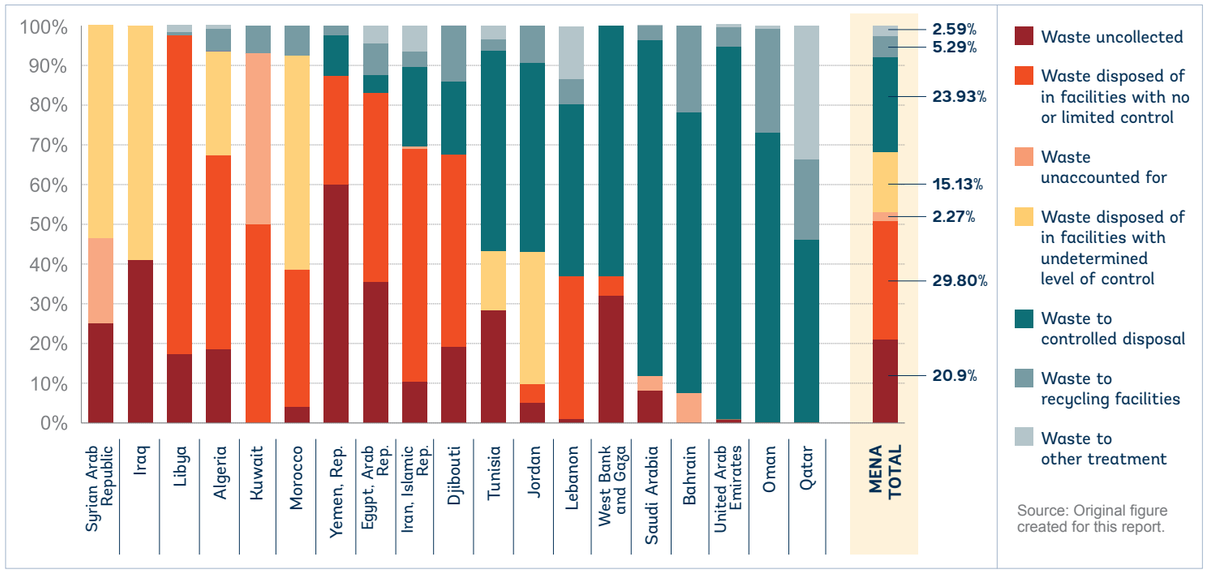
The waste collection rate in MENA is nearly 80 percent, on par with the global average. In much of the MENA region, waste collection coverage is good, with nearly all waste collected in the high-income countries (95 percent) and high collection rates in most stable middle-income countries (80 percent), in line with collection rates in middle-income countries globally. However, substantial gaps remain in fragile and conflict-affected countries (63 percent), as well as in Egypt (65 percent). As a consequence, a total of 21 percent of all waste in MENA remains uncollected.

While waste collection is good, proper treatment and disposal remain challenging. Two-thirds (67 percent) of MENA's generated waste is improperly managed (uncollected, openly dumped, burned, or not tracked) (Figure ES.3). This is far above the global average of 33 percent (Kaza et al. 2018), underlining the need for more efficient waste management systems and better disposal practices.

With only 10 percent of waste recycled, reused, or composted, MENA is forgoing significant opportunities to reduce waste and make economic gains. Landfilling is the predominant waste disposal method in the MENA region, even though many countries have included waste recycling targets in their sector plans. Despite relatively high fractions of recyclables in waste composition, there is a notable gap between the recycling rates of MENA's high-income countries (where 8 percent of waste is recycled) and the global average for high-income countries (where 29 percent of waste is recycled). This gap indicates substantial potential for greater value recovery. Given the exceptionally high share of organic waste in MENA, at 57 percent of municipal waste, the lack of composting is an additional missed opportunity.

The informal SWM sector plays a vital, often under-recognized role in MENA. This sector is particularly important where formal systems are lacking, in that it can efficiently handle a substantial portion of urban waste and provide critical economic opportunities for marginalized populations. However, the informal sector's economic contributions are often overlooked, preventing the development of structured integrated SWM systems and collaboration with municipal SWM services. Informal waste workers face significant challenges, including lack of legal recognition, unsafe working conditions, social stigma, and exclusion from social and financial services, which hinder their livelihoods and limit the sector's potential.

Figure ES.3 Waste by destination



Source: Original figure created for this report.

What is the region doing to tackle these challenges?

At US$7.7 billion per year, MENA spends a considerable amount on waste management—but not always in the most efficient way: treatment and disposal levels are not always commensurate with the amount spent. Every year, MENA countries spend about US$3.5 billion on waste collection and US$4.2 billion on treatment and disposal. Global benchmarks suggest that MENA's spending on collection results in service levels that can be expected for the money spent; however, spending on waste treatment and disposal is highly inefficient, and the current limited level of treatment and disposal could be achieved at US$1.2 billion less. Across the region, municipal budgets remain the primary source of financing for SWM, with limited cost recovery from user fees. This limited cost recovery is a fundamental constraint to improving service delivery.

Given the current low level of spending on waste reduction and circular economy, there is substantial opportunity for MENA countries to increase their investments in those areas. Even high-income countries in the region underinvest in recycling and composting compared with high-income countries worldwide, which typically spend between US$30 and US$80 per ton on recycling, and between US$35 and US$90 per ton on composting. In MENA, most high-income countries have started diverting from waste disposal through recycling and other treatment approaches but still largely rely on landfills, with mostly limited formal budgets for recycling or composting.

The 19 MENA countries have legal frameworks for SWM, but enforcement remains a significant challenge, undermining policy effectiveness. Most MENA countries, including those affected by conflict, have legal frameworks and national strategies in place for SWM. These strategies aim to achieve universal waste collection and to implement a feasible circular economy approach based on, for example, enhanced recycling levels or adopting an Extended Producer Responsibility (EPR) mechanism for selected consumer products. However, due to challenges in oversight and enforcement, national commitments and targets are often not translated into actions and achievements.

The limited data available suggests that the SWM sector provides up to 400,000 formal jobs in MENA, and about as many informal jobs. The solid waste management sector provides livelihoods for both formal and informal workers, including marginalized communities across the MENA region. Formal and informal jobs in the sector represent about 1 in every 200 jobs in the region, above the global employment rate of SWM jobs (equivalent of 0.5 percent of all jobs in MENA, versus 0.2 percent of total global employment) (ILO 2024). Informal workers make an important contribution to SWM. Efforts to formalize these jobs have proven difficult, but more policies are needed to raise the incomes of, and improve working conditions for, these workers. Revenues for formal-sector workers are within typical wage ranges and far above the incomes of informal workers, which are closer to the typical earnings of day laborers in the region.

Most MENA countries have defined suitable governance frameworks, but national and local authorities need to coordinate better and countries and territories affected by fragility and conflict face specific challenges. Across the MENA region, governance structures for SWM are evolving. Strong coordination between national and local authorities could help improve performance. This is true in high-income countries, which tend to emphasize central management (for example, Oman and the United Arab Emirates (UAE) both have state-owned waste-management companies but could leverage local institutions more for responsiveness). Similarly, in middle-income countries, local entities tend to lead in SWM but face financing and capacity constraints that could be alleviated by central support. Morocco, Tunisia, and Egypt have responded to such constraints by establishing central government waste agencies mandated to support local governments and provide institutional coordination. By comparison, conflict-affected countries face substantial capacity gaps and will need international support to restore systems.

The private sector, which has been engaged as a service provider in some countries, could be leveraged more. The private sector already provides waste collection services in MENA's high-income countries, Egypt, the Islamic Republic of Iran, and Morocco, and is to some degree engaged in treatment. There are opportunities to attract private expertise and investment for waste disposal, recycling, composting and incineration, particularly through public-private partnerships. Clear regulations, advanced arrangements, and innovative models for contracting private operators could enable greater private sector contributions—in terms of both financial investments and technical expertise—and partnerships.

How do the region's waste management systems measure up—and how can they evolve?

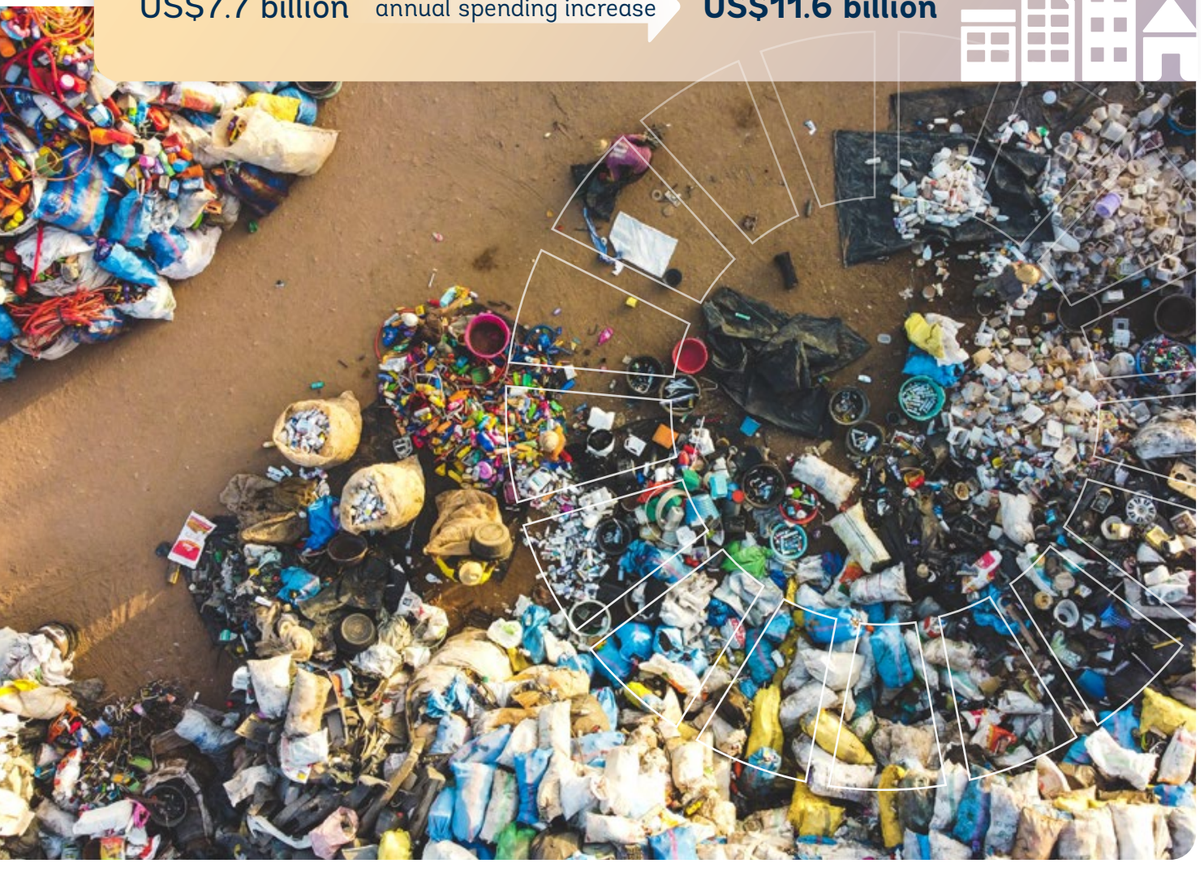
Compared to global benchmarks, MENA's high-income economies are at an intermediate level of building integrated SWM systems; all other economies are at the early stages. Sustainable Development Goal (SDG) 11 ("reduce the environmental impact of cities") highlights a need to pay special attention to municipal waste management (Target 11.6). One of the key indicators under this target is SDG Indicator Target 11.6.1, a metric that tracks the proportion of urban solid waste that is regularly collected and adequately managed in cities. In effect, this target identifies universal waste collection and comprehensive control over recovery and disposal processes as foundational for achieving SDG 11.

Currently, only Oman and Qatar achieve universal collection and comprehensive control over recovery and disposal processes. In other high-income countries, basic services have been consolidated, leaving room for greater ambition—especially for introducing circular economy practices. Other countries remain at an early stage of SWM development, meaning that good service provision and safe disposal are still their main priorities.

Fixing current shortcomings towards achieving SDG Target 11.6 across all MENA countries would require efficient gains and a 50 percent increase in annual spending, from US$7.7 billion to US$11.6 billion per year.

To achieve **SDG Target 11.6**, all MENA countries would need to improve effieciency and increace spending on SWM by an additional 50 percent.

US$7.7 billion annual spending increase **US$11.6 billion**



By 2050, all MENA countries have the potential to improve SWM and introduce a circular economy. Benchmarking shows that, with appropriate investment, MENA's middle-income countries and nearly all conflict-affected countries could develop their SWM systems to intermediate levels of service provision. This means they could achieve universal, reliable waste collection and a good degree of control over disposal or waste treatment to avoid environmental damage. They could then seize circular economy opportunities. The region's high-income countries could further advance (or in some cases introduce) circular economy approaches to reduce the volume of waste generated, helping to realize savings in waste management costs and optimizing the use of resources (Maps ES.1 and ES.2).

To achieve such progress by 2050, MENA countries would need to increase their spending threefold. To deliver better service and manage the projected increase in waste volume while advancing circular economy applications, MENA countries would need to increase their spending from US$7.7 billion to more than US$22 billion per year by 2050. This considers revenues from recyclables sales, estimated at US$4.2 billion per year by mid-century. For the region's high-income countries, expenditure would need to double; for middle-income economies, it would need to triple; and on average for countries affected by fragility and conflict, expenditure would need to increase by six times. These cost increases are expected to be affordable for the region. With the region's expected GDP growth (under an IPCC SSP2 scenario),[3] these costs will only represent 0.2% of GDP.

Map ES.1 Performance of solid waste management systems (2020 and projections for achievable improvements by 2050)

Source: Original World Bank map created for this report.

Note: Development bands (DBs) are used to distinguish between 10 stages of municipal solid waste development, based on the degree of waste collection achieved, the level of control in disposal facilities, and the application of circular economy principles. *Source:* Original map produced for this report.

Map ES.2 Performance of solid waste management systems (2020 and projections for achievable improvements by 2050)

Source: Original World Bank map created for this report.

Note: Development bands (DBs) are used to distinguish between 10 stages of municipal solid waste development, based on the degree of waste collection achieved, the level of control in disposal facilities, and the application of circular economy principles. *Source:* Original map produced for this report.

3 The SSP2 (Shared Socioeconomic Pathway 2) scenario of the IPCC (Intergovernmental Panel on Climate Change) describes a "middle of the road" scenario where socioeconomic and technological development trends continue, with no significant progress towards or away from sustainability.

What opportunities do circular economy approaches offer?

Each 1% waste reduction → US$150 million annual savings

Each percent less waste generated saves MENA US$150 million per year. In MENA, 83 percent of collected waste has the potential to be reused, recycled, composted, or used for energy recovery. However, only 10 percent is currently used for these purposes. Adopting circular practices could yield considerable direct benefits from material recovery, reduction of environmental and other negative impacts, and lower waste volumes to manage with related lower landfilling costs. Indirect benefits include the potential to avoid exhausting resources and the efficient use of materials.

Circular economy interventions such as composting, recycling, and energy recovering could be developed to convert waste into commodities while reducing waste volumes. This transformation requires new policies and infrastructure, and local conditions dictate what is achievable. Global experience shows that recycling rates of between 5 and 10 percent—and in some instances, even 20 percent—can be achieved with interventions from the informal sector, even without incentives. A recycling rate of up to 30 percent can be reached by improving existing systems at a relatively low cost. Higher recovery rates, such as the 65 percent noted in some EU countries, involve significant effort and higher costs.

To "bend the waste curve", there is a need to reduce waste growth rates to keep waste volumes manageable. Effective SWM is not only about waste reduction but also about keeping products away from municipal waste management systems, particularly diverting waste from landfills. Measures aiming at "true" reduction in waste generation, which focus on the upstream part of the products lifecycles and how to avoid the use of the product, are also important to minimize the volumes of waste. These measures require comprehensive approaches that involve many stakeholders. Those include, for example, limiting or banning the use of packaging materials, and bans on plastics. Cities in Japan and Austria, for example, have introduced many measures to segregate waste at the household level and to improve the management of recyclables. As a result, more than 50 percent of material has been diverted from waste streams. These measures, combined with regulations to reduce the use of packaging materials and bans on single-use plastics, could keep waste volumes at current waste volumes, effectively reducing the need to increase public funding for future waste management.

The region's high-income countries are well positioned to benefit from circular practices. MENA's high-income countries have some of the world's highest waste generation rates per person. With 87 percent of collected waste currently going to landfill, or less controlled disposal sites, the opportunity for recovery is high.

There is potential for high-income countries to reduce waste disposal from 87 percent to 30 percent or less (by diverting waste towards composting, recycling, and incineration) by 2050. Sound public policies, strong SWM agencies, active private sector engagement, and substantial financial capacities provide MENA's high-income countries with a strong base to introduce circular economy approaches. Useful approaches for catalyzing a circular economy include creating markets for recycled materials and adopting good international EPR practices for a comprehensive range of materials.

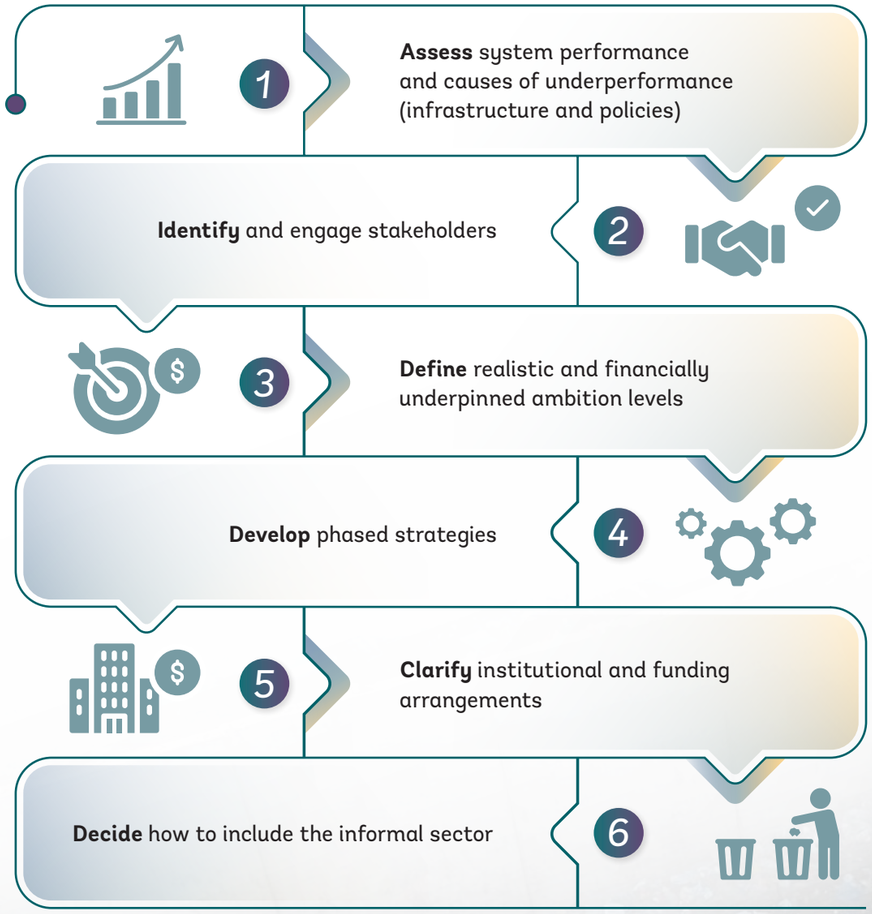
Although the region's middle-income countries face greater financial barriers to implementing circular economy practices, progress is well within reach. The region's middle-income countries can draw on their sound SWM policies and private sector engagement as they reach for further circular economy opportunities. Producers across the region have diverse interests, which may need to be overcome, including those relating to financing arrangements for circular schemes. However, middle-income countries can still make progress by implementing low-cost strategies, which could include: (i) leveraging informal recycling by implementing deposit-refund schemes while supporting the integration of informal recycling activities into formal systems; (ii) introducing EPR arrangements for selected products such as beverage containers; and (iii) providing tax incentives for private sector recycling initiatives. Efforts to improve the overall efficiency of SWM spending and strengthen cost-recovery could prepare the ground for diverting at least 40 percent of waste to composting and recycling by 2050, with more ambitious investments in circular economy solutions possible in the decades that follow.

Economies affected by fragility, conflict, and violence could emphasize circular practices that are low-cost, technically simple, easily adaptable, and small in scale. While MENA countries affected by fragility and violence face considerable SWM challenges, conflict and scarcity have forced the innovative reuse of waste materials and supported learning on resilient approaches. Successful solutions for SWM are typically small in scale, technically straightforward, and low-cost, such as neighborhood-based waste aggregators or small-scale composting and recycling facilities. To further benefit from such approaches, countries could: (i) rely on community-scale approaches with limited funding needs, (ii) emphasize training for local providers, and (iii) enable community accountability for service delivery. For most countries affected by fragility, conflict, and violence, moving to fully controlled disposal and diversion of about 20 percent of waste to recycling and other local initiatives should be feasible.

How can the region seize these opportunities?

MENA countries have different starting points, circumstances, and resources as they transition toward integrated, efficient, and circular solid waste systems. They will therefore need to develop different roadmaps for improvements. Six common decision steps can help build roadmaps and turn plans into action (Figure ES.4).

Figure ES.4 Six common decisions to take when developing a solid waste management roadmap



Source: Original figure created for this report.

BETTER WASTE MANAGEMENT IS WITHIN REACH ACROSS THE MENA REGION

Economies affected by fragility, conflict, and violence can prioritize establishing reliable collection services and building capacity to improve control over disposal.

Middle-income countries can extend collection services and establish safe disposal while advancing recycling and other waste-reduction solutions beyond current low levels. Appropriate circular economy opportunities can be seized or scaled up.

High-income countries are exceedingly well positioned for an ambitious push to capitalize on the benefits of advanced circular economy approaches.

There is no simple, universal solution. Financially affordable solutions require making waste everybody's problem. Citizens, local authorities, national governments, and the private sector are all part of the solution. Economies affected by fragility, conflict, and violence in the region need to prioritize establishing reliable waste collection services and building capacity to eventually improve control over disposal. For middle-income countries, the main tasks are to establish safe disposal, extend collection services, and advance recycling and other waste-reduction solutions beyond current low levels. Meanwhile, the region's high-income economies are well positioned for an ambitious push to seize the full benefits of advanced circular approaches—although appropriate circular economy opportunities also exist in lower-income economies in the region.

In pursuing these goals, MENA countries should consider three priorities: financing, waste reduction, and institutional accountability. These are discussed in more detail on on the next page.

PRIORITY 1

Secure financing

MENA will need higher, more efficient spending to improve SWM performance and make inroads to a more circular economy. But this investment need not solely come from public spending. Secure financing requires improved cost recovery based on customer fees, engaging differently with the private sector, and establishing EPR mechanisms.

Cost recovery

All MENA countries would benefit from cost-recovery systems that are collectable and implementable. Several options are available, depending on the local context, from a simple property tax to a more sophisticated fee structure that targets different user groups (such as households, commercial entities, offices, or shops). Lebanon, for example, has a draft law on cost recovery that gives municipalities the mandate to charge citizens and other waste producers fees that can fully cover adequate waste services. Phnom Penh, in Cambodia, has fully privatized waste services with a waste tariff structure that differentiates between user groups based on an assessment of their financial capacity. To secure public support, the introduction (or increase) of fees should be well communicated and clearly linked to improvements in related waste services.

The private sector

The private sector could be better leveraged to bring in expertise and investment. In many MENA countries, private companies already act as service providers in waste management (they bid for waste management contracts that are publicly funded). This improves efficiency and competitiveness, but does not alleviate demand on public funding. The private sector could also be a source of investment funding for waste treatment activities, such as recycling, composting, and incineration. This would require improved public-private partnership (PPP) arrangements and policy reforms to attract private investment and raise competition through good procurement and contract management practices. A good example is Ningbo, in China, where a PPP arrangement sees the public sector ensure the segregated collection of food waste, while the private sector has invested in designing, building, and operating a 400-ton-per-day processing plant that converts waste biogas into natural gas and incinerates residues.

Extended Producer Responsibility mechanisms

EPR schemes can further lower the burden on public spending. By making the producers of waste responsible for its management at the end of its lifecycle, less waste enters the municipal systems, thus reducing the burden on public finances. Countries can start with simple mechanisms such as deposit-refund schemes. For example, in the Philippines, private companies that place plastic products or packaging materials on the market need to offset this by paying proportionally for plastics recycling. And in France, EPR revenues to municipalities cover the cost of 10 percent of waste management costs.

Longer-term objectives

These measures are expected to benefit the informal sector, and to increase employment opportunities in new sectors. Although formalization is difficult in the short run, policy can focus on raising incomes through access to credit, access to health care and social security, safer working conditions, and introducing elements of formality in recycling.

Ultimately, more reliable financing for SWM services is also expected to help clean the region, increase the attractiveness of tourism areas and, ultimately, boost tourism and create new jobs.

PRIORITY 2

Reduce waste, especially packaging and food waste

"Bending the curve" on waste will require broad public support for segregated waste collection. Close attention therefore needs to be paid to raising awareness, engaging stakeholders, and involving the informal sector.

Various measures, from the simple to the complex, are available to minimize waste and so ease the fiscal burden and save resources. High-income countries could identify new materials to replace single-use plastics; invest in infrastructure for various measures such as composting; and implement full-fledged EPR policies, as in Japan. Middle-income countries could look to EPR as a funding stream and consider proven solutions like deposit-refund schemes. Fragility, conflict- and violence-affected economies could rely on small-scale, low-cost, simple innovations that require minimal maintenance, such as community-level initiatives for waste recycling and composting.

Given the high levels of food waste in MENA, countries would benefit from exploring strategies to minimize it. Consumer attitudes, subsidies, and value-chain weaknesses contribute to high levels of food loss and waste across the region. Strategies to reduce food waste could focus on awareness-raising; price reforms; value-chain investments in storage, cooling, and transport; and recovery through food banks, composting, and other reuse options. Reducing food waste will require behavioral change by all actors, supported by policies that recognize the cultural dimensions behind food waste generation. Examples of countries that faced similar challenges include Mexico, which produced 20 million tons of food waste per year before it adopted dedicated legislation in 2024 to mandate a range of measures to avoid food waste, recognizing the connection between food loss and waste and the right to food.

High fractions of food and organics in MENA waste streams also provide opportunities for composting and waste-to-energy solutions, which have to date found limited application in the region. Solutions should ideally include capturing organic waste from the industry, commercial, and hospitality sectors. Integrating these waste streams would reduce the costs of collection while improving the quality of resources such as compost, a valuable commodity in the region.

PRIORITY 3

Improve institutional coordination and accountability

The governance of the waste sector is relatively straightforward. Typically, municipalities are responsible for proper waste collection and management, while a central environmental agency is responsible for planning and oversight. To make it work, MENA needs good coordination between the national agency responsible for waste management and the ministry in charge of municipalities, with strong accountability and engagement mechanisms to support and monitor local administrations. Though examples of well-functioning, centrally managed waste-management systems exist in some of the GCC countries, institutional mandates to organize and fund waste services at the local level could be strengthened in order to develop good services, engage the public, and enhance accountability. The West Bank and Gaza provides a good example of a strong local government that would be capable of managing waste management infrastructure, with policy and investment support (through development funding) where needed.

Good waste management is crucial for cities to prosper.

1

EXPLORING WASTE IN THE MENA REGION: A PRESSING ISSUE

Key messages

- Rising consumption and waste generation are challenging SWM systems across MENA, driving marine pollution costs of up to 2 percent of GDP in some countries and waste-sector methane emissions per ton that are three times the global average.
- This report explains the performance and challenges of SWM systems in MENA, as well as the region's readiness to introduce circular economy concepts.
- The analysis is based on newly available data from 19 MENA countries and 26 cities and the World Bank Group's practical experience in strengthening waste systems.

1.1 Background

Solid waste management (SWM) is a growing global challenge with significant environmental, economic, and social implications. The world generates more than 2 billion metric tons (tons) of waste each year—enough to wrap the equator with shipping containers 25 times (UNEP and ISWA 2024). Waste generation is associated with population growth, economic development, urbanization, and industrialization. While the amounts of waste and the complexity involved in managing it are increasing, SWM infrastructure and policy reform struggle to keep up. As a result, most global waste is largely mismanaged and contributes to the triple planetary crisis of climate change, biodiversity loss, and pollution (UNEP and ISWA 2024). Mismanaged waste increases public health risks by exacerbating the spread of infectious diseases, which can reduce livelihood potential. Economically, insufficient waste management burdens governments with high cleanup costs, reduces productivity, reduces property values, and negatively affects key sectors, such as tourism, agriculture, and fisheries. Without urgent infrastructure development and policy reforms, global waste generation is projected to increase by 70 percent by mid-century (Kaza et al. 2018), disproportionately more so in low- and middle-income countries where waste systems are underdeveloped.

In the Middle East and North Africa (MENA), a fast-growing population, rapid urbanization, and high and rising consumption are increasing waste generation beyond existing infrastructure capacity. MENA's sociodemographic trends make it particularly vulnerable to rising waste levels (Thabit et al. 2023). By 2050, MENA's waste volumes could nearly double (Kaza et al. 2018) and, without urgent interventions, will exceed already strained system capacities. The consequences of inaction would be stark. Currently, 37 percent of waste collected in the region is reported as openly dumped. This could increase to 73 percent of collected waste by 2050 unless there are significant investments in treatment and sanitary disposal capacity.

Waste management systems are increasingly unable to cope with rising pressures, posing serious environmental, social, and economic risks. This study estimates that the cost of environmental damage alone exceeds US$7.2 billion across MENA. With the blue economy accounting for 10 percent of the region's gross domestic product (GDP) (and more in some areas of the region), growing marine pollution has significant livelihood implications, costing MENA countries and economies an average of 0.8 percent of GDP—and more than 2 percent in some countries—each year (Heger et al. 2022). Open dumping, which remains the dominant disposal method, contributes to a range of public health issues, such as respiratory diseases. Incorrectly disposed of waste is a major source of methane emissions, which account for 82 percent of greenhouse gases (GHGs) emitted by the waste sector. MENA's waste-sector methane emissions are three times the global average per ton and account for 26 percent of regional emissions (Global Methane Initiative 2024), making them an important target under the region's Nationally Determined Contributions for reducing GHGs. Mismanaged waste hampers tourism, lowers property values, and increases municipal cleanup costs—straining already burdened local budgets.

While MENA's policy makers increasingly recognize the need for better waste management, the region has struggled to deliver effective solutions. MENA countries have made political commitments to improve SWM, such as adopting the United Nations' (UN's) Sustainable Development Goal (SDG) targets for universal collection, adequate treatment, and the disposal of waste, as well as committing to adopting circular economy approaches. MENA countries collectively allocate US$7.7 billion per year to SWM,[1] which is a substantially higher rate per person than in most other regions. Despite these efforts, service quality is low and open dumping volumes are high. Recycling, composting, and other methods to reduce disposal volumes and extract revenue from waste streams are mostly informal or otherwise limited. Significant investments are needed to ensure a higher standard of SWM services—from collection to treatment and controlled disposal.

1 Present values are calculated from 2022 data, which is regarded to be representative of other years.

MENA is missing opportunities to support economic growth by reducing food losses and waste volumes while driving circular economy approaches. Food loss and waste are exceptionally high in the MENA region, at 19 percent of available food, or 15 million tons (Goodwin 2023). This not only inflates SWM costs but also threatens food security in a region that imports more than 60 percent of food products consumed—a figure that climbs to 85 percent in the Gulf Cooperation Council countries. Yet, efforts to reduce food loss remain limited. Furthermore, with organics accounting for 57 percent of MENA's waste stream—well above the global average of 44 percent (Kaza et al. 2018)—there is strong potential for composting and biogas production. The significant share of recyclable materials such as paper, plastic, metal, and glass in the waste stream—27 percent for the region, climbing to 34 percent in MENA's high-income countries—presents an opportunity to expand recycling. Qatar is already seizing this potential by recycling 20 percent of its waste. Despite these opportunities, only eight countries report composting initiatives to extract value from organic waste, and recycling efforts outside of Qatar do not go beyond what can be achieved through informal approaches.

Improving SWM performance requires additional resources, but there are clear pathways for progress that this report proposes. Many MENA countries, especially those with lower incomes or facing fragility and conflict, have underfunded waste sectors that are unable to keep pace with growing waste volumes. However, there are opportunities to improve service quality for countries at all income levels. Achieving universal waste collection across the region would require less than a 20 percent increase in operational spending, if paired with system efficiency improvements. Further improvements in controlled disposal and treatment would add to these costs. Similarly, introducing circular economy approaches today presents a strategic opportunity for MENA to achieve waste prevention, recycling, and material recovery in the future. There is potential for countries to ease pressure on waste disposal capacity, while creating green jobs and enhancing resource security.

1.2 Data sources and methodological approach

This report explains how MENA countries currently manage solid waste,[2] what challenges they will face in the future, and how they can improve waste services. It provides global benchmarks for service delivery, analyzes gaps, identifies areas for improvement, and assesses the resources needed to achieve better SWM services. In particular, this analysis identifies opportunities for MENA countries to benefit from circular economy approaches. The goal of the report is to identify concrete options for MENA countries of different income levels to improve services, realize savings, and reduce economic, social, and environmental burdens.

New data on 19 countries and 26 cities was collected for this report, and deep dives were conducted on seven selected countries. For the purposes of this analysis, information was collected on governance structures, legislation, and key metrics related to SWM in each of the 19 countries in the MENA region, as well as the 26 cities. Private sector engagement, sectoral employment, and financing mechanisms in the waste sector, including cost-recovery models and funding sources, were also examined to assess the effectiveness of SWM systems. In-depth country analyses were conducted on the Arab Republic of Egypt, Jordan, Lebanon, Morocco, Saudi Arabia, the United Arab Emirates (UAE), and the Republic of Yemen to assess underlying factors that shape waste management performance levels in the region. In addition, technical background papers were prepared on a range of topics.

The report draws from a combination of primary and secondary data sources, in hierarchical priority. This includes national reports; World Bank data and knowledge; international SWM assessments published by the UN, its affiliated bodies, and other development agencies; published academic research; and stakeholder consultations. The data was cross-checked against multiple sources to identify the most credible sources of information and the most widely reported data. Nevertheless, some data limitations exist, as described in Box 1.1.

2 The primary focus of this report is on municipal solid waste, for which management is provided as a public service for collection, treatment, and disposal. Domestic waste (also called "household waste") is the main source of waste targeted, but similar types of waste (such as from shops, small businesses, or offices) are also included. Other waste categories that are mostly managed separately—such as medical waste, industrial waste, hazardous waste, and agricultural waste—and are outside of the scope of this study. Unless otherwise specified, any refence to "solid waste" in this report refers to "municipal solid waste".

BOX 1.1 Data management: references, benchmarking, and projections

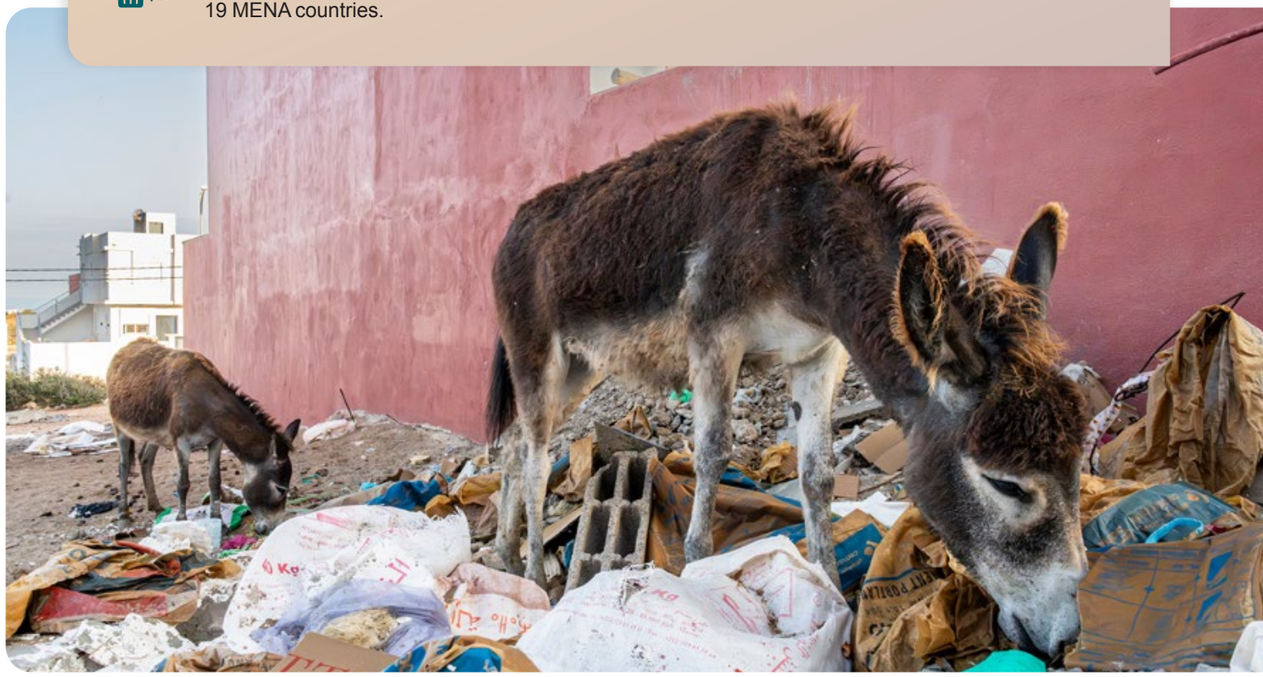
In the Middle East and North Africa (MENA), as well as globally, the availability and comprehensiveness of data present an inherent challenge in solid waste management assessments. This study took the following approaches to data.

Data sources and consistency: Information was gathered from a range of sources, including government reports, academic studies, international organizations, and stakeholder consultations (see appendix G for a list of data sources). While this approach helps address data gaps, it can also create inconsistencies due to variations in definitions, measurement methods, and data completeness, with data from rural areas particularly incomplete. Where possible, efforts were made to use the most recent, nationally reported data to ensure relevance and comparability. Global benchmarking values were obtained from the World Bank Group's *What a Waste 2.0* (Kaza et al. 2018). Values are reported in metric tons or tons (1 ton = 1,000 kg) throughout the report.

Indicator definitions: The analysis in this report is based on the most recent and reliable data sources available on waste generation and related indicators (composition, collection, treatment, and disposal). The methodologies used for this analysis are consistent with other World Bank global studies, including the forthcoming *What a Waste 3.0* (2026).[3] Adjustments have been made to harmonize waste data to a common baseline year (2022) and to account for variability, including estimates of uncollected waste, waste collected by the informal sector, and non-household municipal solid waste. The most recently available global benchmark values date from 2016 (Kaza et al. 2018).

Waste generation projections: Projections to 2050 are calculated according to the adjusted base-year waste generation for 2022 and projected changes to GDP per capita, as well as projected population growth.

Waste expenditure data: Expenditure data is informed by reported tariffs where available, such as for Jordan, but is mainly based on assessments conducted by sector specialists working in the 19 MENA countries.



3 *What a Waste 3.0* (2026) serves as a global reference, grounded in formally published data. It uses defined "rules" for aligning data for regional and global analysis, and for projections by country income groups. The current report also aims to present analysis at the country level. This distinction requires different uses of collected data and may result in differences in data points. This is explained in more detail in the appendix on methodologies and data management (appendix A).

1.3 Defining the country groups in the region

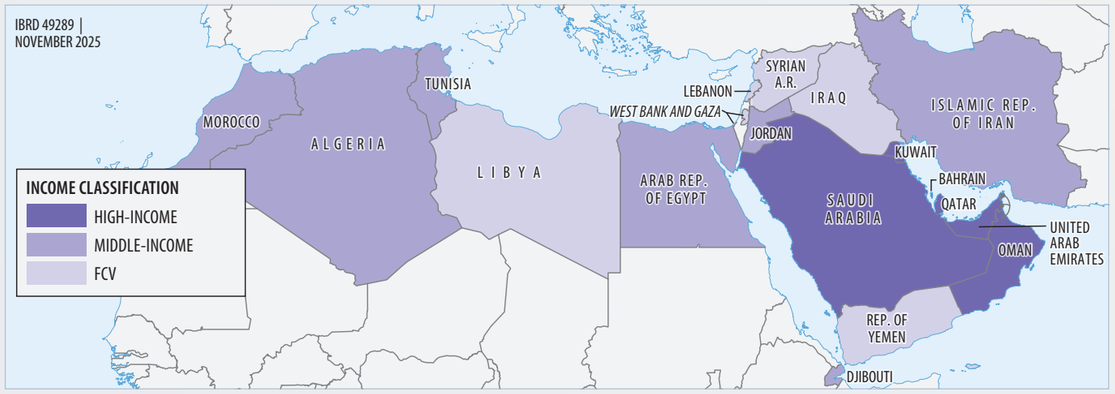
MENA's great diversity is reflected in different SWM needs and performances. Globally, countries' wealth and development shape their SWM needs and performances, notably through their levels of economic development, urbanization, and population growth. MENA is a vast region of 483 million people, and its 19 countries differ widely in these important dimensions of development.

Annual GDP per person ranges from US$832 (2022) in the low-income Republic of Yemen to US$50,863 (2022) in Qatar, one of the world's richest countries. Urbanization rates range from 39 to 100 percent, and population growth ranges from a shrinkage of 0.7 percent per year in Lebanon to rapid growth of 2.9 percent per year in the Republic of Yemen.

For ease of reference, this report organizes its findings around three country groupings based on wealth, stability, and population. While each MENA country has a distinct approach to SWM, with specific opportunities to improve services and realize savings, shared development conditions often shape similar SWM needs and opportunities. To make such shared challenges and opportunities visible, this report organizes its analysis around three groups (Map 1.1 and Table 1.1):

- **High-income countries (HICs):** Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and the UAE. These countries all have strong fiscal capacities, highly urbanized populations, and centralized governance. Even though they represent only 12 percent of MENA's population, these countries generate more than half of regional GDP. Their primary SWM challenges relate to resource efficiency, waste reduction, and sustainability.
- **Middle-income countries (MICs):** Algeria, Djibouti, Egypt, the Islamic Republic of Iran, Jordan, Morocco, and Tunisia. These countries all have stable governance and established municipal institutions. They also face similar SWM challenges, including limited funding, underdeveloped recycling and disposal, inadequate policy enforcement, and difficulty in expanding services to meet growing urban demand. Of these countries, Egypt and the Islamic Republic of Iran stand out as large economies whose size, complexity, and diverse policy pathways warrant separate attention in several thematic areas.
- **Fragility, conflict, and violence (FCV)-affected economies:** Iraq, Lebanon, Libya, the Syrian Arab Republic, West Bank and Gaza, and the Republic of Yemen. Territories in this group range in income level from low-income (such as Syria and the Republic of Yemen) to upper-middle-income (such as Iraq and Libya). Despite this economic diversity, all face institutional fragility, conflict-related disruptions, and limited capacity to deliver reliable SWM services.

Map 1.1 Map of countries, territories, and groupings in the region



Source: Original World Bank map created for this report.

Table 1.1 Characteristics of MENA countries by category

MENA countries		Population total (2022)	Urban population (% of total)	GDP per person (market rates) (2023)	Population growth per year (%)
High-income countries (Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and the UAE)		55,752,000	88%	US$36,500	3.8%
Middle-income countries	**Large middle-income countries** (Arab Rep. of Egypt and Islamic Rep. of Iran)	202,143,000	58%	US$3,900	1.5%
	Other middle-income countries (Algeria, Djibouti, Jordan, Morocco, and Tunisia)	107,319,000	73%	US$4,600	1.3%
	TOTAL MIDDLE-INCOME	309,462,000	63%*	US$4,100*	1.4%*
Economies affected by fragility, conflict, and violence (Iraq, Lebanon, Libya, the Syrian Arab Republic, West Bank and Gaza, and the Republic of Yemen)		122,768,000	60%	US$2,600	2.9%
MENA		487,982,000	65%*	US$8,400*	2.1%*

Source: World Bank World Development Indicators.[4]
Note: * denotes weighted averages.

1.4 Structure of this report

The report consists of six chapters that address various aspects of SWM and the potential to develop a circular economy in the MENA region. Chapter 1 introduced the study's context and methodological approach, and provided an overview of the country groupings used for analysis. Chapter 2 assesses the MENA region's waste sector, with a particular focus on how much waste is generated; the composition of that waste; the methods used to collect, dispose, and treat the waste; and the social, environmental, and economic impacts of ineffective SWM across MENA. Chapter 3 analyzes how the SWM sector is organized, reviewing policy and regulatory frameworks, governance structures, financing mechanisms and efficiency, job creation, and private sector engagement. Chapter 4 benchmarks MENA countries against global best practices, identifying their current standing and projecting possible goals to be achieved by 2050. Chapter 5 explores opportunities to embed circular economy principles in SWM systems. Finally, chapter 6 presents targeted recommendations for each country group to strengthen infrastructure, policy frameworks, institutional governance, financing approaches, and knowledge management systems to support improved SWM outcomes.

4 The World Bank Group's World Development Indicators can be found at: https://databank.worldbank.org/source/world-development-indicators

2

UNDERSTANDING SOLID WASTE FLOWS **AND IMPACTS IN MENA**

Key messages

- Waste management is a pressing issue in MENA, with annual generation currently at 155 million tons and projected to nearly double to 294 million tons by 2050.
- Average per-capita waste generation in MENA is 0.9 kg/person/day—higher than the global average of 0.79 kg/person/day. High-income countries in the region rank among the highest globally, at 1.79 kg/person/day.
- Across MENA, the waste collection rate is 79 percent—above the global average of 71 percent. However, FCV economies collect only 63 percent, below the global average.
- Inadequate SWM causes US$7.2 billion in environmental damage each year, alongside substantial health and economic costs.
- With only 10 percent of waste recycled, reused or composted, MENA is missing significant opportunities to unlock economic value.
- Food waste is a major concern, driving annual economic losses of about US$60 billion across the region.

This chapter presents an assessment of the Middle East and North Africa (MENA) region's waste sector using publicly available country data and global benchmarks. It focuses on:

- **Waste generation,** with data that highlights the scale of the solid waste management (SWM) challenge
- **Waste composition,** which indicates the types and proportions of materials in waste streams and the potential for waste reduction, recycling, and composting
- **Waste collection practices,** which reveal the efficacy and coverage of municipal waste services
- **Waste disposal and treatment methods,** which offer insights into how waste is managed, including reliance on landfills, recycling efforts, composting, and emerging waste-to-energy initiatives.

Together, these indicators provide a structured evaluation of the region's progress and challenges in waste management. This chapter continues to distinguish between the country groupings introduced in chapter 1.[5]

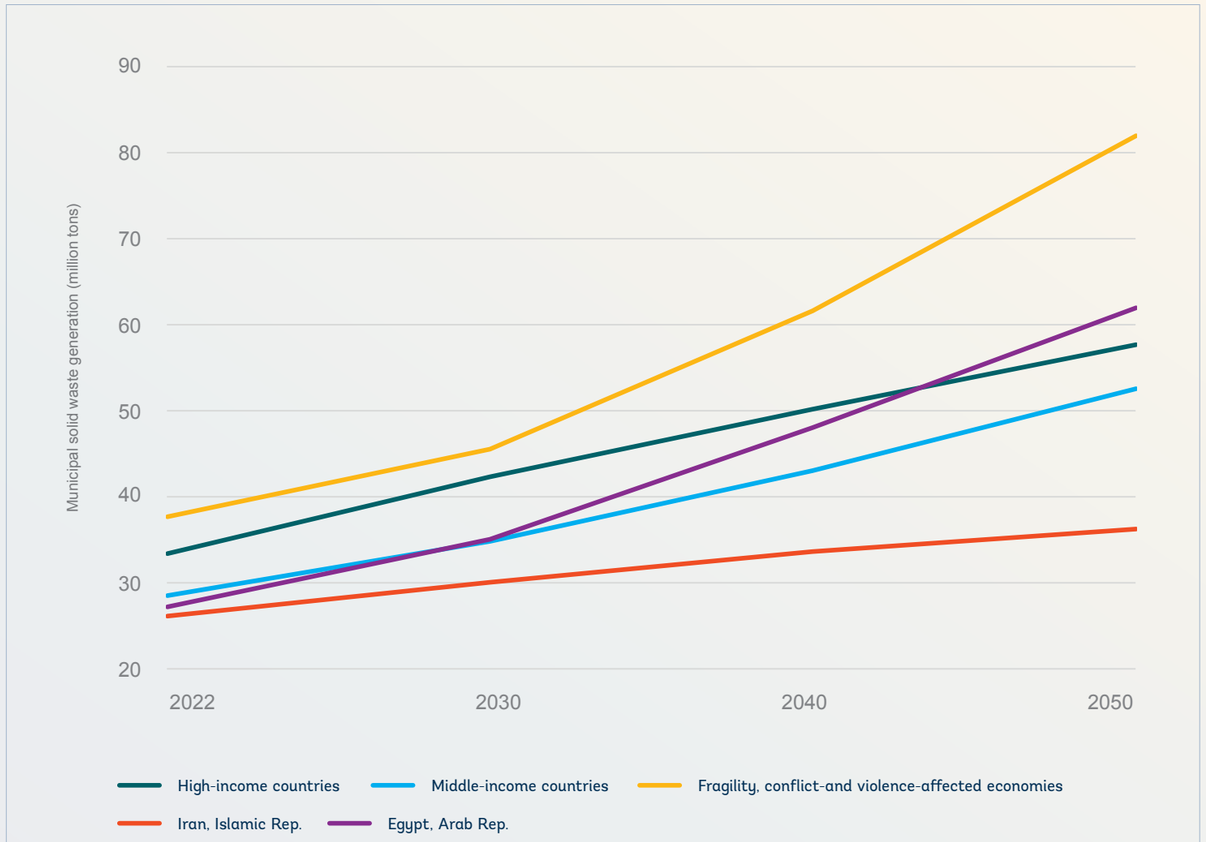
2.1 Waste generation

MENA's waste volume is projected to nearly double by 2050, rising faster than the projected global average. MENA's municipal solid waste volume is expected to increase from 155 million metric tons (tons) per year to 294 million tons in 2050. This increase is driven by population growth, rising incomes, and urbanization. The rate of increase is significantly above global projections of a 70 percent rise by 2050. With rapidly increasing waste generation, investing in waste-management infrastructure is essential to avoid the human and economic costs linked to inadequate SWM. This is especially critical since the increase in waste generation is expected to concentrate in countries that already face significant SWM challenges, including Egypt, other middle-income countries (MICs), and those affected by conflict and violence (Figure 2.1).[6]

5 Certain data is unavailable for some countries or territories. These are omitted from group analysis. These instances are flagged in the discussion only when omissions are likely to make a difference in the reported patterns.

6 Unless otherwise indicated, sources for waste data are provided in appendix G. Throughout, this section reports the most recent data available for MENA from the year 2022, while the most recent available global benchmark values are referenced to 2016.

Figure 2.1 Municipal solid waste generation in 2022 and projected through to 2050 by income grouping, plus the Islamic Republic of Iran and the Arab Republic of Egypt

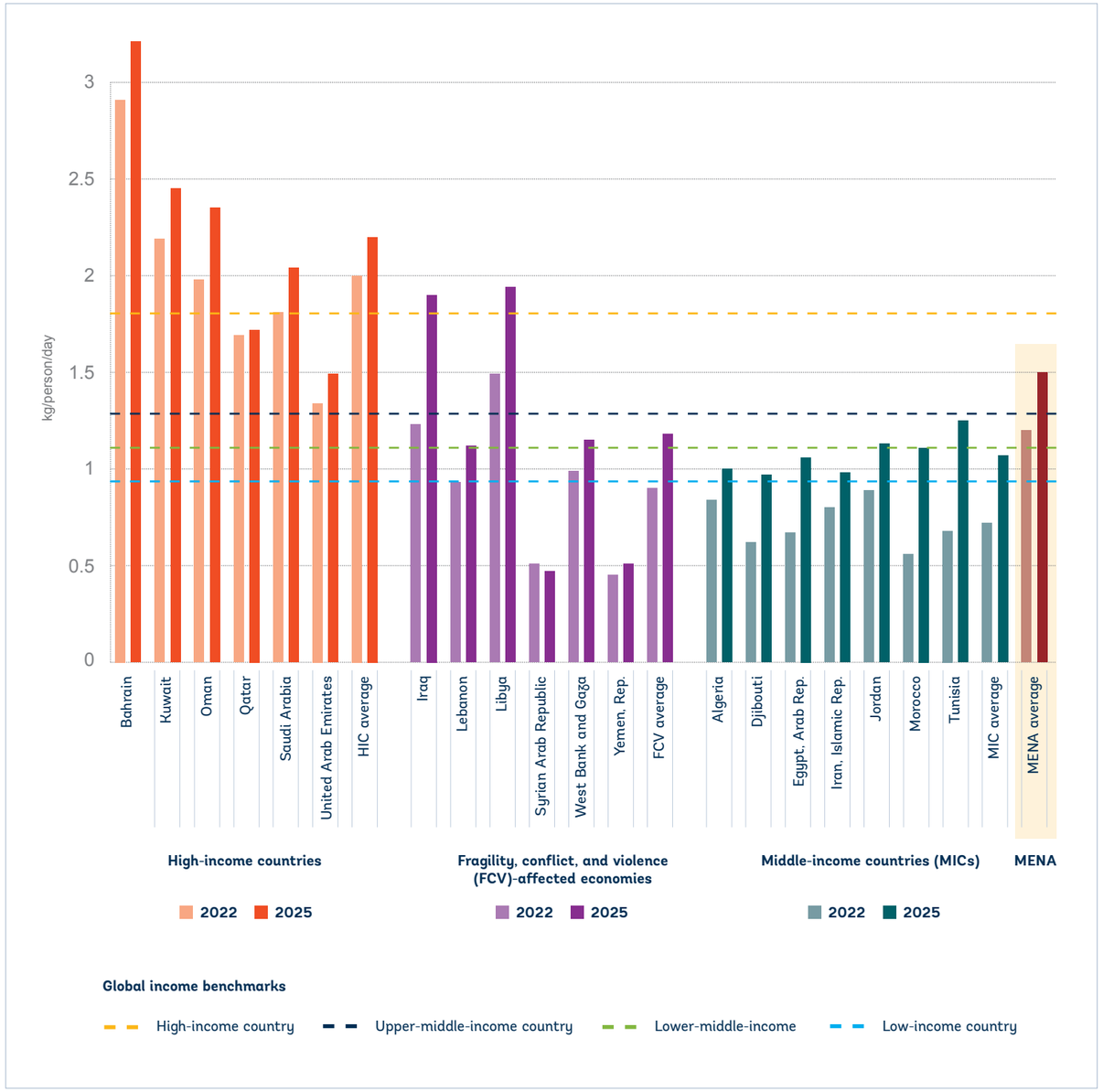


Source: Original figure created for this report.

Waste generated per person in MENA is higher than the global average. MENA's waste generation is 0.88 kilograms per person per day (kg/person/day), compared to the global average of 0.79 kg/person/day. MENA's high-income countries (HICs) generate the most waste per person, at 1.79 kg/person/day, above the global HIC average of 1.58 kg/person/day. The region's MICs produce 0.73 kg/person/day, roughly on par with the global MIC average. Generation in Egypt is slightly lower, at 0.67 kg/person/day, and is somewhat higher in the Islamic Republic of Iran, at 0.80 kg/person/day.

These two countries are the most populated in the region, so tracking their rate of waste generation is especially important. MENA's fragility, conflict, and violence (FCV)-affected economies generate 0.85 kg/person/day, which is higher than typical MIC per-person waste generation, in line with the fact that most FCV-affected economies in MENA are also MICs (with the exception of Syria and the Republic of Yemen) (Figure 2.2).

Figure 2.2 Per-person waste generation by country, with global income-level benchmarks



Source: Original figure created for this report.

2.2 Waste composition

More than half of MENA's waste is composed of food (and green waste), which is a high share considering MENA's socioeconomic context. Globally, food and green waste (often referred to as "organics") make up 44 percent of the waste stream, and the share of organics tends to decrease with economic development and urbanization. In MENA, organics account for 57 percent of all waste, above the global benchmark for every income group. Globally, 36 percent of waste produced by HICs consists of organics, versus 41 percent of waste in MENA's HICs.

The region's MICs, including Egypt and the Islamic Republic of Iran, have a slightly elevated organic waste share of 60 percent, compared to the global MIC average of 55 percent. Similarly, in MENA's FCV-affected economies, organics dominate the waste stream at 65 percent, which can be compared to 57 percent in low-income countries globally. This high share of organic waste is partially due to significant volumes of food waste—a particular concern given challenges in ensuring food security in MENA (Box 2.1).

BOX 2.1 Food loss and waste

Food loss and waste is a significant issue in the Middle East and North Africa (MENA), where 44 percent of all food is lost or wasted (excluding on-farm losses) (Tutundjian and Maroun 2023). One in five of the world's acutely food insecure people lives in MENA (Belhaj and Soliman 2021). Data from several countries in MENA indicate that between 85 and 190 kilograms (kg) of food is wasted or lost per person per year (kg/person/year) in the Middle East and between 84 and 207 kg/person/year in North Africa (United Nations Environment Programme 2024). These figures include both food loss—the loss along agri-food value chains that could be processed into edible food—and food waste, which refers to food fit for consumption that is discarded. In the MENA region, around 19% of the available food (estimated to be 15 million metric tons) is wasted or lost, with one-third of this waste occurring during the consumption stage. The remaining two-thirds of this waste is lost across the entire supply chain—from production to distribution (World Resources Institute 2019).

The economic cost of food loss and waste for MENA is enormous, estimated at over US$60 billion annually (ESG MENA 2023). In addition to these economic losses, food loss and waste also have profound social and environmental implications. Socially, 14 percent of MENA residents suffered from severe food insecurity in 2023 (FAO et al 2024). Saving even some of the wasted food could have alleviated hunger and improved food security in the region. Environmentally, food production consumes substantial scarce water resources, exacerbating water stress. Decomposing food in landfills also emits methane—a potent greenhouse gas that contributes to climate change. Addressing food waste is, therefore, crucial for enhancing food security, conserving resources, and mitigating environmental impacts.

Although food waste management is relatively new to the MENA region, countries are adopting diverse approaches tailored to their unique contexts. Reducing food waste requires policies, consumer awareness, and training of solid waste management service operators. This can include both "hard" interventions, such as food banks and storage technologies, and "soft" measures, such as certification programs and public education campaigns. In countries and territories with governance challenges, private sector and community-led initiatives can still bring about positive change.

MENA countries are taking a diverse set of first steps. Some countries have adopted national strategies and regulations to curb food waste, while others focus on technological innovations, such as food redistribution platforms and advanced storage solutions. Yet others have launched public awareness campaigns and community-driven initiatives, which can play a crucial role in shifting consumer behavior and reducing food waste at the household level.

High-income countries in MENA have invested in policies and startups to tackle food waste. Saudi Arabia has introduced nationwide awareness campaigns, stricter regulations, and the Saudi Zero Food Waste Certification program, leading to significant reductions, particularly during Ramadan (Abiad and Meho 2018). The United Arab Emirates Food Bank redistributes surplus food from hotels and restaurants to those in need. Meanwhile, Qatar is leveraging advanced technologies (such as intelligent packaging and smart sensors) for real-time food-storage monitoring, enhancing food preservation and waste management.

Middle-income countries and fragility, conflict, and violence (FCV)-affected economies currently lack specific food waste legislation, with food waste management typically falling under broader environmental or waste policies. To address this gap, Jordan has launched the National Food Security Strategy 2021–2030 and initiatives like No Food Waste, which focus on reducing waste through policy reforms and awareness efforts. In FCV-affected economies like Lebanon and Iraq, grassroots efforts led by private organizations seek to address the issue of food waste. In Lebanon, initiatives like FoodBlessed and the Lebanese Food Bank recover excess food and redistribute it to those in need. In Iraq, the United Nations Development Organization and the government have provided specialized food safety training to small and medium-sized enterprises to help the food service sector minimize waste during preparation and serving stages (United Nations 2024).

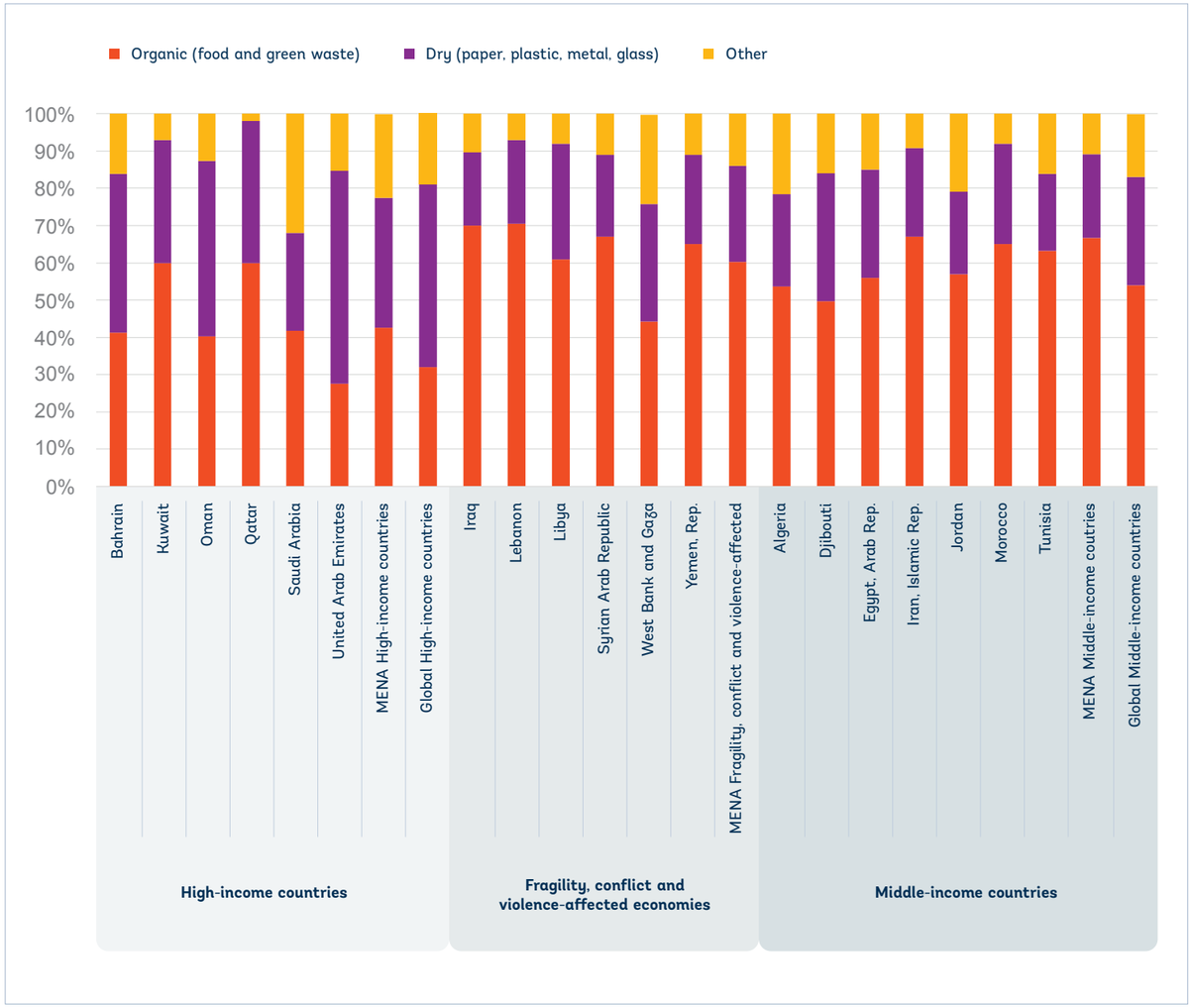
Plastic, paper, metal, and glass account for just over a quarter of MENA's waste (27 percent), which is lower than the global average of 38 percent. Even in MENA's HICs, such dry waste accounts for 34 percent, compared to 49 percent in HICs globally. Among MENA's MICs, the dry waste proportion is comparable to the global MIC average of 29 percent, with Egypt at 29 percent and the Islamic Republic of Iran at 24 percent. Dry waste in MENA's FCV-affected economies represents 23 percent of all waste (Figure 2.3).

In MENA, plastics account for the largest share of dry waste, whereas globally, paper and cardboard are the dominant dry materials in waste streams. Plastic accounts for 12 percent of waste in MENA, while paper and cardboard make up 10 percent, followed by metal (3 percent) and glass (3 percent). This pattern is consistent across all country types, with plastics comprising 16 percent in HICs, 12 percent in MICs, and 8 percent in low-income countries (LICs) affected by FCV.

By contrast, paper can constitute up to 25 percent of waste in HICs globally, highlighting a key difference in material consumption and disposal patterns, as well as recycling opportunities in MENA.

MENA's waste composition highlights a need to focus on reducing food waste, enhancing organic waste management capacity, and maximizing dry waste recovery. The high share of organic waste highlights the importance of reducing food waste and introducing waste treatment methods like composting. The lower proportion of dry waste indicates somewhat more limited recycling potential but still represents opportunities for higher efficiency in recovering materials. Plastics, in particular, constitute a high share of dry waste, reflecting the region's relatively higher plastic consumption. Understanding these patterns will help policy makers design more effective, targeted waste management solutions for the region's key waste streams.

Figure 2.3 Waste composition by country



Source: Original figure created for this report.

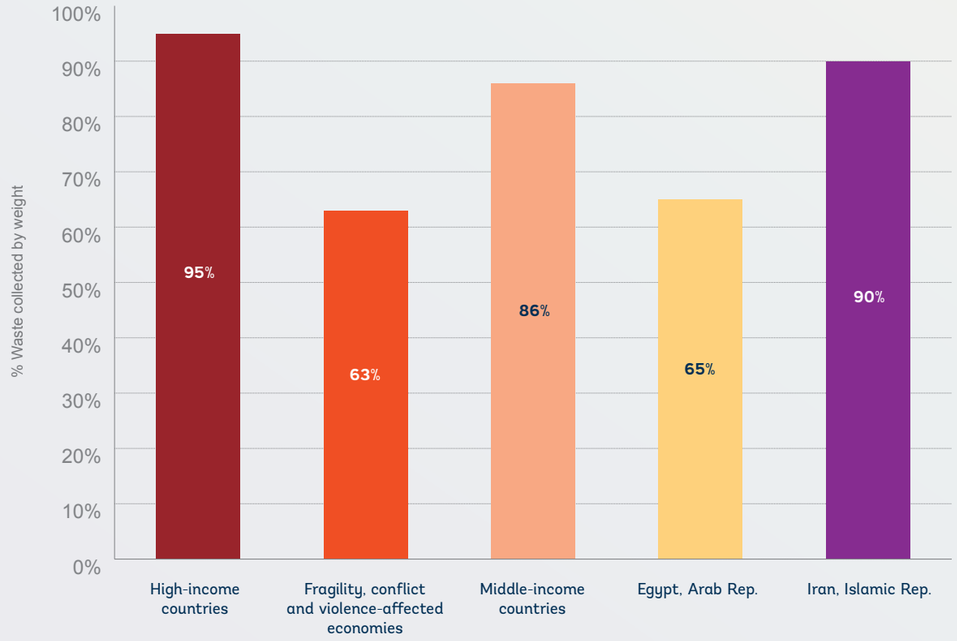
2.3 Waste collection, disposal, and treatment

Waste collection rates across MENA are comparable to global benchmarks, but more than one fifth of waste is still left uncollected. The uncollected waste, which accounts for 21 percent of the 155 million tons of waste generated in MENA (32 million tons), can be assumed to be openly dumped or burned. As is the case globally, waste collection rates in MENA are closely related to economic development. It is highest and nearly universal in HICs (95 percent, the same rate as the global HIC average). Notably, waste collection in MENA's MICs is 76 percent, which is high compared to the global MIC average of 67 percent.

Waste collection is also high in the Islamic Republic of Iran, at 90 percent, while at 65 percent, Egypt's waste collection is comparable to the global MIC average (Figure 2.4). Collection coverage in Syria and the Republic of Yemen, MENA's two LICs, is low and comparable to global LICs' collection rates of 39 percent. Some of the other FCV-affected economies in MENA that are also LICs achieve significant collection rates. For instance, before the ongoing financial crisis that started in 2019, Lebanon achieved nearly universal waste collection (99 percent).

More than half of MENA's collected waste is openly dumped or inadequately disposed of, and at risk of polluting the environment. In addition to the 21 percent of all generated waste remaining uncollected, 37 percent of the waste that is collected is openly dumped, and a further 22 percent remains unaccounted for. Taken together, therefore, about 58 percent of all collected waste must be assumed to be openly dumped or at least is disposed of without adequate environmental control Combining uncollected waste and assumed waste dumping, this means that 67 percent of all generated waste is not adequately managed. This share is significantly above the global average of 33 percent, highlighting the significant environmental and public health risks arising from open dumping in MENA and underlining the need for improved collection efficiency and proper disposal.

Figure 2.4 Waste collection across MENA (by group) and in the Arab Republic of Egypt and the Islamic Republic of Iran



Source: Original figure created for this report.

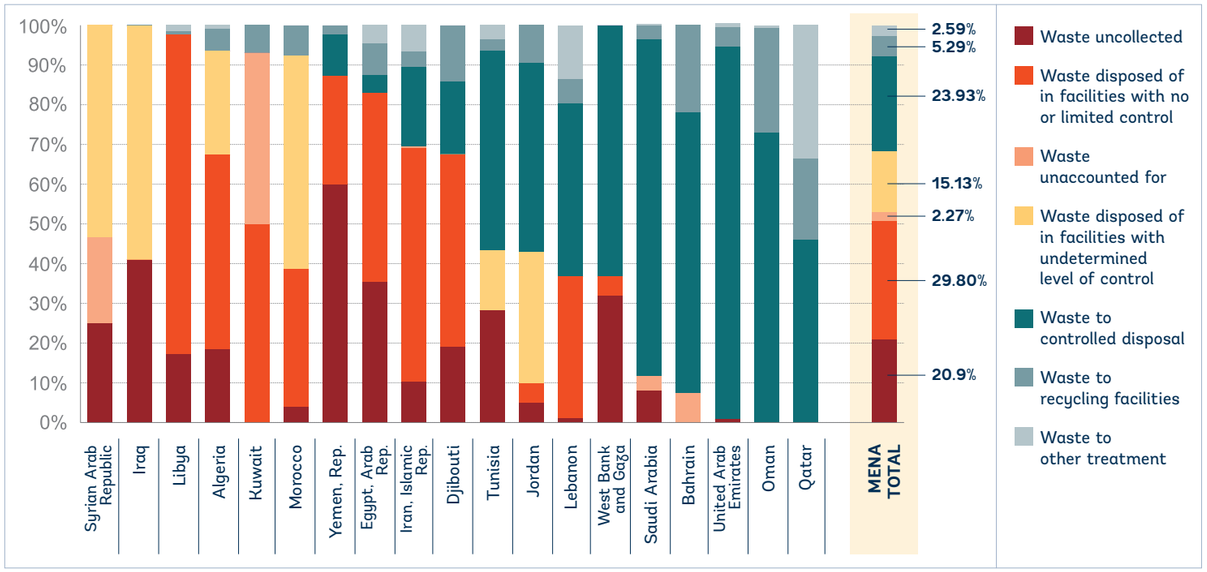
Open dumping is a challenge across all income levels in MENA. In its HICs, an average of 5 percent is dumped in uncontrolled sites, against the 2 percent observed in HICs globally. In MICs, the discrepancy is greater, with 72 percent of waste in MENA's MICs being dumped or disposed of without reported control versus 48 percent globally. In Egypt, 74 percent of collected waste is openly dumped, while in the Islamic Republic of Iran the total is 65 percent. In addition, some 82 percent of waste in MENA's FCV-affected economies is dumped and disposed of without reported control measures.

When waste is managed, landfilling is the predominant waste disposal method. In MENA, only 4 percent of collected waste is disposed of in sanitary landfills with full environmental control ("waste to controlled disposal" in Figure 2.5), while 46 percent goes to landfills with various degrees of control ("waste to other treatment"). Differences by country or economy income level are pronounced. MENA's HICs dispose of about 78 percent of their waste in landfills. The share in HICs globally is lower, at 39 percent, due to the greater use of recycling, composting, and incineration.[7] MENA's MICs use landfills for 29 percent of their waste, below the 36 percent that global MICs achieve on average. The use of sanitary landfills is lower in the Islamic Republic of Iran (22 percent) and far lower in Egypt (7 percent), while MENA's FCV-affected economies use landfills for 11 percent of their waste.

Reuse and recycling remain the exception in MENA, with only 7 percent of waste treated in this way. Reuse and recycling—together with composting and other treatment options, such as digestion and incineration—are sometimes referred to as "landfill diversion". Across MENA, recycling is low compared to global benchmarks. MENA's HICs recycle 8.2 percent of their waste, which is less than half the recycling rate of HICs globally (29 percent).

The recycling share in other MENA countries varies by income bracket. While MICs recycle an average of 7.7 percent of waste (against a global average of between 4 and 6 percent), the region's FCV-affected economies only recycle 1.3 percent of waste on average. Egypt recycles about 13 percent of its waste, while the Islamic Republic of Iran recycles about 4.3 percent. It is worth noting, however, that in many countries—and particularly in FCV-affected economies—the informal collection of recyclable waste materials is underreported.

Figure 2.5 Waste by destination



Source: Original figure created for this report.

Note: Waste to controlled disposal refers to waste sent to a fully engineered sanitary landfill with environmental controls such as liners, leachate collection, and landfill gas management. Landfills with various degrees of control refer to disposal sites with partial measures, ranging from basic controlled dumps to controlled landfills with some environmental controls, such as daily cover, fenced boundary, and so on. Waste unaccounted for refers to the remaining amount In cases where disposal, treatment, and uncollected do not add up to 100 percent. Waste disposed of in facilities with no or limited control refer to dumpsites, which lack infrastructure and systems for environmental protection. Waste to other treatment includes composting, anaerobic digestion, and incineration.

7 The term "landfill" includes sanitary, controlled, or otherwise unspecified landfills.

Although organic waste accounts for more than half of MENA's total waste, composting remains underutilized. Whereas global HICs and MICs report that they compost about 6 percent of all collected waste, only a few countries in MENA report composting, implying that it is not practiced at large scale. Only Egypt, the Islamic Republic of Iran, Lebanon, Qatar, and Tunisia report composting more than 5 percent of their organic waste.

Given the exceptionally high share of organic waste in MENA, at 57 percent, the limited use of composting represents a missed opportunity. Greater adoption would reduce waste levels while supporting the production of valuable compost or alternative energy from biogas.

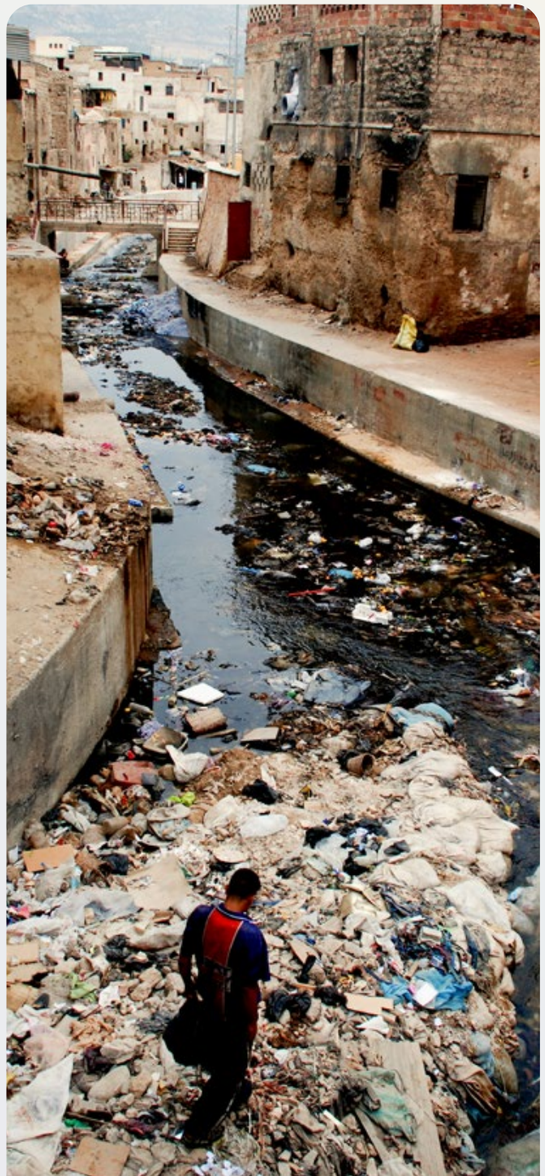
2.4 The social, environmental, and economic impacts of inadequate waste management

2.4.1 Social aspects and public health impacts

Insufficient SWM in the region has significant negative social impacts and economic consequences. Poor urban neighborhoods are the most likely to be negatively affected by meager SWM. Informal waste pickers are among the most vulnerable groups, suffering from constant health hazards and marginalization. In some countries of the region, such as in the Republic of Yemen, women and children are more likely to work as informal waste pickers and face related health hazards. The pollution of water resources and soil contamination affect agriculture and fisheries—important sources of food security and livelihoods for the poor. Community discontent is common, with waste dumps near residential areas leading to opposition and complaints, affecting social cohesion. In Lebanon, for example, there have been protests against the construction of waste dumps near communities.

Most of MENA's waste is either openly dumped or burned, posing severe health risks. An estimated 68 percent of generated waste remains uncollected or is poorly disposed of. One such improper disposal method is open dumping. This creates breeding grounds for disease and increases the spread of illnesses such as dysentery, diarrhea, malaria, and dengue fever (Abubakar et al. 2022). Open burning releases toxic pollutants, including dioxins, furans, and particulate matter, which can lead to respiratory diseases and long-term health effects (Kaza et al. 2018). For instance, during Lebanon's 2015 waste crisis, open burning resulted in a 20-fold increase in the short-term risk of cancer on days when waste was incinerated (Friedrich Ebert Stiftung 2021). Moreover, disadvantaged groups or minorities are more likely to suffer the negative consequences of ineffective waste management or from working informally in waste collection and recycling.

Even the disposal of waste in landfills without full control presents significant health risks. Leachate, a toxic liquid from decomposing waste, can seep into soil and groundwater in landfills without control, posing a risk to drinking water and agriculture (Dagwar and Dutta 2024). Moreover, the burning of waste—which often happens in landfills without control—releases air contaminants and greenhouse gases, such as volatile organic compounds, particulate matter, carcinogens like dioxins and furans, toxic metals, and chemicals, causing respiratory diseases (Kaza et al. 2018). Such exposure to landfill pollution has been linked to respiratory diseases, low birth weight, birth defects, and certain cancers (Siddiqua et al. 2022). Leachate contamination and the burning of waste can only be avoided in well-operated and fully controlled sanitary landfills. Until such processes are in place, poorly controlled landfills—and even more so in uncontrolled dumpsites—present significant contamination risks and contribute to air pollution, odor pollution, and marine contamination through runoff.

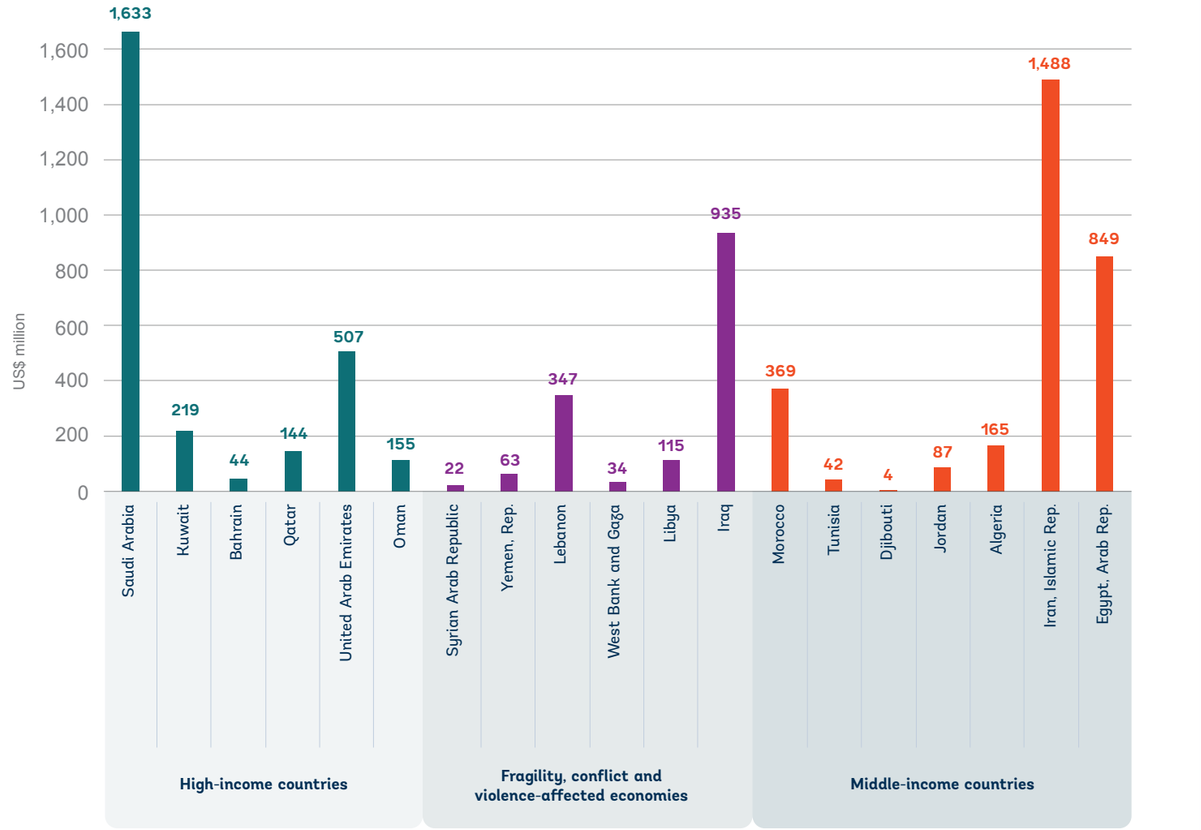


2.4.1 Social aspects and public health impacts

Ineffective SWM costs MENA US$7.2 billion each year through health and environmental impacts, with additional losses due to missed opportunities to recover value. Figure 2.6 summarizes estimated economic losses due to inadequate waste management.[8] This data comes from various sources in several countries in the region and has been extrapolated region-wide (sources available in appendix G). In MENA's HICs, the cost of environmental degradation (COED) is mainly driven by reliance on non-engineered landfills and on missed opportunities to adopt more sustainable waste management methods. In Saudi Arabia and Kuwait, the COED has been estimated at 0.15 percent (US$1.3 billion) and 0.12 percent (US$270 million) of gross domestic product (GDP), respectively.

In MENA's MICs, reported COED levels range between 0.1 and 0.26 percent of GDP, mainly driven by unsanitary landfills and associated land value depreciation. In Egypt and the Islamic Republic of Iran, the COED is driven by open dumping, unsanitary landfills, and untreated waste. Egypt's COED is about 0.2 percent of GDP (about US$850 million) per year, whereas the Islamic Republic of Iran's is estimated at 0.36 percent (US$1.5 billion) per year. MENA's low-income and FCV-affected economies experience COED levels of between 0.2 percent and 1.5 percent of GDP per year, with damages largely associated with increased health risks and contamination from excessive open burning and open dumping.[9]

Figure 2.6 Cost of environmental degradation from solid waste management across MENA



Source: Original figure created for this report., based on sources listed in appendix E.

8 There is no single official or standardized definition of the "cost of environmental degradation", but it is commonly understood to refer to the monetary estimate of welfare losses and damages caused by environmental deterioration—including impacts on human health, productive sectors (such as agriculture, fisheries, industry, and tourism), and the loss or reduced provision of natural resources and ecosystem services. These costs are typically measured using a mix of valuation approaches—such as cost-of-illness, productivity loss, remediation and replacement costs, and stated or revealed-preference methods—to estimate annual monetary damages or their equivalent share of GDP for policy making and comparison.

9 Eleven countries in MENA have reported economic impacts from poorly managed waste under COED studies. These impacts range from 0.1 percent of GDP in Algeria, the Syrian Arab Republic, and Tunisia to 1.5 percent of GDP in Lebanon. To estimate the regional impact, a conservative impact figure of 0.2 percent of GDP was assumed for FCV-affected economies, and 0.1 percent for HICs and MICs without published COED figures.

The benefits of properly managed waste far exceed these—and other—costs. Globally, the total cost of unmanaged waste—estimated at US$375 per ton for uncollected waste—far exceeds what proper waste management should cost (Hauke et al. 2016). For MENA, a good benchmark cost for waste management can be estimated as between US$50 and US$100 per ton. The total cost of unmanaged waste includes: (a) expenses associated with dumping, open burning, and discharging waste into the environment on land and in waterways; (b) costs involved with health impacts; (c) impacts on tourism, fisheries, healthcare, and other sectors; and (d) impacts on land value and hindrances to urban development. These costs cover only a part of overall economic impacts, but are specific to MENA countries, and indicate that the average COED exceeds the cost of US$69 per ton for poorly managing (uncollected or dumped) waste. These comparisons illustrate the potential for economic gains through better SWM in MENA.

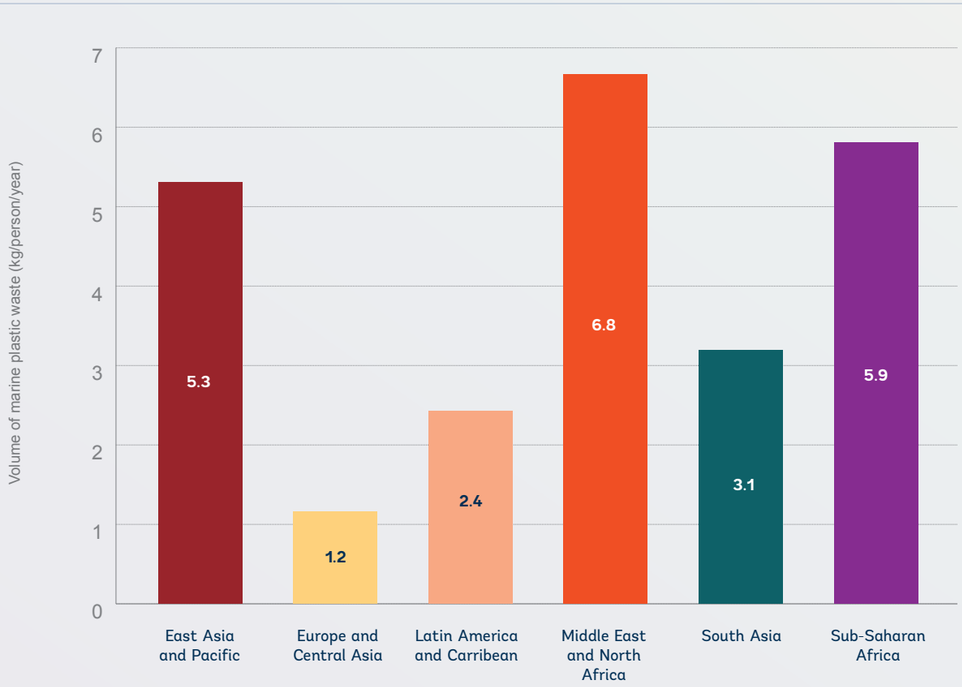
The underdevelopment of circular measures such as recycling and reuse has economic repercussions, and therefore limits economic growth and resource efficiency. Not diverting waste results in lost resources and unseized economic benefits that could be obtained from recycling materials or converting waste to energy or compost. Indeed, capturing waste from municipal waste systems to reclaim useful materials could grow the global economy by US$109 billion (UNEP and ISWA 2024). These circular initiatives are discussed further in chapter 5.

Moreover, land dedicated to waste disposal sites cannot be used for other important needs, such as housing, agriculture, or industrial development. In addition, land values near disposal sites typically depreciate, deterring investment and reducing the potential for economic development.

2.4.3 Environmental impacts

Open burning of waste and anaerobic decomposition in open dumps releases greenhouse gases (GHGs), directly contributing to climate change. The waste sector is the fourth-largest global source of methane, a potent GHG, and is responsible for 20 percent of methane emissions (World Bank 2022a). MENA's waste sector alone accounts for 26 percent of the region's methane emissions (Global Methane Initiative 2024), highlighting its substantial role in climate impacts. Despite 10 out of MENA's 19 countries making Nationally Determined Contribution (NDC) commitments, GHG emissions from the SWM sector remain high, signaling the need for more efficient management systems. Such systems include targeted and performance-based investments in infrastructure—especially fully controlled landfills that capture methane—the mitigation of open dumping and burning, and alternative waste treatment methods like composting. The potential for mitigation is significant: reductions in solid waste related methane in the MENA region could contribute up to 28 percent of the region's total NDCs. GHG reductions in the sector may also present options for carbon finance.

Figure 2.7 Volume of plastic leaked into the marine environment (per person and by region)



Source: World Bank 2022a (from Jambeck et al. 2015).

The MENA region is a major contributor to plastic waste in the marine environment. Each year, between 150,000 and 500,000 tons of macroplastics and between 70,000 and 130,000 tons of microplastics enter and pollute the Mediterranean Sea. Moreover, MENA has the highest per-person footprint of plastics leaking into the region's seas (Figure 2.7). Indeed, the Mediterranean is among the world's most plastic-polluted seas, with as much plastic flowing into it each year as the volume of fish taken out from the two most-caught species (Heger et al. 2022).

Beach litter can lower revenues and imperil jobs in the tourism sector. In the Middle East alone, the tourism sector contributed US$323.6 billion in 2019, accounting for 8.4% of regional GDP (WTTC, 2022). According to the United Nations' World Tourism Organization, for the 19 MENA countries for which data was available, tourism employs nearly 5 million people and creates up to 10 percent of all jobs in Egypt, and 9 percent in Iraq and Tunisia.

Poor SWM poses a significant threat to this key sector. While no damage estimates are available for MENA, studies from Korea, South Africa, and the US have shown that beach litter can substantially reduce the number of visitors and revenue from tourism, with reductions of between 26 percent and 50 percent at severely polluted sites (Jang et al. 2014; Ballance et al. 2000; Ofiara and Brown 1999). Inadequate SWM in urban settings can also deter tourism development. The intention to develop tourism has been the impetus behind improving SWM in places like Montenegro, the Maldives, and Bali in Indonesia.

3

UNPACKING THE CHALLENGES: KEY PLAYERS, POLICIES, AND PRACTICES IN MENA'S SOLID WASTE MANAGEMENT SYSTEMS

Key messages

- The MENA region has developed suitable legal SWM frameworks in line with their income levels, but the enforcement and coordination between national and local authorities remain challenging.
- The private sector is involved in waste collection and treatment but less so in waste disposal. Greater engagement of private sector is crucial, especially where SWM is underdeveloped, and circular measures need to be introduced or strengthened.
- In MENA, SWM sector employs about 400,000 workers formally, with at least as many engaged in the informal sector.
- To reach SDG Target 11.6—universal collection and management in controlled facilities—the MENA region would need to raise annual SWM expenditures from US$7.7 billion to US$11.6 billion.

This chapter examines how solid waste management (SWM) is governed and organized across the Middle East and North Africa (MENA), focusing on the following key elements:

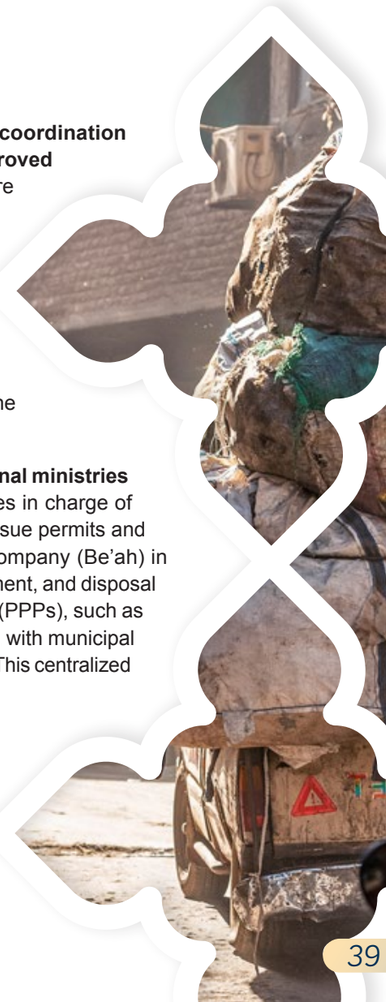
- **Governance** (including policies, regulations, and enforcement)
- **Private sector engagement**
- **Employment**
- **Financing.**

3.1 Governance and policies

3.1.1 Governance

Most MENA countries have well-established SWM institutions but need better coordination between national and local authorities, enhanced regulatory frameworks, and improved enforcement mechanisms. Across the MENA region, governance structures for SWM are diverse. Strengthening governance will enable more effective SWM systems and allow for improved environmental outcomes and greater participation by the private sector. By examining governance models, policy makers can identify gaps, streamline coordination between national and local authorities, and foster private sector participation to achieve better outcomes. Effective governance can also ensure that SWM systems are responsive to environmental concerns and other challenges, such as the region's rapid urbanization and climbing waste generation. As part of efforts to improve governance, it is crucial to address institutional and financial constraints at the level of cities and towns, where many key SWM decisions are taken.

In high-income countries (HICs), SWM governance is highly centralized, with national ministries or state-owned enterprises playing key roles. Line ministries (for instance ministries in charge of the environment or of municipalities) oversee policy and planning. Regulatory bodies issue permits and licenses. State-owned enterprises—like the Oman Environmental Service Holding Company (Be'ah) in Oman and Tadweer in the United Arab Emirates (UAE)—manage waste collection, treatment, and disposal services. The private sector is increasingly involved through public-private partnerships (PPPs), such as Qatar's Domestic Solid Waste Management Centre. Local authorities provide oversight, with municipal fees often integrated into utility bills or managed through contracts with private companies. This centralized approach ensures coordinated policy but may limit local responsiveness and flexibility.

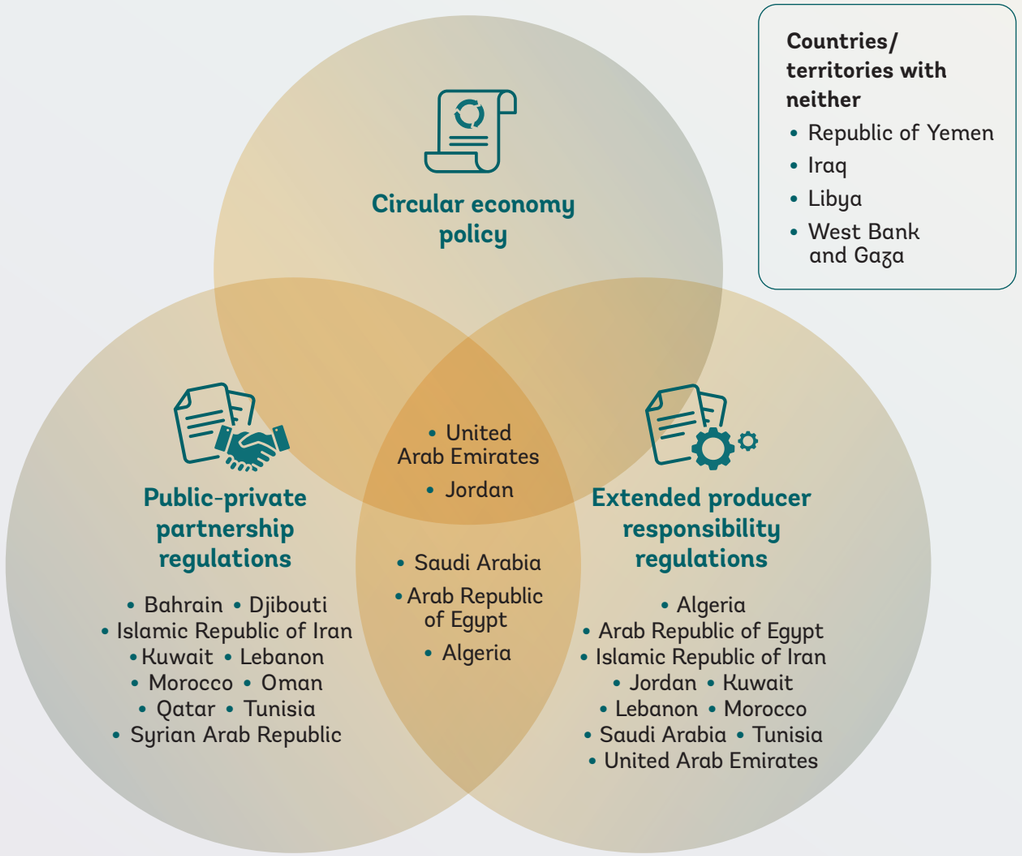


In middle-income countries (MICs), including Egypt and the Islamic Republic of Iran, SWM governance involves collaboration between national agencies and local authorities. Central ministries often work alongside specialized national waste-management agencies and local authorities. For example, Egypt's Ministry of Environment works with the Waste Management Regulatory Authority and the Egyptian Environmental Affairs Agency to oversee compliance and enforce standards, with regional governorates supervising the local municipalities responsible for service provision. Jordan's Greater Amman Municipality exemplifies localized governance, directly managing SWM services and infrastructure. However, limited financial resources and capacity constraints at the local level present challenges regarding the efficiency of this model. In the populous nations of Egypt and the Islamic Republic of Iran, aligning governance frameworks in the context of rapid urbanization and increasing waste generation becomes a challenge.

Fragility, conflict, and violence (FCV)-affected economies face significant governance challenges due to political instability, economic crises, and institutional weaknesses. For example, Lebanon signed a law creating a National Waste Management Authority in 2018, but the authority's establishment has been delayed by ongoing economic and political shifts. In Syria and the Republic of Yemen, local authorities are nominally responsible for SWM but struggle due to limited capacity and the effects of ongoing conflicts. International organizations often fill the gaps, providing essential support for waste management services. These governance challenges emphasize the need for international cooperation to temporarily bridge capacity deficits and restore stable systems.

The waste policy landscape in MENA is diverse but uneven, with only a few countries, such as the UAE and Jordan, having introduced policies that integrate circular economy, PPPs, and extended producer responsibility (EPR). Most others have made progress in one or two areas, while countries such as the Republic of Yemen, Iraq, Libya, and West Bank and Gaza currently have none of these policy instruments in place (Figure 3.1).

Figure 3.1 The policy landscape in MENA



Source: Original figure created for this report.

Global and MENA experience shows that decentralized SWM models are more resilient to economic, climatic, and fragility shocks. Waste management is seen as a core function of local governments. The central governments—through line ministries (for instance, Ministry of Environment) or special sector agencies—are responsible for sector policies and providing the necessary regulatory oversight, often subsidizing investments and operations. Decentralized SWM services and infrastructure facilitate local participation and increase transparency in decision-making. The municipal development programs run by some of MENA's lower-middle-income countries (LMICs) provide an excellent opportunity for local governments to improve the quality of their SWM services. Particularly where there are frequent shocks that disrupt economic life, decentralization with local mandates to manage waste and raise funding can help maintain the capacity to react. Decentralized SWM models are thus particularly important in the region's FCV-affected economies. The provision of SWM services in Lebanon and the West Bank and Gaza illustrate that decentralization helps to maintain significant levels of service provision, despite frequent and severe challenges. However, decentralization can only be efficient if local authorities are equipped with the necessary capacity, resources, and mandates—legal, institutional, and financial—to allow them to deliver services.

3.1.2 Policies, regulations, and enforcement

Countries in the MENA region have developed legal frameworks for SWM, but insufficient enforcement remains a significant challenge and undermines the effectiveness of policies. Many countries have introduced national strategies with targets for 2030 or 2040 that focus on universal waste collection, waste diversion from landfills, reducing waste generation, and improving material recovery. Some countries have adopted circular economy principles by, for example, implementing an EPR—an environmental policy approach that holds producers accountable for waste from their products (Section 5.2). However, due to inefficient institutional oversight and weak enforcement, national commitments and targets often do not translate into action and results.

Nearly all HICs have national waste management strategies in place with goals to divert waste from landfill and adopt circular economy practices. Kuwait, for example, has the National Waste Management Strategy 2040 with specific circular economy goals. Some countries, like Saudi Arabia and the UAE, have implemented policies to reduce plastic use through taxes, to improve segregated waste collection with the help of deposit-refund schemes, and to engage the private sector through EPR mechanisms. Such progress, however, is not yet at scale, given the fact that only 8 percent of waste is recycled in MENA's HICs. This limited improvement suggests that further support and investment are needed to improve waste management systems and achieve sustainability goals.

Most MICs have developed SWM policies, although they are less ambitious than those of the HICs. Limited financing and lack of oversight hamper progress. Jordan stands out as an example of ambition with its ongoing circular economy plan and an EPR mechanism. Similarly, Morocco has enacted regulations that target waste segregation at the source, focusing on households and other municipal solid waste generators. However, as across all MICs, national SWM strategies do not necessarily translate to effective action, primarily due to financial constraints and lack of monitoring and enforcement. For example, even though Egypt has introduced ambitious waste management reforms and is working to establish EPR mechanisms, implementation remains a challenge, particularly at the local level. Meanwhile, the Islamic Republic of Iran has focused on improving its waste management infrastructure but continues to rely heavily on landfills, while progress on circular economy initiatives remains limited.

All FCV-affected economies in MENA have SWM policies in place, but enforcement remains weak. As noted, SWM challenges in these economies remain pronounced, with 37 percent of all waste uncollected, more than 80 percent of collected waste openly dumped or not tracked, and a recycling rate of only 1.3 percent. The absence of enabling and efficient policies and infrastructure further exacerbates waste management issues in FCV-affected economies. Lebanon is the only FCV-affected country with a strategy for SWM that aligns with a circular economy. However, lack of accountability for service providers, insufficient institutional capacity with challenges relating to adequate staffing for regulatory oversight, and an ongoing financial crisis that started in 2019 hamper the implementation of this strategy.

BOX 3.1 How Morocco governs its solid waste management

In the early 2000s, research showed that environmental degradation due to poorly managed waste cost Morocco 0.5 percent of its GDP. Since then, waste management has been a priority for the country, with the government launching its well-articulated Programme National de Valorisation des Déchets Ménagers (National Municipal Solid Waste Management Program, or PNDM) for 2008 to 2022 to improve the sector's environmental footprint. This program has shaped the current municipal solid waste management (SWM) system.

Specific objectives of the PNDM included: rolling out subnational waste-sector master planning; achieving a collection target of 90 percent; recycling at least 20 percent of waste; sending 100 percent of collected waste to controlled landfills; the remediation or closure of dumpsites; the professionalization of the waste management sector by providing training and technical assistance to municipalities; and running public awareness campaigns.

Defined by the Solid Waste Law (N. 28-00) and the Municipalities Organic Law (N. 113-14), municipalities are now responsible for municipal waste management, including collection, treatment, recovery, and disposal. They are also entitled to collect user fees to recover costs. Several other public and private stakeholders are also involved in the sector at both the central and local level, as described in Figure B.3.1.1.

Figure B.3.1.1 Stakeholders involved in municipal solid waste management in Morocco and their respective roles

Central government

- Establish the appropriate regulatory framework for the sector with operational monitoring and enforcement mechanisms
- Formulate a sector vision, sector plan, and a programmatic approach to achieve this vision
- Establish and maintain a dashboard for sector data to inform policy making
- Provide financial incentives and promote appropriate policies for sustainable and integrated sector management.

Municipalities

- Manage municipal solid waste management (SWM), including collection, treatment, recovery, and disposal
- Provide the appropriate technical and financial resources for the sector at the municipal level is adequate to cover related costs with the ability to collect user fees
- Ensure sector planning at the municipal level through the preparation of municipal SWM master plans
- Enter into contracts with private operators following delegated service delivery models
- Interact with all stakeholders to ensure integrated and sustainable service delivery.

Private operators

Operate under delegated service delivery models, meeting contracts related to waste collection, landfilling, and valorization.

Waste pickers, recycling industry, cement industry, and other industries

Collect, sort, and valorize waste through various processes, such as recycling, composting, and waste-to-energy.

Citizens and businesses

- Generate waste and are responsible for waste minimization and separation
- Pay for waste collection and disposal services when a fee is introduced.
- Provide feedback on the service quality.

Source: Original figure created for this report.

The PNDM played a dominant role in developing sector governance and improving waste services. The national program was governed by a national commission that was chaired by the Ministry of Energy Transition and Sustainable Development and included relevant central agencies to ensure coordination at the required decision-making level over the program's implementation period. A support team was also established at the Ministry of Interior to monitor implementation and coordinate with the municipalities.

Important governance achievements from PNDM implementation included: (a) the identification of eligibility criteria for municipalities seeking a dedicated waste management budget; (b) the establishment of legal arrangements around waste classification and technical standards for landfilling; (c) the promotion of access to information, fostering transparency, and improving accountability to citizens through various measures; (d) the introduction of intermunicipal and regional public-asset companies to deliver waste services; and (e) the rollout of a national program to support local governments with intergovernmental institution-building for the first pilots in metropolitan districts and intermunicipal arrangements.

Since the introduction of the PNDM and the governance improvements it brought about, Morocco has managed to more than achieve its targets for waste collection and made significant improvements in planning, waste disposal, recycling, and budgeting. Through the PNDM, municipalities have benefited from financial and technical support to upgrade the quality of the municipal solid waste service delivery. Several municipal SWM masterplans were developed at the provincial level, and contractual frameworks' templates and oversight modalities were prepared for delegated service delivery to the private sector.

However, challenges in planning, service delivery, sector monitoring, and oversight capacity at both central and local levels impacted the sector's environmental and financial situation (namely leachate accumulation and mounting arrears). In parallel, sector governance practices set under the PNDM encountered challenges, including overlapping interventions and mandates, as well as the need to further enhance sector oversight and monitoring, and vertical and horizontal sector policy coordination.

In addition, there remains opportunities for further improvements, for example, more ambitious recycling and disposal targets could be achieved, and the sector's financial management could be enhanced so that it relies less on funding from local government budgets and transfers. Such ambitious improvements might be integrated into the second-generation PNDM, which the Ministry of Interior has recently started leading the development of with the Ministry of Finance, with the Ministry of Energy maintaining regulatory oversight.

3.2 Private sector engagement

Private sector engagement could improve service efficiency, expand coverage, and drive innovation in SWM. Private sector involvement brings valuable expertise, investment, and efficiencies to SWM operations. Across MENA, private sector engagement is most common in waste collection and treatment; waste disposal facilities tend to be managed by the public sector. The private sector is most often engaged as a contracted service provider. Analyzing the degree of private sector participation would enable policy makers to identify gaps in service delivery, optimize SWM, and leverage the strengths of both public and private entities. Appendix C describes existing PPP arrangements in the region.

In HICs, the private sector plays a significant role in SWM, even making investments in waste collection and treatment infrastructure. Waste collection is fully privatized in HICs—except in Saudi Arabia, where private services are primarily limited to urban areas. The governments of HICs engage private companies to treat waste through concession contracts and PPPs, while state-owned entities manage recycling in some cases. HICs are expanding private sector participation through PPP models, enhancing efficiency and service delivery. Private sector engagement is particularly strong in larger cities, affluent areas, and tourist destinations, contributing to a more formal and professional service structure. In practice, the private sector's investments and operating costs need to be recouped through services charges, such as collection fees, gate fees, and revenues from recycling.

The private sector's contribution to SWM in MICs can be expanded. Three out of the four smaller MICs primarily rely on public services. Morocco is the exception in that private companies handle collection, while in Jordan, the private sector manages specific waste streams, such as hazardous waste. In Egypt and the Islamic Republic of Iran, the private sector primarily manages waste collection. Disposal and treatment are often outsourced to the private sector through concession contracts or build-operate-transfer arrangements. The informal private sector also plays a large role: in Cairo, about 40 percent of waste collected is managed by formal and informal waste workers, while in the Islamic Republic of Iran, recycling is largely managed by the informal sector. MICs could engage the private sector more consistently on waste collection to improve the efficiency of collection, mitigate open dumping, and increase the amount of waste that is recycled.

In MENA's FCV-affected economies, private sector involvement is much less developed or entirely absent. In Libya, the West Bank and Gaza, and the Republic of Yemen, the central or local government are responsible for the entire waste management cycle. There is either no private sector participation or private service coverage is limited to certain areas. Even in areas where private companies are involved, service coverage remains limited. In Lebanon, the central government plays a key role in managing waste disposal and recycling facilities, which are mostly operated by private contractors. However, after 2019, the financial crisis decimated the country's fiscal capacity, and most recycling facilities have been taken out of service.

3.3 Role of the informal sector

The informal SWM sector plays a crucial role in MENA countries, particularly where formal systems are ineffective or absent. Informal SWM activities thrive in economic instability, high unemployment rates, and limited job opportunities, especially in economically poor areas. Informal waste workers manage a substantial portion of waste, providing essential services that formal systems struggle to deliver, especially with rapid urbanization. In Egypt, for instance, the Zabbaleen (garbage collectors) have established an efficient system, collecting between 50 percent and 60 percent of Cairo's waste and achieving recycling rates as high as 80 percent (WEF 2021). This demonstrates the potential for informal workers to effectively manage urban waste. In Morocco, the work of informal waste collectors (known as Bou'ara or Mikhala) not only addresses environmental degradation but also represents a vital economic opportunity and source of income for the urban poor. Similarly, in Jordan, informal waste collectors engage in informal recycling markets, extracting valuable materials and alleviating the burden on landfill sites. Women play a critical role in the process. In Moroccan cities, men typically handle higher-value recycling materials like metals and plastics, while women often focus on sorting organic waste. The Zabbaleen communities in the Greater Cairo area have a family business model, with women and girls playing a crucial role in sorting recyclables as the first step in a more sophisticated process.

Informal workers face difficult conditions that hinder their ability to make a good living. Legal and institutional frameworks insufficiently recognize and support the informal sector's contributions. This lack of formal recognition often leads to social stigma and exclusion from the training, social, and financial services that could make informal SWM activities sustainable and more productive, while also helping informal workers adopt innovative SWM practices. Informal workers frequently endure poor living standards and unsafe working conditions, with limited access to health and safety measures. The prevalence of child labor and the absence of social security further exacerbate these challenges, making it difficult for informal workers to achieve economic stability and social inclusion. The economic contributions of informal SWM workers are often overlooked, preventing the development of structured systems that could facilitate collaboration with municipal waste management. Addressing these challenges through targeted policies and strategic integration efforts is vital for improving SWM effectiveness and advancing inclusion in the MENA region.

3.4 Jobs

While data is limited, the SWM sector is estimated to provide up to 400,000 formal jobs and a similar number of informal jobs in MENA. The SWM sector provides livelihoods for both formal and informal workers, including marginalized communities across the region. Globally, the formal SWM workforce in 2023 was estimated at 6.9 million or around 0.2 percent of all employment (ILO 2024). Applying the same ratio to MENA, the sector has the potential to create 300,000 jobs. However, a simple extrapolation from data collected in 12 of the region's 19 countries suggests a higher level of formal employment in the sector of between 334,000 and 422,000 jobs, equivalent to 0.3 percent of all employment in MENA (Table 3.1).[10]

Informal workers play a pivotal role where formal systems are underdeveloped. However, with little systematic data collection, their contributions often go unrecognized. Globally, informal waste workers are estimated to number between 15 million and 20 million—more than double the formal workforce (WIEGO 2019).

Very little data is available on the number of informal SWM workers in MENA. Extrapolation based on information from six countries in the region suggests that between 344,000 and 498,000 people are informally employed in the sector, which is similar to the number of formal jobs.[11] Together, formal and informal employment in the waste sector, therefore, account for about one in every 200 jobs in the region.

Formal employment is highest in the region's HICs, while MICs and FCV-affected economies rely on a mix of formal and informal employment, in line with overall labor market patterns. The share of formal employment in the SWM sector varies with the overall labor market conditions in the region's economies. MENA's HICs mostly rely on formal employees of private sector contractors, while informal employment remains negligible due to stringent regulations and the efficiency of the formal system. In the MICs, formal and informal employment in the sector coexist. Jordan, for instance, had approximately 6,400 formal workers in 2020, along with nearly as many informal workers (6,500) (Table 3.1). These informal workers often operate at dumpsites, playing a critical role in achieving Jordan's 95 percent waste collection rate. The Islamic Republic of Iran's waste sector similarly combines formal and informal systems, with recycling initiatives supported by municipal authorities and independent informal waste pickers. Egypt stands out in the MENA region for its well-organized informal waste sector, led by the Zabbaleen community. It is estimated that up to 200,000 informal workers are active in Cairo's waste sector, vastly outnumbering Egypt's roughly 37,000 formal SWM workers. Similarly, those FCV-affected economies for which data is available engage both formal and informal workers in their waste systems. In 2021, Iraq reported about 34,000 formal SWM workers, supported by more than 40,000 informal workers. In the West Bank and Gaza, 800 formal SWM workers and about twice as many informal sector workers were reported in 2022.

10 To estimate current formal and informal SWM employment, the ratio of SWM workers per 100,000 people in the reference year was applied to the current population for countries for with available data. Where no data was available, the number of SWM workers was imputed based on population and the number of SWM workers per 100,000 people, using either the MENA average or the average for MENA countries within each country's income category.

11 Estimates were obtained by the same process described in the previous footnote, with the range indicating imputation based on the MENA and income group mean, as well as using either the number of Zabbaleen workers reported in Cairo for Egypt or an imputed value.

Table 3.1 Number of formal and informal workers in the waste sector in select countries

Country	Base year	Number of formal workers in the waste sector	Number of informal workers in the waste sector	Number of formal workers in the waste sector (per 100,000 people)	Number of informal workers in the waste sector (per 100,000 people)
Algeria	2014	20,000	N/A	52	N/A
Egypt, Arab Rep.	2018	37,237	up to 200,000	36	N/A
Jordan	2020	6,400	6,500	59	60
Tunisia	2020	N/A	8,000	N/A	66
Lebanon	2022	11,096	5,200	203	95
Iraq	2021	33,593	40,383	78	93
West Bank and Gaza	2022	801	1,636	16	35
	2020				
Bahrain	2021	3,000	N/A	206	N/A
Kuwait	2019	31,500	N/A	710	N/A
Oman	2022	7,005	N/A	154	N/A
Qatar	2019	4,832	N/A	173	N/A

Source: See appendix G.

Note: **In Algeria**, formal workers were only engaged in solid waste collection. **In Egypt**, formal workers were only engaged in SWM activities, while informal workers were from Cairo's Zabbaleen community. **In Jordan**, waste diversion from landfill rates were collected for the year 2018 and were assumed to have remained the same in 2020. **In Lebanon**, formal workers were engaged in sewerage, water supply, and waste management activities. **In Iraq**, formal workers were engaged in sewerage, water supply, waste management, and remediation activities. Waste diversion from landfill rates were collected for 2019 and were assumed to have remained the same in 2021. In **West Bank and Gaza**, formal workers were only engaged in SWM activities. Waste diversion from landfill rates were collected for 2022 and were assumed to have been the same in 2020. **In Bahrain**, formal workers were engaged in sewerage and SWM activities. **In Kuwait**, formal workers were only engaged in solid waste collection and transport, and street-cleaning. **In Oman**, formal workers were engaged in sewerage, water supply, waste management, and remediation activities. **In Qatar**, figures are for formal workers only engaged in SWM activities.

Earnings among SWM workers are competitive in the formal sector, while income among informal workers is more aligned with income for day laborers. Formal workers' wages in Morocco reportedly ranged between US$455 and US$661 per month (ERI n.d.(c)). As is typical of formal wage work in MENA, this is an elevated earnings range, mostly above the typical (median) monthly revenue in urban settings of 5,208 dirham (about US$520) in 2022–2023 (Haut-Commissariat au Plan 2025). Earnings among informal sector workers in Jordan were much lower, between US$212 and US$494 per month (Taher et al. 2022). The low end of this range is well below the median income among day laborers in Jordan of about US$367 per month, while the high end is just below the typical wage among all workers, whether formal or informal, of US$522 per month.

Working conditions for informal workers are often harsh, especially in lower-income countries. Formal workers in MENA's HICs can earn between US$1,189 and US$1,824 per month in Saudi Arabia (the lower end of the spectrum is similar to the mean wage among Saudi nationals with no schooling of 4,444 riyals, or about US$1,185) and between US$1,424 and US$2,212 in the United Arab Emirates, with informal sector waste pickers reportedly receiving similar incomes in Saudi Arabia (ERI n.d.(a), ERI n.d.(b), SalaryExpert n.d.).

3.5 Financing

MENA spends US$7.7 billion every year on SWM but does not always achieve service levels that could be expected at this level of expenditure. Waste collection and treatment are the major expense areas. Compared to global benchmarks, MENA's spending on collection results in service levels that can be expected for money spent. However, spending on treatment and disposal does not achieve the results that should be expected, suggesting inefficiencies. By analyzing the region's spending and how MENA compares to global standards, performance can be evaluated in financial terms. Such evaluations can also lead to the identification of opportunities to improve waste management systems through targeted investments and efficiency improvements.

MENA allocates approximately US$3.5 billion per year to waste collection, or US$29 per ton of waste collected, achieving significant collection efficiency of 79 percent. In MENA, HICs spend on average US$40 per ton of waste collected, while MICs spend an average of US$25 per ton. Global benchmarks for what it should cost to provide adequate collection services suggest that HICs should pay US$45 per ton, MICs should pay between US$34 and US$38 per ton, and low-income countries (LICs) should pay about US$30 per ton.[12] Considering that MENA's HICs (except for Saudia Arabia) and some of its MICs have near-universal waste collection, this data suggests that average spending on collection at US$41 per ton is reasonably efficient in HICs and, at US$25 per ton, particularly so in MICs. However, at an average of US$19 per ton, spending in MENA's FCV-affected economies is particularly low for waste collection. MENA's low-income countries spend even less at US$12 per ton—an amount which is well below the global benchmark for that group of countries, reflected in the lower performance of waste collection in these countries.

Current spending could cover the costs of treatment and sanitary disposal, but more than half of all collected waste is dumped or unaccounted for, reflecting inefficiencies. Even basic waste treatment and disposal require expenditures that are comparable to those of waste collection. MENA's annual spending on treatment and disposal is estimated at US$4.1 billion per year, slightly more than its spending on waste collection. MENA's HICs achieved almost complete sanitary disposal and spent an average of US$46 per ton, which is in line with global benchmarks, considering that they mostly landfill waste (global HICs spend US$40 to US$100 per ton [Kaza et al. 2018], depending on their mix of waste treatment and disposal, with treatment generally more expensive than disposal).

For MENA's MICs and LICs, spending on disposal and treatment were comparable with spending by their global peers. MENA's MICs spent an average of about US$30 per ton, compared to between US$15 and US$65 per ton spent by MICs worldwide. MENA's LICs spend about US$15 per ton, similar to the same group globally (between US$10 and US$20 per ton) (Kaza et al. 2018). Since MICs and LICs across the world significantly underbudget for disposal, it is fair to say that MENA's MICs and LICs also spend substantially less than what would be required to provide adequate services and meet Sustainable Development Goal (SDG) targets (Table 3.2).

12 These estimates include capital cost, which is often not considered in budgeting.

Table 3.2 Spending per country on collection, treatment and disposal, and landfill diversion

Country	Sector expenditures (2022)	Global benchmark cost for reaching 2022 performance level	Global benchmark cost for increasing collection to 100% (2022)	Global benchmark for 100% collection and adequate treatment/ disposal (SDG 11) (2022)	Total spending (collection + treatment/ disposal) (2022)	Spending needs to meet SDG Target 11.6 in 2022 volumes
	(US$ million)	(US$ million)	(US$ million)	(US$ million)	(US$/ton)	(US$/ton)
Saudi Arabia	1,339	1,531	1,664	1,747	70	84
Kuwait	368	228	228	294	105	84
Bahrain	145	164	164	135	90	84
Qatar	192	185	185	147	110	84
United Arab Emirates	536	396	396	413	110	84
Oman	360	327	327	275	110	84
HIC total	**2,940**	**2,832**	**2,965**	**3,011**	**86 (average)**	**84 (avg.)**
Syrian Arab Republic*	61	126	167	261	20	64
Yemen, Rep.*	88	185	247	400	35	64
LIC total	**149**	**311**	**415**	**661**	**27 (avg.)**	**64 (avg.)**
Morocco	476	469	489	527	65	69
Tunisia	141	151	168	208	65	69
Egypt, Arab Rep.	966	918	1,412	1,878	55	69
Lebanon*	144	123	123	134	75	69
Djibouti	9	8	13	18	55	69
Jordan	259	231	243	250	75	69
West Bank and Gaza*	58	90	113	131	45	69
LMIC total	**2,052**	**1,990**	**2,559**	**3,145**	**61 (avg.)**	**69 (avg.)**
Algeria	511	703	781	1,043	45	75
Iran, Islamic Rep.	1,406	1,245	1,383	1,959	60	75
Libya*	161	167	209	293	50	75
Iraq*	462	711	888	1,469	40	75
UMIC total	**2,540**	**2,825**	**3,261**	**4,763**	**51 (avg.)**	**75 (avg.)**
MENA total	**7,681**	**7,958**	**9,200**	**11,581**	**62 (avg.)**	**73 (avg.)**

Source: See appendix G.

Note: This table presents projections based on income groups (HIC = high-income country; LMIC = lower-middle-income country; UMIC = upper-middle-income country; LIC = low-income country or territory). Countries or territories that are affected by FCV are indicated with an asterisk (*). All averages are weighted.

Considering MENA's largely inadequate disposal practices and high spending levels relative to their peers, the region could realize efficiency savings. Global benchmarking suggests that MENA countries could achieve the same levels of waste treatment and disposal they currently experience for about US$2.9 billion each year, which is US$1.2 billion less than current spending. Inefficiencies in waste treatment (the value of services received) exist across all income levels and could be linked to issues such as overemployment in the waste sector and insufficient contracting. High operating costs related to the labor-intensive nature of waste services and inadequate accounting practices render the waste sector more prone to inefficiencies than other municipal service sectors. Further investigation is needed to better understand these inefficiencies and improve accounting in the waste sector.

MENA spends extremely little on funding circular economy initiatives, such as recycling and composting—a missed opportunity for savings and value recovery. Worldwide, such interventions are commonly integrated into waste management budgets. Globally, HICs spend about US$30 to US$80 extra per ton of waste collected on recycling, and between US$35 and US$90 extra per ton of waste collected on composting or digestion, increasing their waste treatment and disposal expenditure from between US$40 and US$100 to between US$105 and US$270 per ton. However, engaging in circular economy initiatives and diverting waste from landfills generates revenues for global HICs while bringing environmental benefits. In MENA, most HICs have started diverting from waste disposal through recycling and other treatment approaches. However, they still largely rely on landfills, with formal budgets for recycling or composting being limited. This presents MENA with an opportunity to increase spending on waste initiatives that divert valuable materials from landfills and generate value from recycling and waste reduction.

To prevent increasing environmental damage from mismanaged waste, MENA countries need to increase spending on the SWM sector and bring their waste management performance in line with global benchmarks. These benchmarks include universal waste collection and greater reliance on sanitary landfills. MENA countries can also realize savings by minimizing the volume of waste directed to landfills ("diverting waste from landfill") by increasing recycling, composting and, if affordable, incineration levels to complement recycling efforts for residual waste fractions.

To make progress on SDG Indicator 11.6.1—which contributes to achieving SDG Target 11.6 (sustainable cities and communities) and aligns with universal collection and safe waste disposal—MENA would need to improve spending efficiency and increase its average SWM budget by 50 percent. This translates to an increase in regional spending of US$3.9 billion annually, from US$7.7 billion to US$11.6 billion, to cover both operating and capital expenditures. Expenditure varies substantially between MENA countries. HICs already spend enough to meet this target; for countries in other income groups, costs would need to double (for MICs) or triple (for FCVs). In countries like Algeria and Egypt, for instance, achieving universal collection and safe disposal would require expenditure to double, while in other countries, possible savings due to improved spending efficiency for SWM services could be so significant that the solid waste component of SDG Target 11.6 could be reached at a lower cost than those incurred today.

If current spending on waste management remains unchanged, the MENA region will face a severe waste crisis. With MENA's waste generation expected to nearly double by 2050, waste leakage into the environment could increase drastically without SWM improvements and additional SWM investment. If current collection and disposal patterns do not improve and MENA continues to either not collect or poorly manage its waste (currently 67 percent of total generated waste), by 2050 natural ecosystems could be exposed to an estimated 242 million tons of waste. Projections for long-term budget requirements to deal with the growth in waste volumes and avoid these costs are presented in chapter 4.

An important question surrounding SWM funding is who will bear the costs, given already stretched municipal budgets. In MENA, high reliance on centralized funding, weak cost recovery, and limited private sector participation are overburdening municipal budgets, undermining financial sustainability, and delaying progress towards more resource-efficient and circular waste management systems. There is a need to diversify funding models, increase municipal financial autonomy, and create incentives for private sector engagement in SWM investments across all countries.

In MENA's HICs, national governments fund both capital and operational costs, typically through earmarked budget allocations to municipalities, with little cost recovery. Municipalities rarely generate significant local revenue through user fees or tariffs—in stark contrast to global HICs, where cost recovery mechanisms based on user fees are widespread. Globally, HICs fund infrastructure through local taxes, user fees, borrowing, and federal grants—creating strong incentives for efficiency and recycling. In MENA's HICs, the centralized model reduces financial efficiency, weakens municipal autonomy, and could disincentivize citizens from participating in schemes to segregate waste at source and, as such, hamper circular economy initiatives. To improve financial sustainability, policy makers need to prioritize reforms that enhance local cost recovery, introduce targeted user fees, and encourage PPPs for efficiency gains and investment funding.

In MENA's MICs, municipal solid waste services are mainly funded through a combination of local taxes, modest user fees, and central government transfers. Cost recovery remains partial, even though progress has been made in some countries, such as Jordan (which has a user fee of between US$1 and US$5 per month for households, depending on size of household and property), Morocco (where households pay between US$10 and US$50 per year), and Tunisia (which has local waste taxes of between US$15 and US$30 per year per household). Globally, MICs face challenges to reduce the budget burden of SWM, although user charges, private investments, and projects with investments financed by international financial institutions are more prevalent. MENA's MICs continue to struggle with public resistance to fees and limited private equity funding. To build financial sustainability, MICs can strengthen tariff systems, promote PPPs for infrastructure investment, and leverage international climate and development finance to support the transition to a circular economy.

MENA's FCV-affected economies face severe financing constraints, with SWM systems largely supported by federal budgets, development finance, and community efforts. Full cost recovery is rarely met through user fees alone. Beyond basic collection services, private sector participation is extremely limited due to lack of funding and other risks. Compared to global FCV-affected contexts, MENA's FCV-affected economies face amplified challenges due to the prolonged nature of the conflicts experienced, coupled with political instability and fiscal collapse. Without predictable, resilient sources of financing, waste services remain fragmented and underdeveloped. Policy makers and international partners can develop flexible, long-term funding strategies that combine emergency support with gradual but robust SWM system improvements to build resilience.

4

HOW MENA'S SOLID WASTE MANAGEMENT SYSTEMS **COMPARE AND COULD EVOLVE**

Key messages

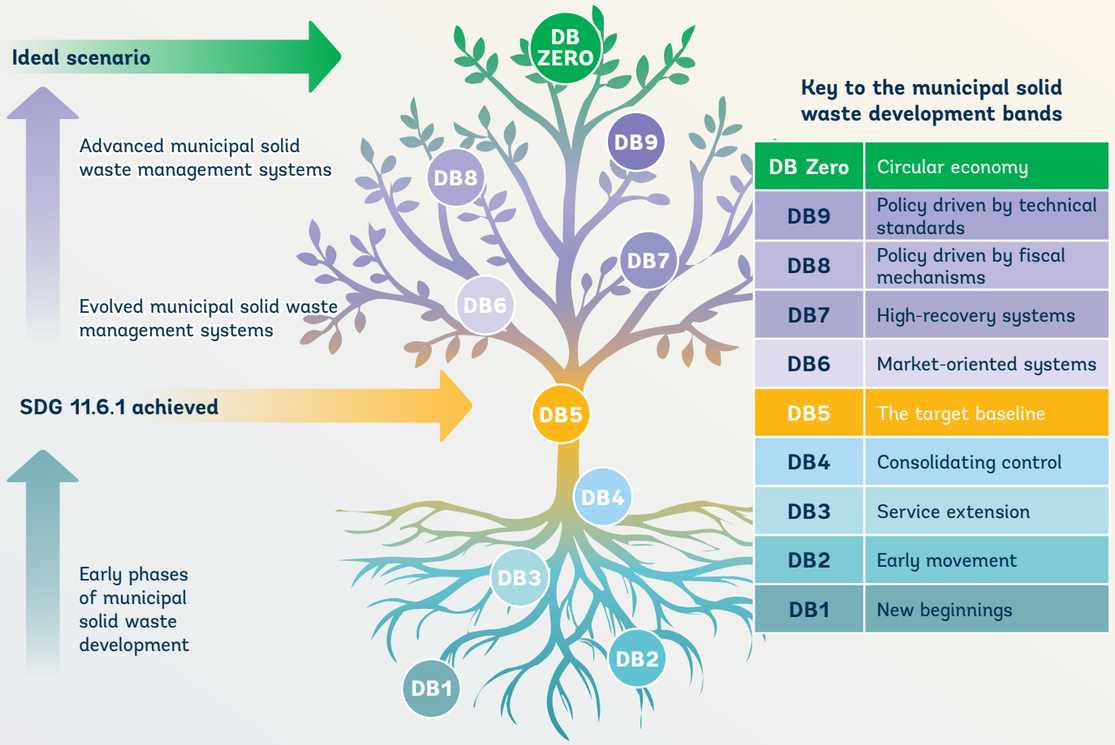
- Global experience offers MENA countries useful performance benchmarks for SWM, helping to set achievable goals for building stronger systems.
- High-income countries could aim for 100 percent collection, with 30 percent going to sanitary landfill, 15 percent composted and 25 percent recycled.
- Middle-income countries could aim for 100 percent collection, with 60 percent going to sanitary landfill, 20 percent composted and 20 percent recycled.
- FCV-affected economies could target 90 percent collection, with 70 percent sent to sanitary landfills, 10 percent composted, and 10 percent recycled.
- With annual investment rising to US$23 billion and proposed reforms implemented, all MENA countries could reach these targets by 2050.

4.1 How MENA's solid waste management systems compare to global benchmarks

Global benchmarks can be used to assess the Middle East and North Africa's (MENA's) solid waste management (SWM) performance and to identify achievable goals for building better systems. To enable effective benchmarking, this study uses the development band (DB) method: a state-of-the-art approach to analyzing municipal SWM systems based on 25 years of experience in waste management (Whiteman et al. 2021). The DB method distinguishes between 10 successive "bands" of municipal solid waste development, informed by the degree of collection achieved, the level of control in disposal facilities, and the application of circular economy principles (appendix E).

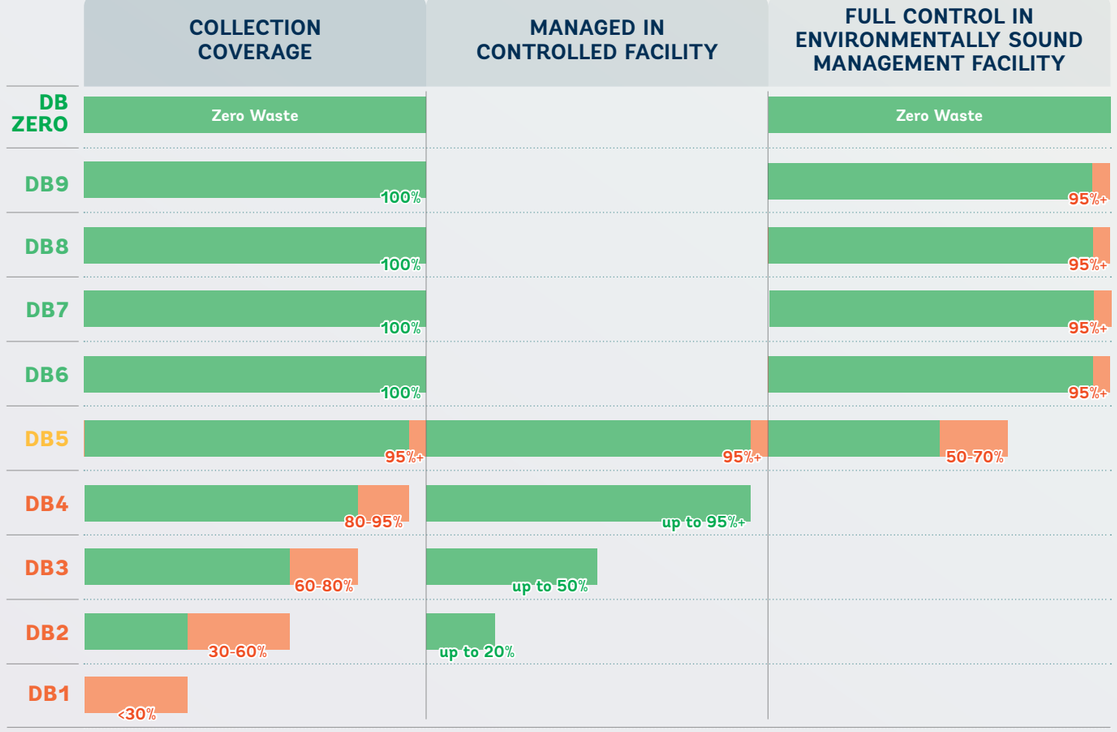
The DB approach is linked to Sustainable Development Goal (SDG) Indicator 11.6.1, which tracks progress towards universal waste collection (in cities), the controlled management of waste, and the elimination of the uncontrolled disposal or burning of waste. Achieving the solid waste-related aspect of SDG Target 11.6 represents the DB midpoint (DB5) (Figure 4.1).

Figure 4.1 The development bands method of assessing solid waste management systems



Key to the municipal solid waste development bands

DB Zero	Circular economy
DB9	Policy driven by technical standards
DB8	Policy driven by fiscal mechanisms
DB7	High-recovery systems
DB6	Market-oriented systems
DB5	The target baseline
DB4	Consolidating control
DB3	Service extension
DB2	Early movement
DB1	New beginnings



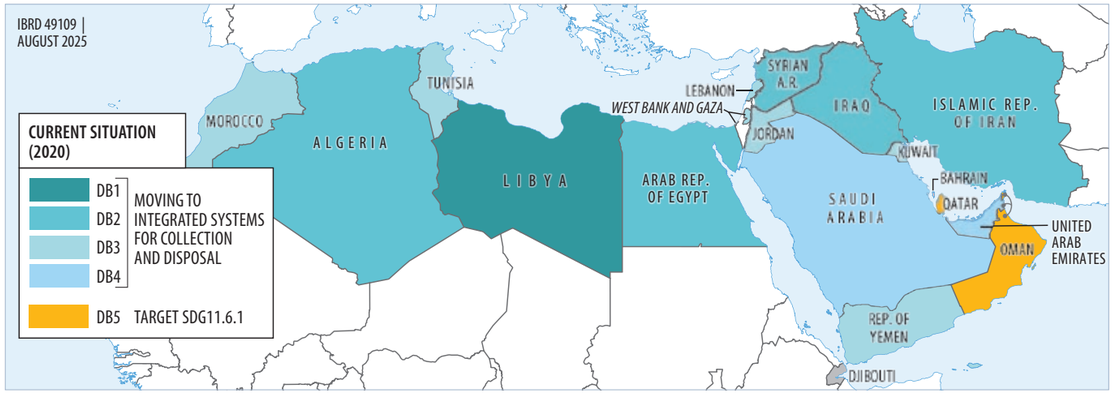
Source: Whiteman et al. 2021 with World Bank additions.

The DB approach categorizes SWM systems based on the degree of collection, the level of control in management facilities, and the application of circular economy principles. These categories align with various bands:

- **DB1, DB2, DB3, and DB4** illustrate the early phases of SWM development, where the goal is to progress towards universal waste collection, and the prevention of uncontrolled dumping and open burning.
- **DB5** is an important milestone that reflects universal collection, the comprehensive control of recovery and disposal processes, and the achievement of SDG Indicator 11.6.1.
- **DB6 and DB7** refer to when at least two or three source-separated waste fractions are collected to support the implementation of the "Three Rs" (reduce, reuse, and recycle). This aligns with SDG Indicator 12.5.1 (the national recycling rate of materials recycled in metric tons (tons)).
- **DB8 and DB9** reflect the broader application of the Three R principle through stringent targets, technical regulations, and fiscal incentives and penalties. These measures aim to maximize the volume of waste diverted from landfills while establishing improved or full levels of collection with two or three separate fractions for very high standards for collection and recovery.
- **DB Zero** represents the ideal scenario in which society has experienced transformative changes in production and consumption patterns alongside significant advancements in material science (Whiteman et al. 2021).

Relative to global benchmarks, SWM systems in MENA's high-income countries (HICs) are at an intermediate level of development, while MENA's other economies are at earlier stages. This report assigned DB rankings to each of the region's SWM systems based on 2022 data and inputs from regional stakeholders and solid waste experts. Only Oman and Qatar achieved a ranking of DB5 ("target baseline"), successfully meeting the solid waste component of SDG Indicator 11.6.1. The United Arab Emirates (UAE) and Saudi Arabia were rated as DB4, reflecting that they are "consolidating control" over solid waste. Six countries—Jordan, Kuwait, Lebanon, Morocco, Tunisia, and the West Bank and Gaza—were classified as DB3 ("service extension"). However, some of the region's largest countries in terms of population (Algeria, Djibouti, Egypt, the Islamic Republic of Iran, Iraq, Syria, and the Republic of Yemen) only achieved the DB2 ("early movement") rating, while Libya was classified as DB1 ("new beginnings"). Appendix E presents a detailed overview of the criteria applied to each DB.

Map 4.1 Performance of SWM systems in 2022



Source: Original World Bank map created for this report.

Note: Development bands are used to distinguish between 10 stages of municipal solid waste development, based on each country's degree of waste collection achieved, level of control in disposal facilities, and application of circular economy principles.

This benchmarking exercise showed that the strengths of MENA's SWM systems include well-developed policies, increasing awareness of circular economy principles, relatively high collection rates, and growing private sector involvement. Most MENA countries have plans and strategies to improve their SWM services, often modeled on best practices, mainly from European Union countries. There is also growing awareness of circular economy practices, such as extended producer responsibility (EPR) and recycling. Solid waste collection rates are high compared to other regions worldwide, resulting in cleaner cities. In addition, the private sector is becoming more involved in waste collection services and, to a lesser extent, waste disposal and treatment. In some of the region's cities—such as in Cairo, Egypt—informal workers also contribute significantly to effective SWM.

Key challenges to developing MENA's SWM sector include insufficient revenue, unclear institutional arrangements, inadequate enforcement, and a difficult working environment for informal waste pickers and recyclers. Key issues constraining the development of the SWM sector include insufficient revenue to finance municipal services, especially operational expenses. This limits the initial scope for circular economy approaches to those that can easily become financially viable. Weak enforcement of regulations and an unclear delineation of responsibilities between national, regional/provincial, and local governments pose additional obstacles. The region is also battling a growing number of illegal dumpsites, inadequate leachate management, and slow waste recycling progress. Models to raise revenues and enhance protection for informal waste pickers and recyclers also still need to be developed.

4.2 How MENA's solid waste management systems could evolve

To show how MENA's SWM systems could evolve, this report projects their development up to 2050 under the various Shared Socioeconomic Pathways (SSPs). Widely used in modeling, the SSPs are designed to support an integrated, multidisciplinary analysis of possible development pathways under alternative socioeconomic development trajectories, based on consistent assumptions of key aspects, such as economic growth and technology development. The SSP scenarios place emphasis on sustainability and are not to be viewed as predictions but rather as ways to illustrate what changes can be achieved through different policy choices. For the purpose of this report, modeling was done under a "middle-of-the-road" scenario in which current policies and practices continue (SSP2). The SSPs are further described in appendix E.

By 2050, all MENA countries have the potential to reach at least an intermediate level of SWM with universal collection and safe disposal, while HICs can go significantly further. The initial priority for MENA's SWM sector is to improve its performance on SDG Indicator 11.6.1 towards achieving SDG Target 11.6. Accomplishing this will require focusing on two aspects:

- **Providing a basic waste collection service that is regular and reliable**, that is, a door-to-door service or collection from easily accessible collection points within 200 meters of domestic residences.
- **Achieving a good degree of disposal control to ensure fully sanitary landfills** by ensuring sufficient staffing, fencing off the landfill, equipping the landfill with weighing scales, ensuring the landfill is free from fires, ensuring collection and treatment of leachate and the management of landfill gas, and ensuring that the landfill is adequately covered, compacted, and protected against landslides.

Achieving SDG Target 11.6 would maximize public health benefits while addressing environmental degradation as swiftly as possible. In the DB framework, this target reaches an intermediate stage of system development (DB5).

Realistically, universal municipal solid waste collection and improved management will likely only be achieved after 2030, except for Oman, Qatar, Kuwait, the UAE, and possibly Saudi Arabia. In the "middle-of-the-road" scenario (SSP2), the volume of municipal solid waste in the MENA region will nearly double by 2050, and there will likely be further deterioration in SWM service quality. Significant investment and policy improvements will be needed to address the challenge of increasing waste volumes while bringing performance levels to within SDG Target 11.6. Appendix E presents an overview of trajectories that, based on SSP2, are considered achievable by 2030, 2040, and 2050, according to DB-based sector performance levels.

Map 4.2 Performance of SWM systems: projections for achievable improvements by 2050

Source: Original World Bank map created for this report.

Note: Development bands are used to distinguish between 10 stages of municipal solid waste development, based on each country's degree of waste collection achieved, level of control in disposal facilities, and application of circular economy principles.

Significant expansion of SWM systems will be needed to prepare for increasing solid waste volumes. The conditions and ambitions to do so will vary from country to country. However, for the purpose of benchmarking, the following ambitious but realistic outcomes for SWM services and measures aligned with the principles of circular economy in 2050 were used when projecting SWM funding needs:

- In high-income countries (HICs): 100 percent collection with 30 percent going to sanitary landfill, 15 percent to composting, 25 percent to recycling, and 30 percent for incineration
- In middle-income countries (MICs), including Egypt and the Islamic Republic of Iran: 100 percent collection, with 60 percent going to sanitary landfill, 20 percent to composting, and 20 percent to recycling
- In fragility, conflict, and violence (FCV)-affected economies: 90 percent collection with 70 percent going to sanitary landfill, 10 percent composting, 10 percent for recycling, and 10 percent remaining uncollected.

To achieve these ambitious targets, even as waste volumes increase, will require annual funding of US$27 billion by 2050—more than three times what the region currently spends. Funding needs are expressed in terms of current US dollars, in other words, what is usually called "real" terms. This amount includes the average annual capital costs of investments and operating costs necessary to manage future levels of 294 million tons of waste per year. Table 4.1 illustrates how costs and revenues differ by country type. With higher costs, there are also additional opportunities to generate revenue. Table 4.1 shows that, on average, these investments would generate an annual revenue of US$4.2 billion across the region (16 percent of projected cost). For instance, in Egypt, by 2050, because of the sheer size of the economy, recycling and energy conversion can generate an estimated US$770 million per year in revenue.

Table 4.1 Spending per county in 2022 and projected to 2050

Country	Sector expenditures (2022)	Total spending (collection, and treatment/ disposal)	Estimate costs for targeted collection, and treatment/ disposal (2050)	Expected revenues from recycling and energy recovery (2050)	Budget-ing needs (2050)	Expected net cost level in 2050	Investment per year (2025–2050)
	(US$ million/ ton)	(US$/ton)	(US$ million/ year)	(US$ million/ ton)	(US$ million/ ton)	(US$/ton)	(US$ million/ ton)
Saudi Arabia	1,339	70	4,272	769	3,503	99	972
Kuwait	368	105	687	124	564	99	156
Bahrain	145	90	302	54	248	99	69
Qatar	192	110	314	57	257	99	71
United Arab Emirates	536	110	1,003	181	823	99	228
Oman	360	110	806	145	661	99	183
HIC total	**2,940**	**86 (avg.)**	**7,385**	**1,329**	**6,055**		**1,680**
Syrian Arab Republic*	61	20	364	36	328	51	83
Yemen, Rep.*	88	35	746	75	671	51	170
LIC total	**149**	**27 (avg.)**	**1,110**	**111**	**999**		**253**
Morocco	476	65	1,461	219	1,242	71	332
Tunisia	141	65	498	75	423	71	113
Egypt, Arab Rep.	966	55	5,146	772	4,374	71	1,171
Lebanon*	144	75	237	36	202	71	54
Djibouti	9	55	40	6	34	63	9
Jordan	259	75	556	83	472	71	126
West Bank and Gaza*	58	45	293	44	249	71	67
LMIC total	**2,052**	**61 (avg.)**	**8,231**	**1,235**	**6,997**		**1,873**
Algeria	511	45	1,904	286	1,618	75	433
Iran, Islamic Rep.	1,406	60	3,192	479	2,713	75	726
Libya*	161	50	575	86	488	75	131
Iraq*	462	40	4,351	653	3,698	75	990
UMIC total	**2,540**	**51 (avg.)**	**10,021**	**1,503**	**8,518**		**2,280**
MENA total	**7,681**	**62**	**26,747**	**4,178**	**22,569**		**6,085**

Source: See appendix G, with additional analysis conducted for this report.

Note: This table presents projections based on income groups. Countries and territories that face FCV situations are indicated with an asterisk (*). All averages are weighted. Figures have also been rounded, which may result in small discrepancies between individual numbers and totals.

Because operating expenses account for most of the projected annual costs, cost-recovery mechanisms could greatly reduce the need for additional funding. The projected costs consist of annual capital investments and operating costs, the latter of which accounts for most of these annual expenses across all countries. In total, by 2050, MENA will need US$23 billion (cost minus revenues [Table 4.1]) per year to meet its waste management needs. Of this amount, the annual financing costs for investments (interest and depreciation) represent US$6 billion per year during the 2025–2050 period, while operating expenses amount to US$17 billion per year. To reach these targets, SWM spending would need to double in HICs, increase threefold in MICs, and increase by six times in FCV-affected economies. The operating expenses that make up most of the increase lend themselves to being funded through better cost recovery from consumers, EPR, or similar mechanisms. Such measures can, therefore, make a substantial difference in limiting the need for more public spending.

Direct benefits outweigh the costs of projected sector improvements. Without these infrastructure developments, and considering that waste volumes will double, mismanaged waste would more than double the current cost of environmental degradation (COED) of US$7.2 billion per year to more than US$15 billion per year in 2050. Given that the envisaged sector improvements would largely eliminate the current COED, the direct environmental benefits of effective SWM management make up for the additional costs compared to today's SWM expenditure. MENA's gross domestic product (GDP) is also expected to grow by 270 percent by 2050, keeping projected expenditures on SWM constant, relative to GDP in 2022.

Global evidence suggests that fully recovering the cost of municipal solid waste services from households and other waste generators is viable at high-income levels, as seen in other HICs across the world. Therefore, establishing a policy that combines public and private funding of municipal solid waste infrastructure and services is crucial. Such a policy would need to consider public health and environmental externalities, and the public good properties of municipal solid waste services. The ideal would be to minimize fiscal subsidies while maximizing system efficiencies and service charges to households and businesses—all while still accounting for externalities and ensuring affordability for the poorest families.

With planning for improvements in waste services, good opportunities for cost savings can be identified and integrated. The following options for efficiency gains have proven effective both in the region and globally:

- **Digitization and implementation of waste-management information systems**, using specialized real-time data apps. Such apps are already being used by waste operators and are available as "off-the-shelf" IT solutions
- **Long-term financial programming** with well-defined subsidies and scenario planning to gradually cover financing gaps with funding from alternative sources such as tariffs, EPR, fines, and cross-subsidizing across waste generators
- **Waste collection and transfer optimization**, which involves optimizing transport routes from the source to a transfer site to lower costs. Separating various waste streams and transporting smaller volumes to adequate treatment facilities would have a similar effect
- **Optimization of waste treatment and disposal**, using a "waste sheds" approach, where multiple local governments can share regional facilities
- **Delegation of service delivery to the private sector,** which requires high capacity on the part of regulators and public-private partnership-enabling frameworks
- **Differentiation between waste generators** with governments organizing different systems for domestic and business-to-business waste management, with further arrangements for various waste streams.

5

IDENTIFYING OPPORTUNITIES FOR A **CIRCULAR ECONOMY IN MENA**

Key messages

- In the MENA region, 83 percent of collected waste can be recycled, reused, composted, or used for waste-to-energy recovery.
- Reducing waste volumes leads to substantial savings and environmental benefits: each 1 percent reduction in waste generation can save US$150 million annually in SWM expenditures.
- Shifting responsibility to waste producers—via extended producer responsibility —could lower public funding needs by 10–15 percent.
- High-income countries can reduce landfilling and scale circular solutions; middle-income countries can improve recovery and treatment through cost-effective innovations; and fragile and conflict-affected states can prioritize low-cost community-based approaches.

5.1 How circular economy practices represent savings for MENA

With high dependency on landfills and low levels of material recovery, the Middle East and North Africa's (MENA's) current solid waste management (SWM) systems offer many opportunities for circular economy solutions, including recycling, composting, and waste-to-energy processes. Such solutions reduce waste that would otherwise go to landfill, recover valuable materials, and treat waste to produce useful products. While the investment and operations costs for circular infrastructure can be significant, the long-term benefits are substantial. In addition to decreased costs for waste services from reduced waste volumes, savings arise from lower reliance on landfills, increases in resource efficiency, and value addition from new products, as well as positive environmental, social, and economic impacts.

By minimizing waste generation, MENA countries could save money: each percent of waste reduction results in savings of about US$150 million per year. This is equal to nearly 1 percent of the region's current total SWM expenditure (US$7.7 billion) and cost of environmental degradation (COED) levels (US$7.2 billion). At current waste generation levels, this is equivalent to US$100 for every ton of waste reduced. Waste reduction is an important element of circular economy approaches, with substantial impacts on the economy. Globally, its potential is estimated at US$4.5 trillion by 2030 based on lost economic growth from a gap of 8 billion metric tons (tons) between the supply and demand of natural resources by above US$500 per ton (Accenture 2015).

There are numerous opportunities to implement circular practices in the MENA region. Eighty-four percent of collected waste has the potential for value recovery through recycling, reuse, composting, or energy recovery. This includes opportunities for the 27 percent of waste that consists of recyclables—such as plastics, paper, cardboard, metals, and glass—and the 57 percent of organics, including food waste. However, only 7 percent of waste is currently recycled in the region, and 3 percent is composted.

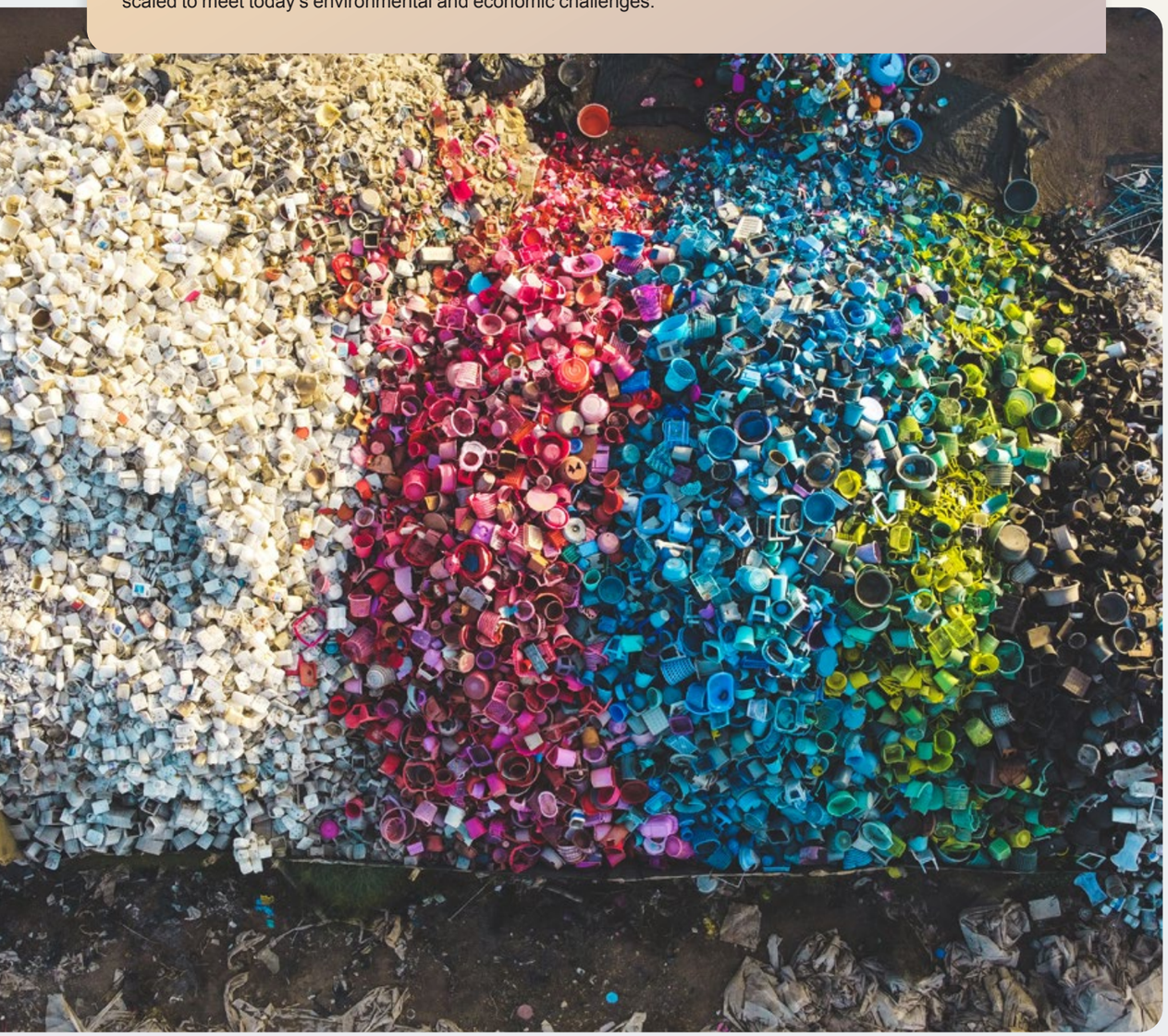
Circular economy implementation remains low in MENA, despite the presence of examples that demonstrate the effectiveness and feasibility of such practices. The United Arab Emirates (UAE) has circular economy plans to reuse construction debris to build highways (Saradara et al. 2023). A World Bank-facilitated composting project in Egypt diverts 1,700 tons of waste to composting facilities each day, reducing organic waste in landfills and turning it into a useful product that supports agriculture. In fragility, conflict, and violence (FCV)-affected areas such as Gaza before the current conflict, communities upcycled plastic waste into durable products like floor mats, showcasing the effectiveness of community-run circular models despite resource constraints. These examples highlight the potential to expand circular economy initiatives and, in so doing, maximize waste recovery, create employment, and mitigate pollution across different countries and income levels in MENA.

BOX 5.1 The circular economy: A modern concept with deep roots in MENA

A circular economy is a resource management system designed to eliminate waste, maximize material efficiency, and extend the lifespan of materials (Kirchherr et al. 2017). Unlike the traditional linear model of "take, make, and dispose", a circular economy keeps resources in continuous use, minimizing the need for raw materials and avoiding the loss of valuable inputs. A practical example of a circular economy is a bottle deposit system, where consumers pay a deposit to purchase a bottle and receive a refund when they return it. This keeps bottles in use through a structured process: manufacturers produce recyclable bottles, consumers are encouraged to return them, and bottles stay in circulation—reducing dependence on landfills and new materials.

While the term "circular economy" is modern, the principles of resource efficiency and material reuse have a long history in MENA. Long before the concept was formalized, MENA's civilizations were already applying circular principles in daily life. In the early Bronze Age (ca. 3200–1100 BCE), ancient Egyptians and Mesopotamians (in modern-day Iraq) reused domestic wastewater for irrigation and aquaculture. In Morocco, craftsmen have an old tradition of using fallen wood to make furniture rather than chopping down trees. Historical reports indicate that even composting was practiced by ancient Egyptians as far back as early 3000 BCE.

These examples show that circularity is not a foreign concept in MENA. It is a legacy that can be revitalized and scaled to meet today's environmental and economic challenges.



5.2 What is needed for an effective circular economy

Circular economy principles consider the entire product lifecycle—from product design to its disposal. These principles envisage a range of foundational elements and roles for each actor in the SWM system (Figure 5.1) (Hafsa et al. 2022). Producers and manufacturers design products for circularity so that they can be reused, recycled, repaired, refurbished, or composted using available technologies. Consumers actively participate in this system by buying less, segregating waste, and disposing correctly of used products. Meanwhile, governments enable such behaviors and practices by establishing regulations, frameworks, and incentives for consumers, producers, and manufacturers.

In a circular economy, waste collection systems are efficient and accessible to consumers so that all waste is gathered for material recovery, diverting waste from landfills and sending only a residual fraction of end-of-life materials to landfills. Such systems include formal collection methods, such as curbside services; informal channels, such as door-to-door waste pickers; and aggregation points, such as buy-back centers and community hubs. In a complete system, all types of collected waste are processed using appropriate treatments. For example, wet organic waste is composted or converted into biogas, while dry waste like plastics and metals are recycled, reused, refurbished, or repaired.

Having a market for circular products is key to the success of a circular economy. For example, compost from organic waste can be used in agriculture, and recycled plastics and metals can be reintroduced into manufacturing. The abovementioned foundational elements represent the lifecycle processes necessary to achieve a circular economy. These elements need not be costly to implement because low-cost options exist for each stage an effective circular economy.

Figure 5.1 The principles of a circular economy

Foundational circular economy elements	Enabling environment				
	Policy and regulatory requirements	Funding	Governance	High-cost examples	Low-cost examples
Manufacturing Products are designed for circularity	Product bans, design mandates (thickness requirements, color bans, etc.), tax, and extended producer responsibility	Private investment in research and development (R&D) for new materials and technologies	Producer responsibility organizations	Biodegradable plastic	Avoid single-use products
Consumer behavior The consumer places waste in appropriate material recovery channels	Mandates for accurate labeling and awareness campaigns	Private investment in R&D for new materials and technologies	Consumer protection organizations, third-party certifications	Documentaries and infrared readable labels	Community workshops
Material recovery There need to be convenient and efficient channels for material recovery	Mandatory curbside pickups Regulations for waste aggregators in commercial areas	Loans for infrastructure and through public-private partnerships	Environmental protection agencies, municipal waste authorities, partnerships with retailers and distributors	Curbside collection and automated material recovery facilities	Community drop-off points and informal waste collection
Material treatment There need to be profitable ways to keep materials in circulation	Grants and subsidies for circular technologies, with standards for technologies	Private investments, credit-based financing, microloans, and tax breaks	Technology monitoring	Industrial composting and chemical recycling	Community garden and small-scale mechanical recycling
Circular market There needs to be a demand for circular materials	Public procurement for circular products and standards for circular materials	Vouchers to encourage purchases, tax breaks, and government contracts	Standards authority that ensures fair pricing	Waste-to-energy	Compost construction materials

Source: Hafsa, et al. 2022, with World Bank additions.

Circular economy elements do not exist in isolation of each other. Rather, they are enabled through comprehensive policies, funding streams, governance structures, data systems and training, and other supporting elements. To implement a circular economy, each foundational element needs to be supported through comprehensive policies. Examples of such policies include Morocco's ban on plastic bags, funding arrangements similar to the private investments in UAE's waste-to-energy projects, and good governance practices.

Governments play a central role in setting the direction for circular economy efforts through policies and regulations. These policies can mandate circular design, restrict single-use products, or require source segregation and curbside collection. They can also: (a) shape consumer behavior (by, for example, requiring product labeling to help consumers make informed choices); (b) drive recycling (by providing businesses with tax incentives, subsidies, or research grants); and (c) ensure the safety of circular products (by developing standards for recycled products to ensure quality and safety). Governments can also use public procurement policies to signal a demand for circular products and directly influence end markets. Policies may cover many foundational elements (such as extended producer responsibility (EPR) or comprehensive action plans) and provide objectives for stakeholders to follow. However, for policies to be implemented, financing is essential.

To build and maintain circular economies, countries need reliable financing. Such financing could come in the form of various mechanisms, including public investments (funded through taxes or service fees), private investments, and partnerships. In many of MENA's high-income countries (HICs), recycling facilities and innovation hubs are funded through public-private partnerships (PPPs). Some high-cost infrastructure could also be funded through loans from multilateral banks. International development finance and crowdfunding could support grassroots efforts, as seen in Egypt and Morocco. Another powerful tool is EPR.

5.3 *Extended producer responsibility*

EPR is a policy approach that holds producers accountable for the entire lifecycle of their products, including end-of-life waste management. By shifting the financial and operational responsibility of managing waste from governments to producers, EPR encourages producers to design products for circularity (reuse, recycle, and compost). Shifting the financial burden to producers and their customers also reduces public funding needs by 10 to 15 percent. When producers pay for the end-of-life management of their products, local governments can direct the resulting financial resources to improving related services.

EPR revenues can be used to strengthen waste collection infrastructure and to finance the research and development of new materials or recycling technologies. In Germany, EPR is also used to ensure transparency and accountability. Other funding tools include outcome bonds, plastic and carbon credits, and microloans for informal workers. However, for financing to be efficient, it needs to be backed by strong institutions and well-coordinated implementation systems.

EPR addresses all foundational elements of a circular economy. Producers are expected to design products with end-of-life considerations, ensuring ease of reuse, recycling, or composting. They may also be expected to inform consumers about proper disposal methods through product labels and awareness campaigns. Crucially, producers are responsible for the waste generated by their products and the end-of-life treatment of such products, for example through recycling. Notable examples of EPR include bottle deposit return systems and electronic waste recycling programs.

EPR leverages all enabling elements of the circular economy—including policies, financing, governance, and data infrastructure—to create a holistic system for sustainable waste management. While countries can choose from a diverse range of policy instruments, funding mechanisms, governance arrangements, and levels of data collection, all of these elements are necessary to set up a functioning circular economy. The arrangements will depend on the country's context and product type.

Policy makers advance EPR through various policy instruments, including regulations, economic tools, and voluntary agreements (OECD 2016). Regulatory approaches may mandate product take-back schemes (such as Japan's Home Appliance Recycling Act), set collection and recycling targets, or establish design standards for recycled content usage (as in the case of the European Union's [EU's] Circular Economy Action Plan [EUR-Lex 2020]). Economic instruments can include taxes on virgin materials (such as with the United Kingdom's Plastic Packaging Tax [Clarity n.d.]), subsidies for recycled content, and eco-modulated fees based on the environmental characteristics of products (such as its recyclability or hazardous content).

A common economic instrument is an advanced disposal fee, which requires consumers to pay an upfront recycling fee for items like TVs and refrigerators in order to fund proper waste treatment once the product reaches its end-of-life. Similarly, deposit-refund policies require consumers to pay a fee upfront when buying an item (for example, a beverage or a lead-acid battery). This fee is then refunded upon the product's return as an incentive for consumers to return the item once used. These policy instruments can be tailored to national contexts and combined for effectiveness.

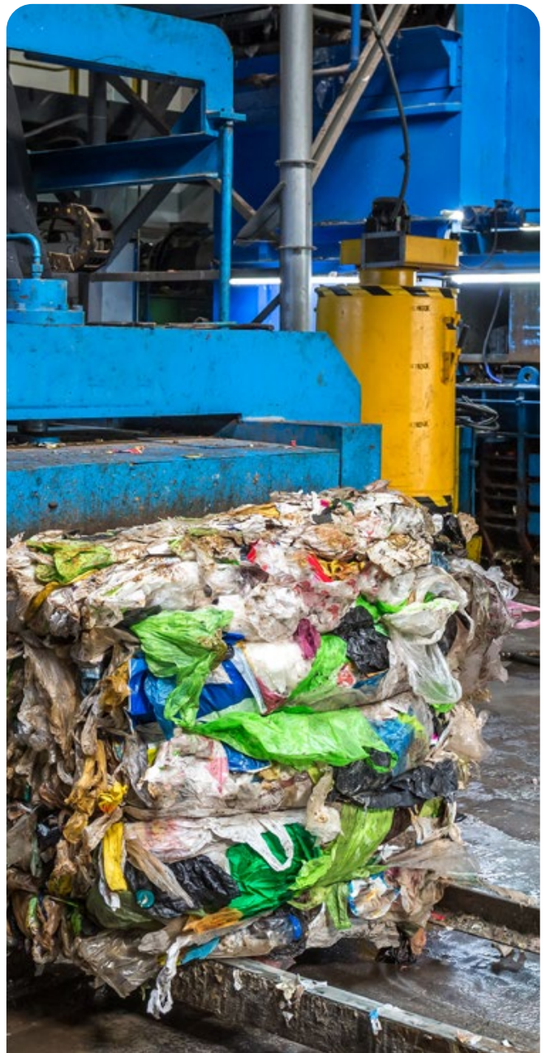
The fees generated by EPR systems ensure that producers, rather than governments, bear the cost of managing products at their end-of-life. These fees may be fixed, such as per-unit charges, or variable based on factors like product weight, recyclability, or hazardous content. EPR fees are typically used to advance waste management needs, such as improved collection, recycling programs, and in some cases, research and development for circular innovations. For instance, across the EU, packaging fees range from €20 to €200 (US$24 to US$235) per ton, of which between 29 percent and 84 percent are allocated toward recycling efforts. Fee structures could be determined through economic analysis to reflect the average cost of collection and circularity. After deciding on a fee structure, it is also important to determine how the fees would be collected. For example, advance disposal fees are collected at the point of sale while eco-modulated fees may be paid at the time of distribution, which could be when products are made available to the market. To ensure fairness and efficiency, these fees need to be transparently managed and linked to actual environmental performance, which is laid out through institutional arrangements.

EPR management or governance can take many forms, each with different implications for efficiency, inclusion, and level of control. Individual producer responsibility requires each producer to manage their products' end-of-life phase. This offers strong incentives for eco-design but poses logistical challenges, especially for smaller producers. More commonly, producers join producer responsibility organizations (PROs) to collectively fulfill obligations for collection, recycling, and disposal. PROs collect fees from member producers and coordinate waste-management activities, serving as a central link between producers, waste operators, and regulatory authorities.

PRO governance models vary. A single PRO (a centralized organization for all producers) simplifies regulatory oversight and system coordination. However, it may lead to monopolistic behavior, reducing transparency and accountability. By contrast, having multiple PROs allows producers to select from several accredited service providers, driving down costs and improving innovation in service delivery. However, having multiple PROs requires strong regulatory oversight to prevent fee avoidance, underperformance, or duplication of efforts. A clearinghouse mechanism, typically overseen by the government, helps allocate market share, validate performance data, and harmonize reporting. PROs can also be government-run, with public authorities managing or contracting out collection and recycling. This approach supports strong oversight but could result in lack of market flexibility. Hybrid models, where governments set regulatory frameworks and performance targets but delegate collection and recycling to PROs or producers, are increasingly common in middle-income and decentralized governance contexts.

The choice of governance structure depends on national policy objectives, market size, regulatory capacity, and the maturity of the waste management sector. Some middle-income countries (MICs) and low-income countries integrate informal workers within PROs, as seen in Colombia and India, improving collection rates and traceability while uplifting vulnerable labor segments.

Robust, transparent data systems are essential for monitoring EPR implementation. Accurate data enables authorities to track the flow of products, monitor compliance, set realistic targets, and evaluate system performance. An electronic registry (e-registry) could serve as a centralized digital platform where producers, PROs, recyclers, and regulators can report on—and access information regarding—product sales, waste collection, treatment outcomes, and financial contributions. An e-registry reduces the administrative burden, enhances traceability, detects issues like free-riding or under-reporting, and provides a reliable basis for audits and inspections. Investment in digital infrastructure and data standardization will become increasingly critical as EPR systems become more complex, especially in contexts with multiple PROs or where transboundary collaboration is an objective.



BOX 5.2 Examples of successful extended producer responsibility systems

Extended producer responsibility (EPR) systems differ from country to country based on the country's income levels and governance frameworks:

Some **high-income countries (HICs),** such as Germany, have well-established EPR systems with clear policies, fee structures, multiple producer responsibility organizations (PROs) to promote competition, and robust electronic registries. Among the Middle East and North Africa's (MENA's) HICs, the United Arab Emirates has launched pilot EPR schemes for packaging and tires, while Saudi Arabia is embedding EPR principles into its waste management law.

In some **middle-income countries (MICs)**, such as Brazil, Ghana, and the Philippines, EPR systems are still evolving, with implementation varying by region and product type, often relying on a single PRO for products like packaging and electronics. Similarly, MENA's MICs (such as Morocco) have signaled their intention to introduce national EPR legislation, targeting packaging and electronic waste.

In **fragility, conflict-, and violence-affected economies**, the implementation of EPR systems is severely limited due to inadequate waste management infrastructure and ongoing conflicts. There are also no significant EPR policies in place. In these contexts, international development finance often supports basic waste management.

These examples illustrate how EPR systems are shaped by a country's economic status and governance capabilities, with HICs leading in implementation, while low-income and conflict-affected countries face significant challenges. Tailoring EPR approaches to national contexts is essential for advancing circular economy objectives across the MENA region.

5.4 Governance of circular economy systems

Circular economy systems involve multiple actors across the product and waste lifecycle, requiring coordination at both the national and local levels. Central governments play a key role in such coordination by setting national targets, developing regulations, and ensuring consistent application between provinces or states. At the same time, decentralized institutions, such as municipalities, are often responsible for service delivery and are best positioned to adapt circular practices to suit local conditions. Effective governance requires aligning these two levels of governance by clearly defining roles and establishing mechanisms to ensure effective coordination and shared accountability.

Other enabling elements include data systems and training. It is difficult to design effective policies or track progress without accurate data on waste generation, collection rates, and recycling outcomes. The UAE has addressed this by rolling out smart waste-management technologies that track waste composition, collection efficiency, and recycling rates.

In addition to technology-based solutions, training and education build the capacity of waste management practitioners to effectively separate waste, use recycling technologies, and implement other circular practices. In Egypt and Morocco, for example, local communities are being trained to manage waste separation and recycling, filling gaps in formal governance systems.

Together, the foundational and enabling elements (policies, financing mechanisms, governance systems, data, and training) provide a clear framework for assessing circular economy readiness, performance, and further opportunities. By identifying which building blocks are already in place and which are missing, MENA governments can make targeted investments and policy decisions to scale circular economy opportunities that are tailored to their economic, social, and environmental needs.

5.5 Why regional cooperation is essential

Progress toward more efficient SWM in MENA requires regional collaboration to support national action. At the regional level, two priorities stand out. The first is strengthening knowledge management and building capacity to improve service delivery and embed circular practices. The second encourages exploring regional market mechanisms to mobilize circular economy investments and promote private sector engagement.

Regional knowledge partnerships are essential for advancing circular economy practices, improving private sector performance, and supporting informal workers. A strategic approach would be to focus on:

- Improving efficiency and competition in private operations
- Raising awareness of food waste and consumption patterns
- Providing legal and financial tools to formalize and support informal workers.

Organizations such as the Arab Forum for Environment and Development, the Solid Waste Exchange of Information and Expertise Network (SWEEP-Net), EcoMENA, and the International Solid Waste Association (Table 5.1) already play a vital role in building capacity, engaging in advocacy, and providing technical training. These platforms could be leveraged to promote cross-country learning and strengthen alignment with the actions and outcomes proposed in this report.

Table 5.1 Regional organizations in MENA

Organization	Role
Arab Forum for Environment and Development	Advocates for environmental policies and sustainable practices in the Arab world, focusing on solid waste management
EcoMENA	Promotes environmental awareness and sustainability in MENA, focusing on waste management, renewable energy, and water conservation
International Solid Waste Association	Is an international organization that promotes global waste management goals and has regional focus, including in MENA, that considers how to address local challenges
International Waste Working Group	Promotes sustainable waste management practices and shares best practices in MENA
Solid Waste Exchange of Information and Expertise Network (SWEEP-Net)	Enhances waste management in Mashreq and Maghreb countries by offering technical assistance and building capacity
Waste Management Middle East conference	Provides a platform for discussing waste management innovations, the circular economy, and sustainable practices in the region

Source: Based on analysis conducted for this report.

A circular economy in MENA will require regional cooperation that transcends borders and income groups. By pooling resources, harmonizing policies, and coordinating investments, countries and territories can amplify the positive impacts of a circular economy. Joint research and development, standardized regulations for recyclables, and regional trade platforms for secondary materials are essential for scaling circular solutions. MENA's HICs have a particularly important role in this process, given that they have the financial and institutional capacity to lead regional cooperation. Notably, they are well positioned to lead in low-cost waste-to-energy and recycling innovations, and in the provision of regional markets for secondary materials.

Their leadership in piloting circular economy technologies and supporting regional research and development can set a precedent for scalable circular solutions. In addition to collaborating with HICs in the region, MICs could benefit from partnerships with EU countries (such as France, Spain, and Italy) to gain technical expertise, secure financing, and access markets. Joint ventures and capacity-building programs could help MICs develop local recycling industries and better integrate into regional circular economy networks.

5.6 Why progress is possible for all MENA countries

MENA's HICs have ample opportunity to improve efficiency through circular economies, and given their strong foundational elements, advanced circular practices are in reach. MENA's HICs have some of the highest per person waste generation rates globally. Although they have nearly universal collection, 87 percent of collected waste is sent for disposal with varying levels of environmental control. This leaves significant room for alternative treatment methods, such as recycling and waste-to-energy projects. For example, e-waste in HICs, which is growing at 8 percent a year, presents an opportunity to recover precious metals (Jain et al. 2023). At the same time, HICs could make better use of circular approaches, given their comprehensive public policies, centralized SWM institutions, and the fact that their private sectors are active in investments and PPPs.

Circular waste practices could be further enhanced through comprehensive, well-enforced policies. HICs have made significant advances in developing circular policies, although policy enforcement needs to be strengthened. HICs would benefit from assessing how each existing policy supports the circular economy elements of product design, consumer behavior, and so on. For example, HICs could provide economic incentives to recyclers or recycled product manufacturers to support a circular market. They could also adopt EPR schemes, following good international practice for packaging materials, electronics and electrical equipment, and vehicles, to name a few manufacturing subsectors. Presently, only Saudi Arabia and the UAE have some form of EPR in place.

More HICs could adopt circular economy principles by investing in the infrastructure needed for collection and treatment, as well as by engaging the private sector. HICs' strong financial capacity allows for the capital investments and operational expenditures needed to achieve waste recycling rates of 50 percent or above.[13] These economies could scale up existing initiatives and invest in research and development to develop innovative solutions, such as chemical recycling and waste-to-energy methods. For large investments, HICs could engage the private sector. The Saudi Investment Recycling Company is a wholly owned subsidiary of the Public Investment Fund that engages in PPPs with local and international private sector partners and provides a good example of a partnership that enables large investments. Except for Qatar, all of the region's HICs have some form of information management system that could be expanded to support data-driven decision-making, reflecting a high level of preparedness for circular economy approaches.

MENA's MICs have an intermediate level of capacity to implement circular practices, but face financial constraints. These countries generally have some foundational elements, such as waste collection, landfills, and some recycling and composting. They also have some enabling elements, such as circular economy-focused policies, private sector engagements for funding, and central institutions. These practices have financial gaps that, on average, equal half of current public expenditure on SWM, which, paired with inefficiencies in service delivery (Section 2.4), affects their ability to fully adopt circular practices.

Given resource constraints, MICs need to advance circular economy practices through low-cost, foundational elements. Despite facing challenges—such as low waste collection rates in rural areas, widespread open dumping, and limited recycling and composting—MICs do not always need high-cost infrastructure. MICs could implement a circular economy through low-cost strategies that leverage informal collection networks and recyclers, as well as community-run waste treatment options. MICs could also emulate proven deposit-refund systems, which ensure that materials are pre-sorted at the source, facilitating both better waste collection and recycling. Such mechanisms allow costs to shift from public budgets to other stakeholders, especially the producers. To make the most of available resources, MICs could also conduct comprehensive public expenditure reviews to assess whether their budgets are being used efficiently.

MICs could also benefit from adopting integrated policies that set objectives, secure funding, and promote institutional coordination. EPR legislation is an example of such an integrated policy. EPR schemes can serve as a funding mechanism because they shift the financial and operational responsibility of waste management and circular solutions from local governments to the private sector and consumers, helping mobilize much-needed financial resources for infrastructure. MICs could also create an enabling environment for private sector investments through fiscal policy instruments, such as tax exemptions for profitable treatment methods in small-scale mechanical recycling or biogas plants. In addition, MICs could use cost-recovery tariffs as a tool to mandate segregated waste disposal—especially in high-income business, industrial, logistics, and tourist areas—to help generate revenue while encouraging behavior that advances circular economy methods.

13 The European Union has adopted a long-term target of 75 percent for recycling waste, with several member states achieving rates of 60 percent and higher.

In MENA's FCV-affected economies, circular practices present an opportunity to foster resilience while better managing waste. FCVs face substantial waste management challenges: 38 percent of waste remains uncollected, and more than 80 percent of collected waste is openly dumped or disposed of without environmental control. Circularity is low, although resource scarcity drives recycling in some areas. Foundational elements of a circular economy—including waste collection, material recovery, and recycling—could create jobs and conserve resources. In addition, circular economy practices could contribute to reconstruction efforts by reusing debris instead of sending it to landfills.

However, circular economy approaches need to be adapted to difficult FCV-affected environments, which are characterized by scarce funding, weak governance, and serious obstacles due to insecurity and movement restrictions. Low-cost, technically simple, easily adaptable, small-scale, community-driven practices are most effective in this context because they can overcome the limitations of decentralized systems and material-limited market conditions (as seen in Gaza and the Republic of Yemen). Such practices can be scaled and adapted based on available resources and local needs. For example, neighborhood-based waste aggregators could facilitate localized waste collection and sorting or implement low-operation, low-maintenance infrastructure solutions such as controlled landfills, horse-cart collection systems, or small-scale, demand-driven composting (usually at the household level). Similarly, small-scale recycling facilities could process material on the spot using minimal infrastructure. Microfactories—compact production units that combine waste collection, sorting, and treatment—could transform waste into valuable products without requiring complex supply chains.

To make sure they work, these solutions need to be designed to operate independently of the electricity grid, potentially using solar power and batteries. In the past, horse- or donkey-operated waste-collection carts have proven to be a resilient method of transporting waste, particularly in areas with limited operations, maintenance capacity, and access to spare-parts markets. Beyond infrastructure, training for waste collectors, recyclers, and composters would enable communities to improve SWM and better capture value from circular economy approaches.

Financing, policy, and data approaches tailored to the FCV-affected economy context can enable local solutions. While scarce funds pose problems, small-scale decentralized solutions lend themselves well to financing approaches that may be within reach, like microloans or phased investments. Non-governmental organizations (NGOs) can act as intermediaries, channeling funds toward localized solutions or providing direct support to informal waste collectors and recyclers. Training local waste collectors or recyclers can enable them to form effective partnerships by educating them on ways to secure funding, form agreements, address grievances, and identify potential challenges. An SWM strategy that recognizes and empowers local service providers contributes to an environment that is favorable to flexible small-scale solutions. In FCV-affected environments, where little data is collected, low-cost digital waste data management solutions and apps that are available off the shelf can enable operators and communities to track performance, ensuring accountability in quickly changing political contexts.

BETTER WASTE MANAGEMENT IS WITHIN REACH ACROSS THE MENA REGION

Economies affected by fragility, conflict, and violence can prioritize establishing reliable collection services and building capacity to improve control over disposal.

Middle-income countries can extend collection services and establish safe disposal while advancing recycling and other waste-reduction solutions beyond current low levels. Appropriate circular economy opportunities can be seized or scaled up.

High-income countries are exceedingly well positioned for an ambitious push to capitalize on the benefits of advanced circular economy approaches.

5.7 *The complex case of food waste*

To effectively integrate and implement global best practices for managing food waste in the MENA region, it is important to adopt a systematic and culturally relevant strategy, focused on both prevention and management of food waste. This involves carrying out a series of strategic measures derived from successful approaches, with innovative practices both in the region and globally, and customizing these measures to local contexts and needs. Applying circular principles to food waste means addressing food loss and waste across all aspects of the food chain—from managing food loss in the upstream stages of production, processing, and distribution to food waste in the downstream stages, such as retail and consumption.

The prevention of food waste should be the longer-term goal. Upstream food losses arise during harvesting and handling of fresh produce, during on-farm storage, and from inadequate transportation and storage infrastructure. It also occurs due to inefficiencies in processing and manufacturing food, as well as when food is damaged during handling, packaging, or transport. Food waste is also linked to the retail and consumer levels—including supermarkets, households, and the hospitality sector—and encompasses food waste from expired or unsold products, over-purchasing, over-preparation, and spoilage from poor storage. There are emerging innovations, retail and distribution initiatives, technologies, and policies across the MENA region to tackle food waste through, for example, food banks and intelligent packaging (Box 2.1). Preventing food waste will take time and persistent public outreach, policies to incentivize change in behaviours from consumers and producers alike, and appropriate awareness, considering the cultural dimension of food waste.

Downstream, the goal is to divert food waste from disposal. There are well-developed technologies available, including those led by the private sector, for managing food and organic waste. These are further improved by composting. Capturing as much organic waste as possible before this waste stream is mixed with other waste materials is critical for producing compost for agricultural purposes. Agricultural compost has significant commercial potential in MENA, given the region's soil fertility challenges. Global experience suggests that priority could be given to capturing and treating organic waste from industrial, commercial, and hospitality sectors, where collection systems for food waste can be organized more efficiently with less contamination than from households.

A comprehensive approach to addressing and preventing food loss and waste in the MENA region requires coordinated action across the entire supply chain. Preventive measures should focus on: (a) engaging stakeholders through multisectoral committees; (b) strengthening PPPs to build infrastructure; and (c) establishing policy frameworks that enforce waste separation while incentivizing reduction strategies. National awareness campaigns and community-based education are also important tools for shifting consumer behaviors and cultural norms. Such campaigns could be especially effective when linked to initiatives that aim to support small farms, enhance local food production, or improve market access. Investment in infrastructure—such as composting facilities, biogas plants, redistribution networks, and digital tracking solutions—could help to prevent food loss both upstream and downstream along the food production chain.

BOX 5.3 Global best practices to prevent and manage food waste

Given that food waste is increasingly recognized as a major global concern, efficient management strategies, cultural changes, and innovative public and private initiatives are significantly influencing approaches in different countries, offering a variety of successful practices that can be adapted to the MENA region (Chirsanova and Calcatiniuc 2021). Here are a few examples of food waste prevention, together with an assessment of how they can apply to MENA:

- **South Korea:** South Korea has implemented a mandatory food-waste recovery system, requiring households to separate waste for composting or energy recovery. Pay-as-you-throw policies and public awareness campaigns have contributed to one of the highest food recycling rates globally by incentivizing households to reduce waste and induce behavior change. Pay-as-you-throw policies are suited to MENA HICs, where collection services are already high.
- **France:** France has implemented strict regulations, prohibiting supermarkets from discarding edible food, requiring such food to be donated to charities instead. Together with programs like Too Good to Go, which became successful in many countries, these initiatives prevent food from ending up in waste streams. In MENA, partnerships with retailers and non-governmental organizations could help redistribute food in cities with food insecurity.
- **Italy:** Initiatives such as the National Day of Food Collection and Last Minute Market demonstrate how collaboration between communities and the government can decrease food waste through partnerships between the public and private sectors, such as Banco Alimentare. Incentives for businesses to donate surplus food could be implemented in MENA, along with legislation to cut down food waste.
- **Brazil:** Brazil uses a robust framework based on public-private partnerships (PPPs) to collect surplus food from markets and restaurants for distribution, and for urban composting programs. Urban composting and PPP models for waste treatment could be adopted across the MENA region.
- **Mexico:** Mexico passed the General Law on Adequate and Sustainable Food (2024), which recognizes the right to food and provides measures to prevent and reduce food waste across the supply chain (CHLPI 2024). Mexico City has complemented this with a Zero Food Waste Certification Program, which encourages large waste generators to adopt prevention, recovery, and recycling measures (Mexico Business News 2024). Alongside PPPs, such as *the Pacto por la Comida*, these initiatives show how legislation combined with collective action can reduce losses and redistribute food. In MENA, similar laws and voluntary certification schemes could provide frameworks for simultaneously engaging businesses and local governments.

6

A WAY FORWARD: OPPORTUNITIES TO TURN THE TIDE

Key messages

MENA countries would benefit from focusing on three priorities: securing financing, reducing waste, and strengthening institutional accountability and coordination.

Secure financing

- Introduce a cost recovery system that is implementable and fees that are collectable.
- Raise private sector participation in SWM for expertise and investment.
- Leverage extended producer responsibility mechanisms to lower the burden on public spending.

Reduce waste, especially packaging and food waste

- Embrace attainable circular economy principles to minimize waste and reduce SWM costs and save resources
- Reduce food loss and waste by raising consumer awareness with price reforms; making investments in storage, cooling, and transport; and encouraging recovery through food banks, composting, and other forms of reuse.

Strengthen institutional coordination and accountability

- Strengthen coordination between national and municipal authorities to ensure efficient use of SWM resources and improve service quality.

6.1 Priorities for action

Investment and reform can help the Middle East and North Africa (MENA) improve solid waste management (SWM) services, avoid substantial cost, and seize opportunities for gains from reuse. As this report has discussed, the estimated cost of environmental degradation in MENA due to poor SWM is substantial (US$7.2 billion per year), which is US$69 per ton of waste that goes uncollected or is otherwise mismanaged. This cost is nearly equivalent to the US$73 per ton needed in MENA to collect and adequately dispose of waste and is likely to be an underestimate of the true cost of poor SWM. Further gains are available from better reuse of waste materials through circular economy interventions. This section identifies the most important opportunities to improve SWM, reduce waste, and realize cost benefits.

To improve SWM and realize circular economy gains, MENA needs to confront current shortcomings and commit to a step-by-step transition. With waste volumes projected to double by 2050, costs will only rise further, unless SWM services improve and circular economy measures reduce waste growth rates. MENA countries need to reflect critically on their current SWM performance, mobilize political support, and engage potential private sector partners to codevelop realistic but ambitious SWM targets. While first steps vary across countries, the imperative is the same: a shift away from uncollected waste and uncontrolled disposal where needed, and a shift towards less waste and circularity where possible. The road to such a future begins with practical and gradual progress that needs to begin now.

Each income group's SWM challenges determine priority investment needs. Progress toward better SWM will require significant investments. The priority challenges in each income group shape investment needs:

- **MENA's high-income countries (HICs) have achieved near-universal waste collection but predominantly rely on controlled landfills, positioning them to advance circular economy practices.** They can invest in large-scale circular infrastructure, including recycling, composting, and waste-to-energy plants. These improvements can include automated recovery facilities to efficiently sort high volumes of recyclables, chemical recycling plants to process complex plastic waste, and large-scale composting and mechanical recycling facilities to manage organic and dry waste from urban centers. To maximize their impact, these facilities need to be supported by optimized supply chains—from segregated waste collection and the production of secondary materials (those produced by repair, recycling, and remanufacturing) to centralized waste processing hubs, integrated collection networks, and developed markets for circular products. Delivering this infrastructure at scale will require an enabling environment, including targeted policies, private sector participation, and financial incentives for large-scale investment.
- **In middle-income countries (MICs), where open dumping remains common, investment priorities could include universal collection coverage, controlled landfill capacity, and appropriate circular solutions.** To achieve universal collection, foundational infrastructure is critical. This could include curbside collection services, decentralized waste collection hubs, public drop-off points for source-segregated waste, and strategically located transfer stations. Innovative, low-cost models, such as informal collector integration and community-run aggregation centers, could complement such infrastructure. To ensure sound disposal of collected waste (and in so doing, reduce greenhouse gas emissions and groundwater contamination), MICs could increase their number of sanitary landfills with essential control measures, such as engineered liners and methane-capture technologies. These infrastructure changes will require innovative financial mechanisms, and active engagement with the private sector and community-run organizations. In addition, MICs could use recycling and composting to supplement waste treatment capacity. To this end, MICs could upgrade processing equipment for higher recovery and improve logistics between collection hubs and treatment centers.
- **MENA's fragility, conflict, and violence (FCV)-affected economies urgently need resilient and adaptive SWM systems that expand services, increase waste collection, and reduce open dumping.** FCV-affected economies need to prioritize low-cost, technically simple, small-scale, and community-driven solutions that can be quickly deployed and adapted as conditions evolve. Where possible, infrastructure would benefit from being designed as standalone operations, using renewable energy like solar-powered battery systems to function independently of unreliable or damaged electricity grids. For waste collection, neighborhood-based waste aggregators could facilitate local waste sorting, the composting of organics, and the preparation of residual waste for disposal. Low-cost solutions could be simple operational models, such as horse carts equipped with separate bins for dry and wet waste, or small material-recovery facilities in population-dense areas that could be used for quick drop-offs and material recovery. For the disposal of residual waste, FCV-affected economies need to prioritize small-scale, controlled landfill sites with basic environmental protection. Suitable circular economy investments could include microfactories and compact production units that combine waste collection, sorting, and treatment in a single, decentralized facility for both composting and recycling. While simple and low-cost, these changes still require solid governance arrangements and funding.

Sound planning can help define roadmaps for SWM reform that are well adapted to country circumstances. To build roadmaps that can turn planning into action, six common decision steps apply:

1. Assess system performance and causes of underperformance
2. Identify and engage stakeholders
3. Define realistic, financially underpinned ambition levels
4. Develop phased strategies
5. Clarify institutional and funding arrangements
6. Decide how to include the informal sector.

These steps provide a structured approach to building tailored roadmaps for sector reform and have been further specified for different country contexts in appendix A.

Reform efforts can focus on three goals: securing reliable financing for better services, reducing waste, and improving governance. While next steps toward better SWM vary across MENA's diverse economies, the reform goals are shared. First, all economies would benefit from ensuring reliable financing for better services to ease the burden on public spending. Second, effort needs to be made to reduce waste generation, which would offer large cost savings and is critical to avoid overwhelming the SWM system. Third, governance reform to align national and municipal efforts would create a supportive environment for managing effective SWM services.

6.2 Why stakeholders hold the key to success

The success of the circular economy depends on transforming consumer behavior and consumption patterns. Adopting a circular economy requires a societal shift in beliefs and attitudes, with active roles for individuals, policy makers, and businesses. To enhance the circular economy in the MENA region, public outreach and stakeholder engagement need to be prioritized. Despite some progress, the region is still in the early stages of adopting circular economy practices, with most efforts localized and driven by non-governmental organizations (NGOs) and private entities, with minimal government involvement. There is a clear need for comprehensive national strategies and greater governmental commitment to circular economy initiatives. Expanding government involvement, supporting local initiatives, and documenting and evaluating efforts are essential steps to enhance circular economy practices and improve SWM. Strengthening public outreach and stakeholder engagement will foster a more engaged and sustainable approach to waste management, ensuring that circular economy practices are effectively implemented across the region.

Stakeholder engagement principles need to be mainstreamed. Good practices include openness, adopting a lifecycle approach, informed participation and feedback, inclusiveness, sensitivity, flexibility, accessibility, and cultural appropriateness. Specific initiatives could be established to raise awareness and engage in persuasive communication, with clear goals and targeted strategies for each stakeholder grouping. In non-Gulf Cooperation Council countries, where regulatory enforcement is relatively weak, persuasive communication would play a more significant role because legislative tools alone will not lead to the required behavioral changes. Engagement needs to be continuous, informative, and complemented by efforts to empower local communities to take action, which would strengthen relationships between them and central agencies. Defined consumer outreach strategies with clear goals and objectives that can be monitored are critical, along with ex-post evaluation of consumer education programs to ensure their effectiveness.

BOX 6.1 On the productivity and working conditions of informal sector workers

The informal sector plays a critical role in waste collection and recycling across MENA, yet informal workers are exposed to extremely poor working conditions. In the past, formalization efforts have struggled due to high transaction costs, regulatory hurdles, and social stigma.

Rather than attempt to fully formalize informal waste sector workers, a pragmatic approach would be to focus on improving working conditions, increasing earnings, and facilitating informal sector participation in organized waste value chains. Governments could support informal workers by recognizing their contributions toward national recycling goals, offering access to protective equipment, setting up inclusive material-recovery centers, and providing financing for microentrepreneurship.

Supporting rather than displacing the informal sector would drive recycling rates upward while preserving livelihoods. This is important for all MENA countries, particularly in middle-income countries and fragility, conflict-, and violence-affected economies, which rely heavily on informal workers for waste management.

6.3 Secure financing

Introduce a cost recovery system that is implementable and where fees are collectable

Better cost recovery is critical to funding municipal solid waste services, but it needs to be implemented in a way that stands the test of practice and is socially acceptable. Low funding for capital investment and unpredictable revenue streams for operational expenses are major obstacles to sustainable SWM funding. Infrastructure, such as sanitary landfills and large-scale recycling facilities, require large upfront investments with long payback periods, while the typical amortization period for equipment is five to 10 years. Reliable revenue streams are, therefore, imperative.

Outside of FCV-affected environments, user fees could help carry the cost of SWM investment and complement additional funding sources. For example, a draft law in Lebanon on cost recovery gives municipalities the mandate to charge citizens and other producers for waste services, generating income that could fully cover adequate levels of such services. As another example, in Phnom Penh, Cambodia, where waste services are fully privatized, the city has developed a waste tariff structure that allows for differentiation between user groups based on an assessment of their financial capacity.

MENA's HICs could target full cost recovery, either from users through household waste collection fees or from producers through "producer pays" mechanisms. Carbon markets could further help expand financing options (for example, methane credits from landfills could be sold). Similarly, plastic credit trading platforms and green bonds could be explored to recover costs in a way that is tailored to waste sector investments.

In MENA's MICs, user fees could be used to complement public funding and private sector participation. Full cost recovery through user fees is often politically and socially challenging in such contexts. A gradual approach may be needed, in which subsidies are progressively reduced and user charges are carefully increased even as services improve. MICs could also introduce targeted user fees for commercial and high-income residential sectors, where willingness and ability to pay are higher, while maintaining subsidies for low-income households.

MENA's FCV-affected economies require different financing approaches because conventional revenue models like user fees are often unworkable. In immediate crisis situations, FCV-affected economies can sometimes obtain short-term SWM funding through humanitarian assistance programs as part of emergency public health responses. Over the medium term, they could explore decentralized financing approaches, such as supporting community-led waste systems through microgrants or cash-for-work programs. International donors, development banks, and NGOs can also play catalytic roles by providing technical assistance and bridging finance for basic infrastructure, such as waste transfer stations and community composting sites.

Stimulate private sector participation to harness expertise and attract investment

Private sector participation is an underused opportunity to strengthen SWM systems and advance the circular economy in MENA. By increasing private sector engagement, MENA countries could improve operational efficiency, enhance service quality, and ease fiscal pressures on municipal governments. With public budgets often constrained, leveraging private investment and operational expertise is critical for scaling up SWM solutions. Unlocking private sector participation across MENA will require governments to strengthen regulatory frameworks, de-risk private investments, and foster a competitive and transparent market environment.

MENA's HICs already have strong private sector engagement in SWM, which they can leverage to advance circular economy approaches. Private operators can be particularly effective in financing and operating complex waste-treatment infrastructure, such as chemical recycling facilities, waste-to-energy plants, and large-scale composting systems for agricultural use. By providing stable and transparent regulatory frameworks, HICs could attract long-term private investment for such undertakings and accelerate the transition toward higher-value waste recovery.

MENA's MICs have limited private sector participation but could expand it to improve the efficiency of SWM services. Governments could engage private companies to play different roles. The private sector could contribute to more efficient waste collection, expanding service coverage in underserved areas, managing controlled landfills, and developing recycling, composting, and waste-to-energy plants. Private sector involvement in material recovery could increase the quantity and quality of materials recovered from waste streams. To harness these opportunities, MICs would need to build investor confidence and strengthen competition for SWM services by developing standardized, transparent procurement procedures for private contracts and by professionalizing contract management and supervision to ensure accountability. They could also create an enabling environment for private sector investment across the entire circular economy value chain by implementing tax incentives for recycling facilities, subsidies for the production of circular products, and regulatory support measures, such as preferential tariffs. By fostering a business-friendly ecosystem, MENA's MICs could attract a wider range of private actors, including large multinational companies and local entrepreneurs, which could in turn drive technological advances essential for circular economy transformation.

MENA's FCV-affected economies could struggle to engage the private sector, but progress is still possible and necessary. In FCV-affected environments, efforts to engage the private sector need to be adapted to local conditions. However, opportunities still exist to mobilize private capacity for essential services such as basic waste collection and community-level recycling, particularly by small- and medium-sized enterprises. Governments and donors can facilitate this by offering microgrants, technical assistance, and simplified regulatory processes to local businesses and cooperatives. Where formal contracting mechanisms are difficult, informal partnerships and social enterprise models could help sustain basic waste services while creating livelihoods. Voluntary private sector initiatives, including partnerships with humanitarian agencies, can also support infrastructure recovery and circular economy activities, such as material reuse and repair practices, and small-scale composting.

Maximize the role of the informal sector

To harness the full potential of the informal sector, governments in the MENA region could develop policies that support coordination with the informal waste sector as a possible step towards formalization. This includes creating structured systems that acknowledge the sector's role, ensure compliance with health and safety standards, and promote collaboration with municipal waste management systems. As informal workers become more integrated with formal recycling and waste management systems, their efficiency could be maximized, their economic stability ensured, and their methods expanded. Such engagements would not only improve resource efficiency and stimulate economic growth, but also promote social equity, offering marginalized communities the opportunity to participate in—and benefit from—sustainable economic growth.

Leading waste companies in the region could adopt corporate social responsibility principles, such as the Fair Circularity Principles, to support greater respect for informal workers' rights and help integrate them into formal waste management systems. Establishing a mutually beneficial connection between formal waste management strategies and the informal sector at the grassroots level could foster innovation, inclusivity, and sustainability in waste management practices. Such collaboration is essential for maximizing the economic potential of the circular economy, and promoting fairness and inclusion. Policy makers, industry leaders, and sustainability advocates are encouraged to establish methods that incorporate informal waste workers into the circular economy, acknowledging their vital part in achieving circular economy goals. This approach aligns with the United Nations' Sustainable Development Goals by providing a multifaceted contribution to sustainability and community development, and significantly impacting urban environmental management.

Leverage extended producer responsibility mechanisms

Extended producer responsibility (EPR) is a powerful tool to engage the private sector on SWM. By shifting responsibility for the management of certain products to the businesses that make them, EPR mobilizes both funding sources outside of public spending and engages private expertise in addressing SWM challenges. When producers pay for the end-of-life management of their products, local governments can use the resulting resources to improve services. EPR revenues can also be used to strengthen waste collection infrastructure, and to research and develop new materials and recycling technologies.

MENA countries have an opportunity to build on global and regional experiences to define EPR systems that suit their needs. Globally, EPR differs from country to country, depending on their income level and governance frameworks. MENA countries have a range of choices for implementing a potential EPR:

- **MENA's HICs could aim for ambitious EPR policies.** Among MENA's HICs, the United Arab Emirates (UAE) has launched pilot EPR schemes for packaging and tires, while Saudi Arabia is embedding EPR principles into its waste management law. To scale up, these countries could consult stakeholders to define the scope of a possible EPR, and based on this understanding, develop legally binding EPR regulations that: (a) define producer categories and their obligations, (b) establish producer responsibility organizations (PROs), and (c) generate investment in digital systems for tracking and enforcement. While early EPR models are emerging, as can be seen in Saudi Arabia and the UAE, these models need to be expanded across MENA's HICs to cover key issues like packaging waste.
- **MENA's MICs could gradually introduce EPR regulations in sectors where the regulations can be effectively managed.** Efforts to scale up EPR systems in MENA's MICs could focus on engaging stakeholders, conducting assessments to determine the readiness for such systems, and building consensus around the need for these systems. Based on such assessments, countries might roll out pilot schemes in urban areas, potentially phase in EPRs for priority sectors (such as plastic packaging and e-waste), and establish baseline data systems before national-level scaling. Voluntary schemes could also help build private sector readiness, while blended governance models involving municipalities, informal sector actors, and PROs could offer practical paths forward.
- **MENA's FCV-affected economies could explore opportunities to start developing schemes that follow the principles of EPR.** In FCV-affected contexts, the implementation of EPR systems is severely limited or nonexistent. Selectively introducing development finance-linked voluntary EPR schemes could encourage manufacturers and NGOs to consider product lifecycle management—perhaps most plausibly for selected products, such as imported electronics, medical equipment, or packaging. Development organizations could help countries by analyzing the potential to pilot voluntary EPR systems in collaboration with community associations, non-profit organizations, local governments, and private businesses. Such pilots could be designed to build the capacity of countries and economies to track data and safely dispose of waste, establishing the foundations of organizations that could evolve into more structured PROs.

6.4 Reduce waste, especially packaging and food waste

Strengthen circular economy approaches

MENA countries could implement measures to minimize waste—whether simple or complex—to ease the fiscal burden and save resources. For example, HICs in the region could innovate on new materials to replace single use plastics, invest in infrastructure, and implement fully fledged EPR policies, building on models from other HICs like Japan. MENA's MICs could look at EPR as a funding stream and consider proven solutions like deposit-refund schemes. FCV-affected economies could focus on small-scale, low-cost innovations that are simple to operate and maintain, such as supporting community-level initiatives for recycling and composting waste. At any level of technical complexity, bending the waste curve requires public participation, which necessitates close attention to raising awareness, engaging communities, and involving the informal sector.

Despite their high quality overall, SWM policies in MENA's HICs lack detailed frameworks that promote circularity. HICs have a wealth of opportunities to lead a regional initiative to recover more value in SWM. Developing and implementing stronger policies would be a first step to seizing such opportunities. Measures to significantly reduce waste—such as bans on single-use plastics, mandatory design-for-circularity standards, recycled content requirements, and regulations to reduce food loss and waste—are achievable. Specifically, requirements for clear recyclability labels or eco-design certifications would better inform consumers and enhance market demand for circular products. HICs could also consider economic instruments like taxes on virgin raw materials, penalties for excessive food waste, and targeted subsidies for recycling and composting industries. With strong public funding, HICs can use public procurement to signal demand for circular products, such as recycled plastics or compost. Alternatively, comprehensive policies that address a product's entire lifecycle (such as EPR frameworks) offer a practical solution.

MENA's MICs have established SWM policy frameworks but face challenges when it comes to integrating circular economy goals and achieving financial sustainability. To advance a circular economy, MICs could prioritize clear, enforceable regulatory targets for recycling rates and landfill diversion. They could simultaneously explore funding strategies that attract private sector investment, including tax incentives for recycling equipment and facilities, preferential tariffs for businesses that implement source segregation, and penalties for non-compliance with waste management regulations. Targeted EPR initiatives could also serve as a funding mechanism.

In MENA's FCV-affected countries and territories, circular economy approaches can build on informal and community-based efforts that are simple yet effective at saving scarce resources. As is the case with SWM approaches overall, circular economy elements in FCV-affected economies need to be low-cost, simple, and community driven. Informal waste separation and recycling methods have emerged in the region and could provide scalable models. Further investments in small, decentralized composting and recycling facilities can be explored where the environment is stable enough to secure funding and allow for reasonable governance.

Reduce food loss and waste

Although some MENA initiatives seek to reduce food loss and waste, overall the region still needs effective policies and better consumer-facing strategies. To reduce food loss and waste, countries in MENA would benefit from adopting a value-chain approach that combines reducing food loss at the source, supports the redistribution of excess food before it goes to waste, and enables the recovery of resources by driving the composting of food waste for use in agriculture. Effective strategies would need to be differentiated by country income level, but all approaches would need to include awareness-raising and community engagement.

MENA's HICs are well placed to lead the region on preventing food waste by implementing regulations and driving innovation. Authorities could mandate food-waste audits in targeted sectors, such as hospitality and retail, especially during high-waste periods. Tax incentives and legal frameworks could encourage food donations by reducing liability concerns for businesses without increasing health risks for the recipients of such donations. Digital tools and technology-enabled redistribution platforms could be scaled to connect surplus food with communities in need. In addition, municipalities would benefit from investing in infrastructure to compost food waste and convert waste to energy as a part of broader climate and circular economy strategies.

MICs in the region could work on establishing food-waste reduction strategies, including raising awareness about the value of food and supporting grassroots efforts to redistribute surplus food, rather than letting it go to waste. Strategies could usefully define clear targets and sectoral action plans. For concrete first steps, public awareness campaigns to encourage people to value food and buy food responsibly would help shift consumer behavior. Governments could also support local food banks and community redistribution programs, while enabling informal actors to safely participate in food-to-feed recycling and decentralized composting.

In MENA's FCV-affected environments, food waste strategies need to align with humanitarian and public health goals. Given the high level of food insecurity in these countries and territories, efforts to reduce food loss and waste could usefully be integrated into emergency food distribution and recovery efforts. This includes ensuring that surplus food from donors and development finance agencies is used effectively. Support for low-tech food preservation methods and informal food-sharing networks would also help reduce spoilage and waste. NGOs and humanitarian actors could also play a role in integrating food loss, and waste monitoring and reduction efforts into nutrition and recovery programs, especially in displacement settings.

6.5 Improve institutional coordination and accountability

Effective governance underpins successful SWM and circular economy transitions. In turn, it requires institutions to be empowered with professional oversight, strong coordination capabilities, and the authority to enforce regulations. While tailored to country circumstances, governance frameworks ideally need to promote transparency and accountability to build trust and ensure sustained performances.

Waste management challenges have grown beyond the scope of what local authorities can handle. Historically, SWM has been treated as a basic household-level or municipal responsibility, and many central governments in the region continue to view waste as a local service issue. Awareness of the environmental and economic scale of the problem remains low, and national policies, regulations, and financing mechanisms have consistently lagged behind evolving needs. However, waste volumes and costs have grown rapidly and, now, commonly consume between 30 and 50 percent of local government budgets. This development has made reliance on local responsibility unsustainable.

Better coordination between national and municipal authorities is key for improving management and oversight. The governance of the waste sector is usually straightforward. Typically, municipalities are responsible for collection and proper management, while a central environmental agency is responsible for planning and oversight. To make SWM work, MENA needs good coordination between the national entities responsible for waste management and municipalities. Engagement mechanisms to support and monitor local administrations, coupled with strong accountability models, are also essential. Such models exist, for instance in the West Bank and Gaza prior to the current conflict, where national authorities support strong empowered local governments with policies and investments where needed.

MENA's HICs have well established SWM governance, but advancing the principles of a circular economy will require new, decentralized governance models. National ministries or state-owned companies can play a leading role in setting policy direction, establishing regulations, and providing services. However, local governments will require training and capacity building to increasingly take responsibility for organizing and overseeing SWM services, as well as for managing contracts and running public awareness-raising campaigns. This will become increasingly important when, for instance, MENA's HICs explore EPR schemes and need to engage with—and monitor—the producer organizations responsible for implementing the schemes.

MICs can improve governance for SWM and circular economy by building capacity and establishing partnerships between public authorities, private companies, and civil society. Local government institutions could be trained and provided with tools to supervise private sector contracts, enforce environmental regulations, and engage communities through source separation and recycling programs.

To foster partnerships, and particularly to advance circular solutions, MICs would benefit from assessing how engagement regulations could be improved. For example, procurement processes that are transparent and competitive would cultivate more trust. MICs can also pilot community-driven governance models in urban and peri-urban areas and, in rural areas where municipal reach is limited, integrate informal sector actors without rigid legal formalization.

MENA's FCV-affected economies require novel and resilient governance approaches that can function even with limited state authority. Decentralized systems rooted in community networks, such as those seen in Gaza and Lebanon, have demonstrated resilience and adaptability in maintaining basic SWM services during conflict and instability. Institutional arrangements could be structured in ways that empower local communities and build partnerships among NGOs, informal workers, and municipal actors.

Better data is needed to empower governance. Across MENA, countries would benefit from improved SWM data collection, which would allow authorities to better understand service levels and challenges. Data on waste disposal and treatment is often unavailable beyond HICs, limiting MENA's capacity to develop effective SWM services and identify circular economy opportunities. This includes information about open dumping, which could help with the identification of key sources of damage, and about the contributions of informal waste workers—an overlooked asset in SWM. In addition, most countries lack systematic reporting on sector finances, making it difficult to assess the efficiency and sustainability of their SWM systems. At a minimum, countries would benefit from regularly reporting on total municipal spending on SWM, including revenues collected from user fees; operational costs for collection, transport, and disposal; and capital expenditures.

Appendix A. Methodologies for data collection, waste sector performance analytics, and financial analysis and projections

Methodology for analytics

Country classifications

As explained in chapter 1 of the report, for the 19 countries in the Middle East and North Africa (MENA) included for the study, analytical work was performed at the country level by income groups, fragility, conflict, and violence (FCV)-affected status, and at the regional level. This resulted in three country groups:

- High-income countries (HICs), namely Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and United Arab Emirates
- Middle-income countries (MICs), namely Algeria, Djibouti, Egypt, the Islamic Republic of Iran, Jordan, Morocco, and Tunisia
- FCV-affected countries and economies, which include Iraq, Lebanon, Libya, Syria, West Bank and Gaza, and the Republic of Yemen.

Where considered useful, for instance with cost analyses, FCV-affected countries and economies were analyzed by their income-group categorization, and for MICs, a distinction was made between lower-middle-income countries (LMICs) and upper-middle-income countries (UMICs). In these cases, Syria and the Republic of Yemen are classified as low-income countries (LICs); Algeria, the Islamic Republic of Iran, Iraq and Libya as UMICs; and Djibouti, Egypt, Jordan, Lebanon, Morocco, Tunisia, and West Bank and Gaza as LMICs and economies.

Data collection and data gaps

For the purposes of this report, the definition of "municipal solid waste" encompasses residential, commercial, street cleansing, and institutional waste. Also, when "waste" is used for brevity, this refers to municipal solid waste, unless otherwise specified.

Municipal waste management performance indicators—developed based on global practices and aligned with other World Bank publications—were used to investigate the status of waste management practices, and to assess and to benchmark performances in MENA.

Data was collected for the following parameters: gross domestic product (GDP), population (urban, rural, slum, and so on), waste generation, collection rate, waste composition (organics, glass, metals, paper and cardboard, plastics, recyclables, leather, wood, yard and garden waste, textiles, electronics and electrical equipment, hazardous waste, and so on), waste treatment mix (sanitary and controlled disposal, dumping, recycling, composting, digestion, incineration, and so on), governance (waste information system, solid waste management agency, public-private partnership (PPP) regulations, public budgeting, policies regulations, and so on), informal sector contributions, formal and informal sector employment, the sector's greenhouse gases and methane emissions, Nationally Determined Contributions for the waste sector, private sector involvement, operating expense estimations, and cost of environmental degradation (COED) from waste management.

With these indicators, data was gathered in 2024 from a range of sources, including government reports, academic studies, international organizations, and stakeholder consultations, with references in appendix G. Priority was given to formal statistical data and government publications. Global benchmarking values are obtained from *What a Waste 2.0* (Kaza et al. 2018).

Adjustments have been made to harmonize all waste data to a common baseline year (2022) and to account for variability, including estimates of uncollected waste, waste collected by the informal sector, and non-household municipal solid waste. Where possible, this was done by using data from the same country and, for instance, for generation rates to use data from before 2022 to extrapolate and estimate 2022's waste generation. For country group and regional analytics, individual country data gaps were filled by estimations based on values from countries in the same income group. For example, COED data was available for 11 of the 19 MENA countries. For the missing eight countries, COED levels were estimated based on comparable COED values in other MENA countries.

For global benchmarking, data from 2016, as reported in *What a Waste 2.0* (Kaza et al. 2018), was used.

A special case is the reported data on public expenditures in the waste sector. Generally, while formal reporting on waste data and performances is already limited and often inaccurate, data on expenditures is scarce. Some expenditure data in the study are based on reported tariffs where available, for example, for Jordan, but they are mainly based on the assessment of sector specialists working in the 19 MENA countries.

GDP, population, and waste generation projections

Projections for the years 2030, 2040, and 2050 are based on the adjusted baseline year waste generation for 2022, and projected changes in economic development and projected population growth. This was done using a correlation between waste generation per person and GDP per person, PPP data (constant 2021 international US$). The estimated waste generation for each of the target years was multiplied by United Nations' (UN's) population projections for those years.

Cost estimations

Cost estimates were calculated at the country level using 2022 data. The collected data on total public expenditure (Table 3.2) covered integrated operational expenses and the financing (costs for servicing investments) for the full waste management chain.

Global unit cost estimates were differentiated for costs of waste collection, treatment, and disposal, and they were also adjusted for country income levels for benchmarking and projections.

These global unit costs include operational costs, financing costs for investments, and other costs.

The global unit costs are based on the World Bank Group publication "Municipal Solid Waste Cost Calculation Technical Guidelines for Low and Middle-Income Countries."

On this basis and for this study, the global unit costs outlined in Table A.1 have been estimated and applied.

Table A.1 Unit cost per ton for waste management operations

Waste management operation	Low-income countries (US$/ton)	Lower-middle income countries (US$/ton)	Upper- middle income countries (US$/ton)	High-income countries (US$/ton)
Mixed waste collection	23	26	30	35
Sanitary landfill	22	23	23	25
Recycling (integrated costs of separate collection and sorting)	104	113	125	140
Composting	46	48	51	54
Incineration with energy recovery	-	-	85	85

Source: World Bank 2024.

Note: These are integrated costs for both operations and maintenance, and depreciations and other costs. These were calculated without VAT and other taxes. The costs estimates are provided in 2022 prices, which does not consider inflation.

These global unit costs were then used to calculate a "shadow" cost level for the current waste systems in MENA to assess whether value-for-money is being achieved for the current (2022) expenditure levels. For 2022, an estimate was made of the cost levels for adequate systems (universal collection, moderate recycling rates, sanitary disposal, and so on) that could handle current waste volumes. This estimate also identified the financing gap that would need to be addressed to achieve adequate waste services in all MENA countries, in line with UN's Sustainable Development Goal targets.

The same global unit costs were used to predict costs for waste management in 2050, expressing these costs in today's monetary values. Thus, the projected costs do not account for discounts, nor do they account for inflation. They thus allow for direct comparison with today's expenditure levels and budgeting requirements. The 2050 cost projections were calculated based on the 2050 waste volume projections (Figure 2.1) and applied with the following performance levels with all percentages as fractions of total volumes of generated waste:

- **HICs:** Waste collection 100 percent; sanitary landfill 30 percent; composting 15 percent; recycling 25 percent; incineration (waste-to-energy) 30 percent
- **MICs:** Waste collection 100 percent; sanitary landfill 60 percent; composting 20 percent; recycling 20 percent
- **LICs:** Waste collection 90 percent; sanitary landfill 70 percent; composting 10 percent; recycling 10 percent.

Applying the global unit costs to these 2050 scenarios resulted in integrated waste management costs of US$121 per metric ton (/ton) for HICs; US$88/ton for UMICs; US$83/ton for LMICs; and US$63/ton for LICs.

These costs do not include reductions from revenues through the sales of recyclables and, in the case of waste-to-energy capacity, through feed-in tariffs from electricity sales. For higher levels of recycling and incineration, revenues can make up 20% and even more of total costs. Including revenues, net costs in 2050 were estimated at: US$99/ton for HICs; US$75/ton for UMICs; US$71/ton for LMICs; and US$51/ton for LICs.

Appendix B. Solid waste management governance in the region

Table B.1 outlines solid waste management governance arrangements by country and country income group. It also provides detail regarding the entities responsible for licensing and regulation across the region.

Table B.1 Solid waste management governance in the region

Country	Responsibility				
	Policy, strategy, and regulations	Implementing agency (for permitting, licensing, compliance assurance, and/or data management)	Waste management services		
			Collection	Treatment	Disposal
High-income countries					
Bahrain	The Supreme Council for Environment sets the national waste management strategy, and develops and enforces environmental regulations, including those related to waste management	The Supreme Council is responsible for issuing permits and licenses for waste treatment and disposal, import-export, and monitoring compliance with environmental regulations. It also conducts inspections of waste management facilities. The Ministry of Works, Municipalities Affairs and Urban Planning issues construction and operational licenses for waste management facilities, which are contingent on obtaining Supreme Council environmental permits. The Ministry also issues licenses for waste collection and transportation, and is responsible for tendering these contracts.	The Ministry of Works Local councils play an advisory role and are involved in decision-making processes regarding waste management services at the municipal level. The private sector is involved in these services. The Ministry oversees the operations at the Askar Landfill. Law No. 41 of 2022 on public-private partnership (PPP) has been issued to enable participation of the private sector in government projects, including in waste management. Private investments in waste-to-energy projects are done under this framework.		
Kuwait	The Environment Public Authority develops and implements national environmental policies, including those related to waste management. It establishes the standards and regulations for waste management practices.	The Authority issues licenses and permits for waste management activities—such as treatment, disposal, and import and export—and it monitors compliance with environmental regulations in collaboration with the Environmental Police of Kuwait.	Kuwait Municipality	Ministry of Public Works, although there is involvement of the private sector in line with PPP models, such as waste-to-energy projects	Kuwait Municipality

Source: Based on analysis conducted for this report.

Table B.1 Solid waste management governance in the region (continued)

Country	Responsibility				
	Policy, strategy, and regulations	Implementing agency (for permitting, licensing, compliance assurance, and/or data management)	Waste management services		
			Collection	Treatment	Disposal
High-income countries (continued)					
Oman	The Environment Authority (formerly Ministry of Environment and Climate Change) sets the national waste management strategy, and develops and enforces environmental regulations, including those related to waste management.	The Authority sets environmental standards for waste management activities (collection, transportation, treatment, and disposal). Be'ah (Oman Environmental Services Holding Company), a state-owned company, was established for waste management in Oman. It sets the technical standards and ensures the Authority's environmental standards are also complied with.	Be'ah is responsible for all waste management activities in Oman, including collection, transportation, and disposal. Local municipalities are responsible for the collection of municipal solid waste in cities and towns, often doing so through private companies or with the support from Be'ah.		
Qatar	The Ministry of Municipality develops the policies and plans required for solid waste management (SWM) and oversees the implementation of solid waste strategies. The Ministry of Environment and Climate Change develops policies and strategies to reduce waste generation and promote sustainable waste practices.	The Ministry of Environment and Climate Change is primarily responsible for setting the environmental standards for waste facilities and issuing environmental permits. The Ministry of Municipality is responsible for issuing permits specific to waste management projects and activities.	Qatar has a notable PPP arrangement with private operators to operate the Domestic Solid Waste Management Centre in Mesaieed, which includes composting and waste-to-energy facilities.		
Saudi Arabia	The Ministry of Environment, Water and Agriculture is responsible for overarching environmental policies, including broader aspects of waste management. The National Center for Waste Management is a newly established waste regulatory agency that develops the national waste management strategy and focuses on waste related policies and regulations.	The National Center for Waste Management is the main licensing and permitting body related to SWM activities. The National Center for Environmental Compliance sets and enforces environmental regulations and standards in collaboration with the National Center for Waste Management, including formal environmental impact assessments that license the construction and operation of a waste management facility.	The Ministry of Municipal, Rural Affairs & Housing along with local authorities	The Ministry of Municipal, Rural Affairs & Housing and Amanas The Saudi Investment Recycling Company was established to promote circular economy in the country by investing in recycling and recovery facilities.	The Ministry of Municipal, Rural Affairs & Housing and *Amanas*

Table B.1 Solid waste management governance in the region (continued)

Country	Responsibility				
	Policy, strategy, and regulations	Implementing agency (for permitting, licensing, compliance assurance, and/or data management)	Waste management services		
			Collection	Treatment	Disposal
High-income countries (continued)					
United Arab Emirates	The Ministry of Climate Change and Environment is the federal authority for environmental planning and action in the United Arab Emirates, including waste management policies and strategies. Each emirate has a dedicated entity responsible to set their own waste management policies, as exemplified by the Environment Agency – Abu Dhabi and the Dubai Municipality.	Each emirate's environmental agency is responsible for permitting and licensing waste management activities, and for monitoring and assuring compliance with standards and regulations. The main entities are: • Abu Dhabi: Environment Agency • Dubai: Environment Health and Safety Agency • Sharjah: Environment and Protected Areas Authority • Ajman: Municipality and Planning Department • Fujairah: Fujairah Environmental Authority • Ras Al Khaimah: Environment Protection and Development Authority, which provides environmental permits; and the Public Service Department, which manages infrastructure like waste management, certifies waste management vendors, and issues waste disposal permits.	Local authorities and government-owned companies, such as Tadweer in Abu Dhabi and Bee'ah in Sharjah		
Upper-middle-income countries					
Iraq	The Ministry of Construction, Housing, Municipalities and Public Works is responsible for overall SWM policies, including municipal solid waste. The Ministry of Environment handles environmental policies and strategies, including waste management.	The Ministry of Environment sets the standards and is responsible for ensuring compliance.	Local authorities (municipalities under the supervision of governorates) engage private sector contractors.	The Ministry of Construction, Housing, Municipalities and Public Works Local authorities (municipalities under the supervision of governorates) engage private sector contractors.	The Ministry of Construction, Housing, Municipalities and Public Works Local authorities (municipalities under the supervision of governorates)

Table B.1 Solid waste management governance in the region (continued)

Country	Responsibility				
	Policy, strategy, and regulations	Implementing agency (for permitting, licensing, compliance assurance, and/or data management)	Waste management services		
			Collection	Treatment	Disposal
Upper-middle-income countries (continued)					
Libya	The Environment General Authority has overall environmental regulation responsibility in Libya. The Authority advises on environmental issues and operates at national, regional, and local levels. It formulates a national environmental policy for sustainable development and setting standards. Regionally, seven branches implement these policies.	The Authority is Libya's environmental monitoring and permitting body.	The Ministry of Local Governance		
West Bank and Gaza	The Ministry of Local Government sets general policies about SWM and coordinates the activities of the Local Government Units and Joint Service Councils.	The Environment Quality Authority handles SWM at a strategic level. It develops the standards, procedures and guidelines for sustainable SWM, and determines the solid waste sites specificities.	Local Government Units are responsible for primary collection.	The Ministry of Local Government provides oversight.	Joint Service Councils are responsible for disposal.
Lower-middle-income countries					
Algeria	The Ministry of Environment and Renewable Energies is responsible for overall strategy and policy making. The National Waste Agency, under the Ministry, is responsible for implementing national waste strategies and action plans.	The Agency	Local authorities (environmental directorates)		
Djibouti	The Ministry of Urban Planning, Environment, and Tourism is responsible for developing and implementing environmental policies, and creating legislative and regulatory tools.	The Ministry is also responsible for permitting, licensing, and compliance assurance.	Local Municipalities		
Egypt, Arab Rep.	The Ministry of Environment is the main body responsible for defining and providing the overall direction for SWM policies and strategies.	The Ministry is also the main regulator with its technical arm (the Egyptian Environmental Affairs Agency) and its newly established arm, the Waste Management Regulatory Authority. Permitting and licensing is also provided by the Ministry.	Local municipalities, under the supervision of regional governorates and the Waste Management Regulatory Authority		

Table B.1 Solid waste management governance in the region (continued)

Country	Responsibility				
	Policy, strategy, and regulations	Implementing agency (for permitting, licensing, compliance assurance, and/or data management)	Waste management services		
			Collection	Treatment	Disposal
Lower-middle-income countries (continued)					
Iran, Islamic Rep.	The Department of the Environment is the main stakeholder at national level for planning and the establishment of regulation and policy frameworks.	The Department is responsible for permitting and compliance assurance.	Local authorities (in provinces with over 200,000 residents, municipalities have municipal solid waste organizations)		
Jordan	The Ministry of Environment sets waste management policies.	The Ministry monitors and enforces compliance. It issues the necessary permits to construct and operate various municipal SWM facilities and is responsible for the selection of sites for the establishment of landfills.	The Ministry of Municipal Affairs, Local Authorities (Municipalities and Joint Services Councils delegated by Municipalities) with oversight from the Ministry of Environment and Ministry of Local Administration In Amman, the Greater Amman Municipality oversees waste management services and infrastructure.		
Lebanon	The Ministry of Environment is the main body responsible for defining and providing the overall strategy for the SWM sector.	The Ministry is responsible for permitting, licensing, and enforcing standards and regulations.	Law 80/2018 enabled the establishment of a National Waste Management Authority to oversee the implementation of regional and local management plans in coordination with local authorities. However, the National Authority has not yet been established. Central government authorities (especially the Council for Development and Reconstruction and the Office of the Minister of State for Administrative Reform) still play a role in the contracting of waste management services in the absence of the National Authority.		
Morocco	The Ministry of Energy, Mines and Environment is responsible for environmental policy and overall strategy. The National Agency for Waste Management is responsible for overall waste management strategy.	The Ministry oversees environmental standards, and the National Agency ensures compliance with technical standards for waste facilities and services.	Local municipalities		
Tunisia	The Ministry of Environment is responsible for environmental policies, regulations, and strategies for waste management	Tunisia's National Waste Management Agency oversees waste policies and enforces regulations to protect citizens' health and the environment. Additionally, the National Environmental Protection Agency monitors pollution, enforces regulations, manages natural resources, and conducts impact assessments.	Local authorities and municipalities		

Table B.1 Solid waste management governance in the region (continued)

Country	Responsibility				
	Policy, strategy, and regulations	Implementing agency (for permitting, licensing, compliance assurance, and/or data management)	Waste management services		
			Collection	Treatment	Disposal
Low-income countries (continued)					
Syrian Arab Republic	The Ministry of Local Administration and Environment is the main organization with primary responsibilities for setting the national policy on the environment, including SWM.	The Ministry	Local authorities, however, in a few towns, municipalities contract private companies	Local authorities	Local authorities
Yemen, Rep.	The Ministry of Local Affairs drafts, amends, and approves waste management policies, regulations, and so on.	The Environmental Protection Agency monitors and enforces adherence to environmental laws and regulations. It also ensures compliance with health, safety, and pollution standards.	Local authorities		

Appendix C. Private sector participation in the region

Table C.1 describes existing public-private partnership arrangements in the region by country and income group.

Table C.1 Private sector participation in the region

Country	Private sector involvement in collection	Private sector involvement in treatment	Private sector involvement in disposal
High-income countries			
Bahrain	Companies like the Gulf City Cleaning Company, Sphinx Services, and Nidukki are involved.	Companies like Nidukki and Crown Industries are involved.	The Askar Landfill is managed by the MWMUAP. No reported involvement by the private sector.
Kuwait	Companies like the National Cleaning Company (collection and transportation) are involved.	Companies like Tazur Recycling, Omniya, and Al Afraj Group are involved.	A waste-to-energy project in a public-private partnership (PPP) structure went to a consortium led by CNIM (Infrappp World 2017).
Oman	Companies like Averda (in collection and treatment) are involved.		No reported involvement by the private sector.
Qatar	Service contracts involve companies like Qatar MCC and Aamal Services.	Companies like Pearl Recycling, the United Development Company, and POIL Group are involved in recycling. Mesaieed Waste Management Complex (composting and a waste-to-energy facility) are run by government PPP contract.	Qatar Primary Material Company signed cooperation agreement with the Ministry of Municipality to recycle construction waste at Rawdat Rashed landfill.
Saudi Arabia	Companies like Averda are involved.	Companies like Tadweer, Saudi Investment Recycling Company, Wasco, and Nesma are involved.	Involvement from the private sector is unreported.
United Arab Emirates	In Dubai, a concession contract involved M.A.H.Y El Khoory (Green Arabia). In Abu Dhabi, Al Dhafra Waste Management, Veolia, and Green Mountains Environment and Transport are involved.	Companies like Veolia and Averda are involved.	Involved through PPP agreements, such as Bee'ah in Sharjah and Tadweer in Abu Dhabi
Upper-middle-income countries			
Algeria	State-owned companies sometimes sub-contract to private companies.	Companies like AFC Recyclage are involved in waste treatment.	No reported involvement from the private sector
Iran, Islamic Rep.	Sometimes sub-contracts involve companies.	Companies like Tamkar, Azarbayejani Machinery Industrial Company, and Machine Ajza Co. (recycling) are involved	No reported involvement from the private sector
Iraq*	Companies like Bahjat Aladaa are involved.	Companies like Al-Kawthar Plastic Recycling Company (recycling) are involved.	No reported involvement by the private sector
Algeria	State-owned companies sometimes sub-contract to private companies.	Companies like AFC Recyclage are involved in waste treatment.	No reported involvement from the private sector
Iran, Islamic Rep.	Sometimes sub-contracts involve companies.	Companies like Tamkar, Azarbayejani Machinery Industrial Company, and Machine Ajza Co. (recycling) are involved	No reported involvement from the private sector
Iraq*	Companies like Bahjat Aladaa are involved.	Companies like Al-Kawthar Plastic Recycling Company (recycling) are involved.	No reported involvement by the private sector
Libya*	There is no reported involvement by the private sector in collection, treatment, or disposal.		

Source: Based on analysis conducted for this report.

Table C.1 Private sector participation in the region (continued)

Country	Private sector involvement in collection	Private sector involvement in treatment	Private sector involvement in disposal
Lower-middle-income countries			
Djibouti	There is no reported information on private sector involvement in collection, treatment, or disposal.		
Egypt, Arab Rep.	Concession contracts involve companies like Enviromaster and Ertkaa.	Companies like Titestic and Green Tech (recycling) are involved.	Green Planet is involved in the management of the Al Obour landfill.
Jordan	Reportedly, companies are only involved in the collection of hazardous or special types of wastes.	PPP contracts engage companies in operations like build-operate-transfer to mixed materials recovery facilities in Ghabawi or build-own-operate-transfer of hazardous waste to treatment centers in Ghabawi and Swaqa.	No reported involvement from the private sector
Lebanon*	Concession contracts involve companies like CityBlu	IBC provides Saida with anaerobic digestion treatment services. CityBlu manages the sorting facility in Karantine.	Operations involve Al Jihad Group for Commerce and Contracting landfill in Costa Brava.
Morocco	The private sector is involved in collection, treatment, and disposal through service-management contracts and build-operate-transfer arrangements. Companies like Averda are responsible for collecting waste and transporting it to the Casablanca landfill.		
Tunisia	Only minor inclusion of the private sector	Involved through ECO-LEF system	Private sector runs the Djebel Chakri landfill through service and management contracts.
West Bank and Gaza*	Carried out in partnerships with private companies	Companies like Ommar el Ard (recycling) are involved.	No reported private sector involvement
Low-income countries			
Syrian Arab Republic*	The private sector is partly involved.	Some private establishments (recycling) are involved.	No reported involvement from the private sector
Yemen, Rep.*	There is no reported involvement from the private sector.	Companies like BUCHI, BioKube, and Green Consultants (recycling infrastructure and activities) are involved.	No reported involvement from the private sector

Note: This table presents projections based on income groups. Countries that face fragility, conflict, and violent situations are indicated with an asterisk (*).

Appendix D. Overview of the solid waste sector circular economy initiatives in the region with global examples of good practices

Table D.1 presents an overview of circular economy initiatives in selected countries, highlighting key challenges, enabling factors, and lessons learned. Challenges explain the need for adopting and implementing circular economy initiatives. Enabling factors are supportive conditions that make circular economy adoption possible. Lessons learned reflect key insights that can inform policy development and adaptation in other contexts, particularly in the Middle East and North Africa.

Table D.1 Examples of circular economy good practices

Country	Challenges	Enabling factors	Lessons learned
China	• Environmental issues due to massive economic expansion	• Need to reduce pollution and waste management, cleaner production • Decoupling economic growth from environmental impacts	• Government leadership is key • Public participation is encouraged through green purchasing, renting, etc. • Eco-design and environmentally friendly designs introduced at the design stage • Steps taken at the manufacturing/production stage (e.g., cleaner production, eco-industrial parks)
Japan	• Oil dependence on foreign countries and high domestic energy consumption • Lack of understanding and acceptance on recycling by local companies	• Lack of landfill space • Limited domestic metal and mineral resources • Reduce dependency on oil	• Strong public education campaigns and easy collection/return/recovery, leading to high compliance • Providing circular trading markets for businesses • Using an all-inclusive legal framework for transition to a circular economy (CE) society • Producers are encouraged to develop high-tech designs for repair, reuse, and recycling
Germany	• Availability of land for waste disposal • Reliance on imported raw materials and use of domestic resources	• Global crises led to awareness of environmental and economic issues • Government commitment to promote sustainable resource use • Passed various laws to ensure circularity across various sectors	• Top-down government approach, along with extended producer responsibility central to success, with manufacturers and retailers required to develop take-back schemes • Shifting from waste management to CE approach to incorporate sustainable development principles
Colombia	• High and indiscriminate use of single-use plastics packaging, coupled with low recycling and inadequate sorting • High cost of developing infrastructure, and processes for recycling and reuse • Lack of supply chains for other material packaging	• Cities updated their integrated solid waste management plans with a CE approach • Cities have technical and legal instruments in place to develop CE strategies • Awareness initiatives on climate change, waste, CE, and plastics already exist at the national, city, and private sector levels	• Collective participation of sectors, academia, citizens, businesses, and non-governmental organizations • Identifying business-to-business and business-to-consumer partnerships at the city level, with stakeholder coordination at the city level led by local government • Public sector promotes women's rights and gender equality in CE practices

Sources: Ogunmakinde 2019 (for China, Germany, and Japan) and GIZ 2024 (Colombia).

Appendix E. Development bands for the waste management sector

The development band methodology was developed for the waste management sector by Andrew Whiteman, Mike Webster, and David C. Wilson (2021). Table E.1 summarizes the nine development bands from this methodology. Column A provides the waste and resource management system characteristics, with indicators for collection coverage, management in a controlled or properly managed facility, and the "Three Rs" (reduce, reuse, recycle). Column B outlines the common challenges. Column C shows the developmental pressure points hindering transformational change, using the nine institutional functions (Figure 4.1). Column D provides examples.

Table E.1 The development bands method

Development band (DB)	A System characteristics	B Common challenges	C Pressure point	D Examples
DB1: New Beginnings	• Collection coverage: <30% • Most waste is self-managed, dumping is uncontrolled, and open burning is the norm • Managed in controlled facilities: 0% • Anything with value is reused, repaired, or recycled at home or by the informal sector	• Introducing basic collection systems	Operator	• Many towns and cities in least developed countries • Many areas recently affected by conflict or natural disasters • Refugee camps, peri-urban areas, and slums in cities in many lower-middle-income countries (LMICs)
DB2: Early Movement	• Collection coverage: 30–60% • Some collected waste is disposed of at designated sites • Managed in controlled facilities: up to 20% • Active informal recycling	• Expanding collection coverage • Introducing basic operational management practices at disposal sites	Municipal capacity to assume responsibility for service provision (client-employer function)	• Many LMICs are growing rapidly due to influx from rural areas. Includes many secondary cities
DB3: Service Extension	• Collection coverage: 60–80% • Managed in controlled facilities: up to 50% • Informal recycling is often well established with limited range of materials	• Further expanding collection coverage • Introducing some engineered control measures and upgrading operational management practices at recovery and disposal sites	Planner	• Many cities and megacities in LMICs

Table E.1 The development bands method (continued)

Development band (DB) (continued)	A System characteristics (continued)	B Common challenges (continued)	C Pressure point (continued)	D Examples (continued)
DB4: Consolidating Control DB4a: Universal Collection DB4b: Controlled Disposal	• Collection coverage: 80–95+% • Managed in a controlled facility: moving towards 95+% • As collection and disposal costs rise, diversion of waste from landfills by extending recycling moves up the municipality's agenda	• DB4a: Extending collection service coverage in cities to 95+% • DB4b: Extending controlled disposal in cities to 95+% • Introducing gate fee or distinct line budget for disposal, while avoiding illegal dumping • Building on existing informal recycling sector to enhance recovery system performance, such as by greater separation at source	Revenue collector (Environmental regulator)	• Diverse situations across the world, in cities of all sizes on most continents • Include many small islands • Residual pockets may persist for some time after a country progresses to higher DBs
DB5: The Target Baseline	• The new target baseline to meet SDG Indicator 11.6.1 • Collection coverage: 95+% • Managed in controlled facilities: 95+% • Managed in full control environmentally sound management (ESM) facilities: 50–70+% • Increased focus on recycling; building on existing (informal) systems and increasing separation at source	• Creating a landing place for consolidation of achievements and preparation for next steps • Expanding collection services to rural areas and any unserved urban areas • Transitioning towards improved recovery and disposal standards as a step towards full control ESM • Integrating recycling systems and extending separation at source • Keeping costs under control	Financial regulator	• Most countries currently in higher DBs have spent a period in this transitional DB • Current incumbents include many of the newer European Union (EU) member states
DB6: Market-Oriented Systems	• Managed in full control ESM facilities: 95+% • High standards set for each technology • Recycling, recovery, and landfills compete in an open market, so landfilling rates are often high and recycling rates low to moderate	• Ensuring and maintaining full control ESM standards for all facilities • Managing the transition when standards increase • Preventing organized criminals from undercutting legitimate operators • Amplifying public acceptance of new landfill sites	Environmental regulator	• Some western and southern EU countries passed through DB6 in the 1980s–90s • North American states and Australasian provinces have either passed through this or are still here

Table E.1 The development bands method (continued)

Development band (DB) (continued)	A System characteristics (continued)	B Common challenges (continued)	C Pressure point (continued)	D Examples (continued)
DB7: High Recovery Systems	• Managed in full control ESM facilities: 95+% • High standards set for each technology • Recovery (particularly waste-to-energy) favored over landfills • Recycling rates are often low to moderate	• First ramping up, then maintaining facility standards • Sustaining high investment and operating costs • Enriching public acceptance of new waste-to-energy facilities	Technical regulator	• Some central and northern EU countries passed through DB7 in the 1980s–90s • Some east Asian countries are still here
DB8: Policy Driven by Fiscal Mechanisms	• Improved or full level of collection services, with two or three separate fractions: 95+% • Stringent targets to divert waste from landfills • Stringent recovery and recycling targets • Reliance primarily on economic instruments	• Using fiscal mechanisms like landfill tax, landfill allowance trading schemes, and recycling credits to reach policy targets • Instigating initiatives for waste prevention	Policy maker (change agent)	• Countries tend to move from DB6 to DB8 • Some countries in western and southern Europe are here • Some states in North America and Australasia provinces are also here
DB9: Policy Driven by Technical Standards	• Improved or full level of collection services, with two or three separate fractions: 95+% • Stringent targets to divert waste from landfills • Stringent recovery and recycling targets • Primary focus on mandating required changes • Set very high technical standards for both collection and recovery	• Implementing stricter technical requirements for separation at source • Banning landfills or requiring recycling of municipal solid waste components • Upgrading recovery facilities to latest technical standards • Instigating initiatives for waste prevention	Technical regulator	• Countries tend to move from DB7 to DB9 • Some countries in northern and central Europe, and in east Asia
DB Zero: Circular Economy	• "Zero waste"	• Attaining transformational changes in production and consumption practices • Striving for waste generation to be as close as possible to zero • Innovating in materials science with widespread uptake	Change agent	• An aspirational goal with work in progress • There are no current examples

Source: Adapted from Whiteman et al. 2021.

Current classification and indication of potential for sector development for the region's countries up to 2050

The trajectories of municipal solid waste development for the 19 Middle East and North Africa (MENA) countries are supported by narratives summarized in Table E.2. Under an optimistic scenario, all MENA countries will achieve the United Nations' Sustainable Development Goal (SDG) Indicator 11.6.1 by 2050. It projects that the region's high-income countries and Tunisia will achieve universal collection and treatment of waste in controlled facilities by 2030. Large countries like Egypt, the Islamic Republic of Iran, and countries in the Mediterranean basin (Morocco, Jordan, and Lebanon) will do so by or before 2040. All conflict countries will stabilize their internal and territorial disputes over the decade that follows and achieve the SDG goal by 2050. A conservative scenario assumes that achieving SDG Indicator 11.6.1 is delayed by ten years in conflict countries.

High-income countries

These countries are diversifying their economies to focus on high-end tourism, advanced technology development, and global logistics, while adhering to stringent environmental standards guided by the SDG. The oil, gas, and petrochemical industries are expected to continue growing, serving as the primary drivers of economic growth. Governance systems remain stable and centralized, rooted in established Islamic culture and principles.

Due to the increasing municipal solid waste, there is a growing reliance on private arrangements for operations and investments. Under the Shared Socioeconomic Pathway 2 (SSP2) scenario, the population is projected to increase by 51 percent but stabilize by mid-century. Meanwhile, solid waste generation is expected to rise disproportionately by 73 percent between 2022 and 2050.

Under the SSP1 scenario, which emphasizes sustainability, gross domestic product (GDP) growth is expected to multiply significantly. Qatar and Oman have already made strides in complying with SDG 11.6.1 and have met the recyclable proportion standards at the European Union (EU) level. They are likely to achieve net zero waste by 2050. Most oil-rich countries (except Kuwait) are expected to meet SDG 11.6.1 by 2030, despite facing challenges like significant open waste dumping reported in 2020.

Middle-income countries

Countries are diversifying their economies in response to the high demand for Mediterranean tourism, favorable climates, and strategic locations for agribusiness exports to the EU. Algeria's oil and gas sector is the backbone of its exports and government budget. The population is projected to grow by 29 percent from 2022 to 2050, resulting in an 84 percent increase in municipal solid waste. Urbanization rates in Algeria, Morocco, and Tunisia are expected to rise significantly between 2022 and 2050. Governance systems in these countries are improving, with established decentralization efforts aimed at better implementing approved laws and strategies for the municipal solid waste sector. The private sector also plays a significant role through delegated management and build-operate-transfer arrangements.

Fragility conflict-, and violence-affected economies

The region includes countries experiencing various types of conflicts—each of which may require different solutions for resolution. The population is projected to increase by 68 percent between 2022 and 2050. Meanwhile, municipal solid waste is expected to grow by 120 percent, surpassing anticipated levels in oil-rich and Mediterranean countries.

Lebanon, Syria, and the West Bank and Gaza are struggling with decreasing municipal solid waste management because of ongoing internal conflicts and shrinking GDPs. If these conflicts subside, these regions could begin to align with Mediterranean development trends as outlined in the SSP2 scenario. However, if the situation does not improve, they will likely remain in the SSP3 (fragmentation) or SSP4 (inequality) scenarios. Libya and Iraq could follow a path similar to Kuwait or descend into an SSP4 scenario of high inequality if conflicts persist. The Republic of Yemen is expected to remain in a fragmentation scenario SSP3.

Table E.2 Projected progression of countries' solid waste management, by development band

	Baseline (2020)			Planning trajectories			
Country	Collection	Disposed of in controlled facilities and treatment	Development band	Shared Socioeconomic Pathway 2020–2050	Likely Development Band 2030	Likely Development Band 2040	Likely Development Band 2050
Algeria	82%	8%	DB2	SSP2 Middle of the road	DB3	DB4	DB5
Bahrain	100%	22%	DB4	SSP1 Sustainability	DB5	DB7	DB9
Djibouti	N/A	N/A	N/A	SSP3 Regional rivalry	DB3	DB4	DB5
Egypt, Arab Rep.	65%	27%	DB2	SSP2 Middle of the road	DB4	DB5	DB6
Iran, Islamic Rep.	90%	12%	DB2	SSP2 Middle of the road	DB4	DB5	DB6
Iraq	59%	0%	DB2	SSP3 Fragmentation	DB3	DB4	DB5
Jordan	95%	60%	DB3	SSP2 Middle of the road	DB4	DB5	DB6
Kuwait	100%	7%	DB3	SSP1 Sustainability	DB4	DB5	DB7
Lebanon	99%	20%	DB3	SSP2 Middle of the road	DB4	DB6	DB8
Libya	N/A	3%	DB1	SSP3 Fragmentation	DB3	DB4	DB5
Morocco	96%	8%	DB3	SSP2 Middle of the road	DB4	DB5	DB6
Oman	100%	26%	DB5	SSP1 Sustainability	DB7	DB9	DB Zero
Qatar	100%	54%	DB5	SSP1 Sustainability	DB7	DB9	DB Zero
Saudi Arabia	92%	4%	DB4	SSP1 Sustainability	DB5	DB7	DB9
Syrian Arab Republic	75%	0%	DB2	SSP3 Fragmentation	DB3	DB4	DB5
Tunisia	72%	79%	DB3	SSP2 Middle of the road	DB5	DB6	DB8
United Arab Emirates	99%	5%	DB4	SSP1 Sustainability	DB5	DB7	DB9
West Bank and Gaza	68%	4%	DB3	SSP3 Fragmentation	DB3	DB4	DB5
Yemen, Rep.	40%	0%	DB2	SSP3 Fragmentation	DB3	DB3	DB4

Source: See appendix G, with additional analysis conducted for this report..

Note: In the DB framework, achieving DB5 (orange blocks) would in effect also achieve SDG Target 11.6, which aims to maximize public health benefits while addressing environmental degradation as swiftly as possible.

Appendix F. The World Bank Group's experience in solid waste management in the region: Lessons learned and approaches for future engagement

Solid waste management (SWM) is a critical but often overlooked service, with significant implications for public health, the environment, and economic growth. These services often go unnoticed until they are disrupted or inadequate, as evidenced by the collapse of SWM services in Beirut, Lebanon, in 2021, which led to illegal dumping and the open burning of waste. These cases highlight how crucial uninterrupted SWM is to the functioning and well-being of cities and communities, underscoring the need for robust and integrated systems.

The World Bank Group, recognizing the complex and interconnected challenges of the SWM sector, is actively working with countries to address these issues. This section presents the lessons learned from prior engagement in the sector both globally and regionally, and the approaches for current and future engagement in the region.

Lessons learned across the solid waste management sector

The World Bank Group has drawn significant lessons from global SWM engagements that inform its current and future strategies while aligning with global public goods and development agendas.

Globally, the World Bank's SWM efforts align with its overarching goals of poverty reduction and shared prosperity. Between 2010 and 2020, the Bank committed approximately US$3 billion to SWM activities, including advisory services and operational projects. Recognizing that plastics are an increasingly significant component of municipal solid waste, fueling a global environmental crisis, the World Bank Group portfolio includes over US$2.5 billion in projects that target plastic pollution, marine litter, and waste management (World Bank 2024).

A strategic assessment of SWM projects in the World Bank Independent Evaluation Group's "Transitioning to a Circular Economy" report (2022) reveals that the Bank has shifted from the provision of specific infrastructure to a more integrated strategy, addressing all stages of the waste value chain—generation, collection, transport, recycling and treatment, and disposal. Prioritizing the waste hierarchy and advocating for circular economy approaches in SWM not only aligns with global climate and sustainability goals but also offers a pathway to reduce resource consumption and minimize waste. In addition, the World Bank Group recognizes that insufficiently addressing critical issues at any stage of the waste value chain undermines the overall effectiveness of the entire system.

Thus, the World Bank Group's support for more integrated approaches over the last decade or so—combining policy reforms, capacity building, infrastructure investments, and stakeholder engagement—has proven essential in ensuring long-term success. A comprehensive approach enables countries to address pressing environmental challenges, such as marine plastic pollution and methane emissions, while fostering economic opportunities in recycling and waste-to-energy sectors.

A critical insight is that ensuring adequate, continued access to municipal solid waste services requires long-term financial sustainability, which is essential for maintaining and expanding these services over time. This requires mechanisms like improved cost recovery, earmarked municipal revenues, or budget transfers from state or central governments. All current and pipeline SWM lending projects show a clear prioritization in promoting financial sustainability.

Another key takeaway is the importance of phased long-term engagement in driving sustainable reforms. This approach was illustrated by Morocco, which achieved a significant milestone by becoming the first country globally to initiate comprehensive reforms of the SWM sector through a development policy loan for SWM. This experience provided valuable lessons for long-term reforms in other regions. The loan program demonstrated how comprehensive national reforms, including governance improvements and financial mechanisms, can drive lasting changes. Lending has proven to be an effective tool to kickstart reforms in the municipal SWM sector, particularly when combined with support for technical capacity building and infrastructure development. Integrating technology with behavior change is critical for promoting source separation and advancing the Three Rs to foster a circular economy. Furthermore, consistent communication and engagement with communities through education and outreach brings lasting change, particularly in encouraging waste reduction and recycling through source segregation rather than relying on sorting waste at landfills, which has proven to be insufficient.

Finally, innovative financing mechanisms, such as results-based financing and public-private partnerships (PPPs), have proven effective in enhancing service delivery and attracting investments in SWM infrastructure. This includes attracting private sector investment through PPP to construct and maintain facilities, applying the "polluter pays" and extended producer responsibility principles, and promoting environmental taxation.

World Bank engagement in the region's solid waste management

In the Middle East and North Africa (MENA) region, the World Bank Group's engagement spans 11 countries across a wide spectrum of economic conditions and political landscapes. Reimbursable Advisory Services are employed in high-income countries, such as Qatar and the United Arab Emirates, while International Development Association funding is used in fragility, conflict, and violence (FCV)-affected contexts like the Syria and the Republic of Yemen. This disparity influences the World Bank Group's approach in the region, determines the type of support provided (whether advisory or focused on low-cost, community-based solutions), and affects the outcomes, given the region's volatile and ever-changing landscape. Morocco's loan program and the World Bank Group's engagement in the West Bank and Gaza since 2000 are key examples of successful SWM reforms in MENA. Box F.1 summarizes the sector-wide reforms in Morocco, and Box F.2 highlights the work in Palestinian territories aimed at closing uncontrolled dumpsites and transitioning to recycling and proper disposal.

BOX F.1 Morocco's success in solid waste management reforms

Morocco's Development Policy Loan (DPL) program, supported by the World Bank Group, represents a landmark achievement in solid waste management (SWM) reforms—not only for the region but also globally. This DPL represents the first loan for the SWM sector globally. Between 2009 and 2015, the DPL disbursed US$535 million to address institutional, financial, and environmental challenges (World Bank 2022a). The reforms included the enactment of the "Solid Waste Management Law 28-00" (2006), the creation of the National Municipal Solid Waste Management Support Program, and the introduction of financial mechanisms to support municipalities.

The phased approach of the DPL, structured in two series comprising four loans in total, enabled Morocco to modernize its SWM sector, strengthening governance by establishing a clear legal and institutional framework. This ensured financial sustainability through incentives for municipalities, and mainstreaming environmental and social considerations into municipal SWM. The first loan series focused on establishing an enabling environment for an integrated and affordable municipal solid waste system, while the second series deepened reforms at the regional and municipal levels.

Key lessons from Morocco's experience highlight the importance of lending to kickstart sector reforms, the need for sustained long-term engagement, and the value of providing comprehensive support, including for infrastructure and policy development. In addition, integrating technology to advance the Three Rs and transition toward a circular economy was essential, as well as bringing about behavioral change to encourage source separation.

BOX F.2 The impact of conflict on solid waste management in West Bank and Gaza

The World Bank Group has supported solid waste management (SWM) reforms in West Bank and Gaza since the early 2000s, focusing on infrastructure development, inclusion of waste pickers, and environmental sustainability. Initiatives include closing uncontrolled dumps, constructing sanitary landfills, and promoting small-scale recycling and composting. Efforts like the construction of the Zahrat Al Finjan Landfill were to centralize waste disposal, thus reducing environmental and health hazards from open dumping and burning (GPRBA 2013). Waste pickers affected by dumpsite closures received transitional assistance in the form of financial support to launch their own businesses, finish college, or work in the new facility (GPRBA 2013).

Innovative approaches like results-based financing were used to cover the increased costs associated with operating the new sanitary landfill. This subsidy helped municipal and village councils concentrate their resources on improving primary waste collection services. Private sector partnerships, facilitated by the International Finance Corporation, improved waste transport from transfer stations to the landfill, implemented recycling and composting activities, and operated and maintained the Al-Minya Landfill (World Bank n.d.).

However, the long-standing political and economic instability in the West Bank and Gaza has intensified existing challenges and introduced new ones. The ongoing conflict in Gaza has resulted in extensive damage to SWM infrastructure, with five out of six facilities rendered non-operational, causing high levels of pollution and severe impacts on human health (World Bank, European Union, and United Nations 2024). Moreover, lack of adequate disposal facilities, expensive transportation costs, and newly introduced movement restrictions are leading to the proliferation of dumpsites with many local governments unable to afford transport and disposal costs. Constrained financial resources impede capital investments, significantly impacting the quality and reliability of service delivery. Despite these setbacks, past efforts underscore the potential of targeted investments and innovative solutions in building sustainable and inclusive SWM systems.

Lessons for future engagement in the region

The World Bank Group's investments in SWM provide valuable lessons for future engagement in the region and beyond.

First, in the FCV-affected contexts, tailored and sometimes immediate approaches are essential to address governance gaps and financial constraints. Over the past two decades, the World Bank Group has sponsored several flagship SWM projects in both the West Bank and Gaza, which have been transformational in the provision of services while operating in fragile and capacity-constrained environments. In Lebanon, the government's financial crisis has severely impacted its ability to provide basic services, including waste management, which severely hampered its recovery efforts after the 2020 Beirut explosion. Working in FCV-affected economies has highlighted the need to build resilience in local institutions and to develop low-cost, community-driven strategies that prioritize debris management, reconstruction, and capacity building. Through these engagements, the World Bank Group has brought together global, regional, and national experience in SWM programs and gathered key lessons, which are applicable to other FCV-affected environments. Moreover, there is an ever-increasing need for an integrated and more programmatic approach to SWM—one that focuses on resilient infrastructure, waste minimization, and operational efficiency across the entire SWM service chain.

Second, post-conflict debris management is another critical area of focus, particularly in MENA's conflict-affected countries. For instance, the Israel-Gaza conflict has resulted in an estimated 26 million metric tons of debris and rubble, which is double that generated in Aleppo during the civil war in Syria—a volume that will take years to clear. The cost of this effort is estimated at approximately US$327 million, underscoring the scale and complexity of the task. Effective debris management will be essential not only to clear the land for redevelopment but also to mitigate environmental risks associated with the improper disposal of hazardous materials mixed in the debris. Therefore, future engagement in the MENA region should ideally prioritize integrated approaches to post-conflict debris management that address both reconstruction needs and environmental risks, while aligning with climate resilience and sustainable development goals.

Third, being one of the most climate vulnerable regions in the world, climate adaptation and mitigation are crucial in this region. In response to these challenges, the World Bank Group has integrated climate considerations across all its operations in MENA, with the goal of aligning 100 percent of new initiatives with the Paris Agreement (World Bank Group 2023). Disaster risk management is also a critical component of climate adaptation efforts in MENA, particularly in light of the region's exposure to climate-induced disasters. Strengthening waste management systems can contribute to both disaster preparedness and recovery efforts by reducing vulnerabilities and improving infrastructure.

Last of all, many small, fragile, and low-income countries in MENA face significant capacity constraints in developing comprehensive strategies for building resilience, which impairs governments' ability to effectively use external support. The World Bank Group and other development partners are well placed to address these gaps through a framework, suggested by the International Monetary Fund, that is built on three complementary pillars: structural resilience, financial resilience, and post-disaster resilience (OECS and World Bank 2022).[14]

Conclusion

SWM is identified as a key pillar of "no-regret" investments that support economic growth and contribute to climate change mitigation. Improving SWM presents a unique opportunity to simultaneously address SWM priorities, pursue climate goals, and achieve broader environmental objectives. As an example, a World Bank-funded SWM project in Egypt aims to reduce air pollution and greenhouse gas emissions by targeting methane emissions from organic waste and reducing the prevalence of open burning. Strengthening resilience not only supports recovery and reconstruction but also ensures the long-term sustainability of climate adaptation efforts.

14 The International Monetary Fund's policy paper on building resilience is informed by the Sendai Framework for Disaster Risk Reduction and builds on World Bank experience of disaster risk management.

Appendix G. Data references

Table G.1 Data sources used by country and theme

Country	Reference
Waste generation	
Algeria	République Algérienne Démocratique et Populaire, Ministère de l'Environnement. 2020. *Rapport sur l'état de la gestion des déchets en Algérie (Report of the State of Waste Management in Algeria)*. https://and.dz/rapports/.
Bahrain	Bahrain Open Data Portal. n.d. Management of Municipal Waste. https://www.data.gov.bh/explore/dataset/01-management-of-municipal-waste/table/?disjunctive.indicator&sort=-n.
Djibouti	Transport & Infrastructure Expertise Group. 2022. *Rédaction du schéma directeur de gestion de déchets de la ville de Djibouti, Rapport de diagnostic*. https://search.openaleph.org/entities/eu-fts-project-17d727e7f78a4af5a33b1d18ab385d311afd9e59.4de3489d7cd3a2e5f91dd8254330fa155be162e1. World Bank Open Data. n.d. World Bank Open Data. https://data.worldbank.org/indicator/SP.POP.TOTL?end=2013&locations=DJ-CF&start=1960.
Egypt, Arab Rep.	Ministry of Environment. 2021. *Egypt State of the Environment Report 2021*. https://www.eeaa.gov.eg/Reports/1141/Details.
Iran, Islamic Rep.	Golhosseini, Z., and Ghazizade, M. J. 2024. "Municipal Solid Waste Status in Iran: From Generation to Disposal." *Environmental Protection Research*, 4(1), 16–29. https://ojs.wiserpub.com/index.php/EPR/article/view/3553/1925.
Iraq	Ministry of Construction and Housing and Municipalities and Public Works. 2022. *Data Collection Study on Solid Waste Management in Iraq: Final Report*. https://openjicareport.jica.go.jp/pdf/12367256.pdf.
Jordan	Department of Statistics (Jordan). 2022. *Jordan in Figures 2022*. https://dosweb.dos.gov.jo/DataBank/JordanInFigures/Jorinfo_2022.pdf.
Kuwait	Gulf Cooperation Council Statistical Centre. 2023. *Waste*. https://dp.marsa.gccstat.org/search/og_group_ref/342/type/dataset.
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Oman	National Centre for Statistics & Information. 2022. Municipal Waste Generated. https://data.ncsi.gov.om/?q=dataset/municble-waste-generated.
Qatar	Planning and Statistics Authority. 2022. *Environmental Statistics in State of Qatar*. https://www.psa.gov.qa/en/statistics/Statistical%20Releases/Environmental/EnvironmentalStatistics/Environment_Statistics_bulletin_2020_En.pdf.
Saudi Arabia	General Authority for Statistics. 2023. *Environmental Statistics Publication 2022*. https://www.stats.gov.sa/en/1182.
Syrian Arab Republic	Planning and International Cooperation Authority. 2020. *First Voluntary National Review of the Sustainable Development Goals 2020*. https://sustainabledevelopment.un.org/content/documents/26292VNR_2020_Syria_Report_Arabic.pdf.
Tunisia	Acerbi, M. H., Chaabane, W., Hasegawa, K, and Soudi, B. 2022. *Stratégie de la Tunisie: Littoral Sans Plastique (LISP) – Diagnostic de la Situation et Ébauche de Plan d'Action: Réduction de la Pollution Marine par le Plastique et Promotion des Approches de l'Économie Circulaire*. Washington, DC: World Bank. http://documents.worldbank.org/curated/en/099900205192222188/P17059607dab3e0240987407b5689c83231.

Table G.1 Data sources used by country and theme (continued)

Country	Reference
Waste generation (continued)	
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West Bank and Gaza	Heinrich Böll Stiftung. 2020. "Palestine: Solid Waste Management Under Occupation." Online article. https://ps.boell.org/en/2020/10/07/palestine-solid-waste-management-under-occupation.
Yemen, Rep.	UN Environment Programme. 2019. *Waste Management Outlook for West Asia*. https://wedocs.unep.org/bitstream/handle/20.500.11822/31205/WMOWA.pdf?sequence=2&isAllowed=y.
Waste composition	
Algeria	SNID. 2024. *Indicateurs de Performance*. https://snid.and.dz/indicateurs.php.
Bahrain	Composition of Municipal Waste. 2022. Information and eGovernment Authority. https://www.data.gov.bh/explore/dataset/04-composition-of-municipal-waste/table/?sort=-n.
Djibouti	No data available.
Egypt, Arab Rep.	Handawy, M. K., Snegirev, A. Y., Stepanov, V., and Talalov, V. A. 2021. "Energy Recovery Strategies as a Sustainable Solutions for Municipal Solid Waste in Egypt." IOP Conference Series. *Materials Science and Engineering*, 1100(1), 012052. https://doi.org/10.1088/1757-899x/1100/1/012052.
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Jordan	ACTED. 2021. *Circular Economy National Study in Jordan*. https://www.acted.org/wp-content/uploads/2018/01/circular-economy-national-study-final.pdf.
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Qatar	Mariyam, S., Cochrane, L., Zuhara, S., and McKay, G. 2022. "Waste Management in Qatar: A Systematic Literature Review and Recommendations for System Strengthening." *Sustainability*, 14(15). https://doi.org/10.3390/su14158991.
Saudi Arabia	General Authority for Statistics. 2023. Environmental Statistics Publication 2022. https://www.stats.gov.sa/en/1182.
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Tunisia	Acerbi, M. H., Chaabane, W., Hasegawa, K, and Soudi, B. 2022. *Stratégie de la Tunisie: Littoral Sans Plastique (LISP) – Diagnostic de la Situation et Ébauche de Plan d'Action: Réduction de la Pollution Marine par le Plastique et Promotion des Approches de l'Économie Circulaire*. Washington, DC: World Bank. http://documents.worldbank.org/curated/en/099900205192222188/P17059607dab3e0240987407b5689c83231.

Table G.1 Data sources used by country and theme (continued)

Country	Reference
Waste composition (continued)	
United Arab Emirates	United Nations Statistics Division. 2022. Composition of Municipal Waste (latest year). https://unstats.un.org/unsd/envstats/Questionnaires/2020/Tables/Composition%20of%20Municipal%20Waste%20(latest%20year).xlsx.
West Bank and Gaza	MoLG-JICA. 2022. *MoLG-JICA Project for Capacity Development in Solid Waste Management in Palestine Phase-III (CDSWMP-III) – A Technical Cooperation between Palestine (MoLG) and Japan (JICA).* https://openjicareport.jica.go.jp/pdf/1000054032_05.pdf.
Yemen, Rep.	Al-Dailami, A., Ahmad, I., Kamyab, H., Abdullah, N., Koji, I., Ashokkumar, V., and Zabara, B. 2022. "Sustainable Solid Waste Management In Yemen: Environmental, Social Aspects, And Challenges." *Biomass Conversion and Biorefinery*, 15, 22229–22255. https://doi.org/10.1007/s13399-022-02871-w.
Waste collection	
Algeria	GIZ (Deutsche Gesellschaft für Internationale Zusammenarbeit) and SWEEP-Net. 2014. *Report on the Solid Waste Management in Algeria.*
Bahrain	Kingdom of Bahrain. 2023. *Bahrain Voluntary National Review 2023*. https://sdgs.gov.bh/PDFfiles/EN/VNR%202023%20Bahrain%20Report_1.pdf.
Djibouti	Directorate for Statistics and Demographic Studies. 2018. *Results of the Fourth Survey from Djibouti for Household Social Indicators (EDAM4-IS)*. https://share.google/ZcsS3diq3cGZIrw6d.
Egypt, Arab Rep.	Nassar, H., Biltagy, M., and Safwat, A. 2023. "The Role of Waste-to-Energy in Waste Management in Egypt: A Techno-Economic Analysis." *Review of Economic and Political Science*, 10 (2): 151–167. https://doi.org/10.1108/reps-09-2022-0062.
Iran, Islamic Rep.	Esmaeilizadeh, S., Shaghaghi, A., and Taghipour, H. 2020. "Key Informants' Perspectives on the Challenges of Municipal Solid Waste Management in Iran: A Mixed Method Study." *Journal Of Material Cycles And Waste Management*, 22(4), 1284–1298. https://doi.org/10.1007/s10163-020-01005-6.
Iraq	Ministry of Construction and Housing and Municipalities and Public Works. 2022. *Data Collection Study on Solid Waste Management in Iraq: Final Report*. https://openjicareport.jica.go.jp/pdf/12367256.pdf.
Jordan	Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH (GIZ). 2023. *The Circular Economy Ecosystem in the MENA Region*. https://www.greentechknowledgehub.de/sites/default/files/2023-05/230502%20EXI%20Publikation%20CE%20Mena%20Web.pdf.
Kuwait	Emisk; Fraunhofer. 2023. *Waste Management Atlas of Kuwait*. https://epa.gov.kw/Portals/0/PDF/Atlas_En.pdf.
Lebanon	GIZ and SWEEP-Net. 2014. *Country Report on the Solid Waste Management in Lebanon.* GIZ and Regional Solid Waste Exchange of Information and Expertise Network in Mashreq and Maghreb Countries (SWEEP-Net), on behalf of the German Federal Ministry for Economic Cooperation and Development [Bundesministerium fur wirtschaftliche Zusammenarbeit und Entwicklung (BMZ)]. April.
Libya	No data available.
Morocco	United Nations Economic Commission for Europe. 2022. *Environmental Performance Reviews: Morocco*. https://unece.org/sites/default/files/2023-01/ECE_CEP_191_E.pdf.
Oman	Environment Authority (Oman). n.d. "Waste Management." Webpage. https://www.ea.gov.om/en/e-participation/responsible-community/waste-management/.
Qatar	Planning and Statistics Authority. 2022. *Environmental Statistics in the State of Qatar*. https://www.psa.gov.qa/en/statistics/Statistical%20Releases/Environmental/EnvironmentalStatistics/Environment_Statistics_bulletin_2020_En.pdf.
Saudi Arabia	Ministry of Environment, Water and Agriculture. 2023. "International Environment Day Reveals: 1.7 kg Per Capita Waste Production Rate In The Kingdom Per Day." Online article. https://www.mewa.gov.sa/ar/MediaCenter/News/Pages/News6452020.aspx. General Authority for Statistics. 2023. *Environmental Statistics Publication 2022.* https://www.stats.gov.sa/en/1182.
Syrian Arab Republic	Correspondence with ELARD.

Table G.1 Data sources used by country and theme (continued)

Country	Reference
Waste collection (continued)	
Tunisia	Hassen, A. B., Zaafouri, K., and El Asmi, A. M. 2021. "Waste and Biomass Management in Tunisia: Current Situation and Opportunities for Renewable Fuels Production." Conference paper from 8th International Symposium on Energy from Biomass and Waste. https://www.researchgate.net/publication/350278391. World Bank Open Data. n.d. Population, total – Tunisia. https://data.worldbank.org/indicator/SP.POP.TOTL?end=2023&locations=TN&start=1960&view=chart. World Bank Open Data. n.d. Urban population (% of total population). https://data.worldbank.org/indicator/SP.URB.TOTL.IN.ZS?locations=TN.
United Arab Emirates	Federal Competitiveness and Statistics Centre. n.d. Waste Statistics 2022. https://fcsc.gov.ae/en-us/Pages/Statistics/Statistics-by-Subject.aspx#/%3Ffolder=Agriculture%20Environment%20and%20Energy/Environment/Waste&subject=Agriculture%20Environment%20and%20Energy.
West Bank and Gaza	Comprehensive Assessment and Roadmap for Sustainable Solid Waste Management in the West Bank Report IV.
Yemen, Rep.	Arab Reform Initiative. 2023. "Yemen's Environmental Crisis: The Forgotten Fallout of an Enduring Conflict." Online article. https://www.arab-reform.net/publication/yemens-environmental-crisis-the-forgotten-fallout-of-an-enduring-conflict/.
Waste treatment and disposal	
Algeria	United Nations Climate Change. 2023. *Algeria. National Communication (NC). NC 3.* https://unfccc.int/documents/636692.
Bahrain	Bahrain Open Data Portal. 2024. Management of Municipal Waste. https://www.data.gov.bh/explore/dataset/01-management-of-municipal-waste/table/?disjunctive.indicator&sort=-n.
Djibouti	International Monetary Fund. 2004. *Djibouti: Poverty Reduction Strategy Paper.* IMF Staff Country Reports. https://www.imf.org/en/Publications/CR/Issues/2016/12/30/Djibouti-Poverty-Reduction-Strategy-Paper-17424.
Egypt, Arab Rep.	Nassar, H., Biltagy, M., and Safwat, A. 2023. "The Role of Waste-to-Energy in Waste Management in Egypt: A Techno-Economic Analysis." *Review of Economic and Political Science*, 10 (2): 151–167. https://doi.org/10.1108/reps-09-2022-0062.
Iran, Islamic Rep.	Golhosseini, Z., and Ghazizade, M. J. 2024. "Municipal Solid Waste Status in Iran: From Generation to Disposal." *Environmental Protection Research*, 4(1), 16–29. https://doi.org/10.37256/epr.4120243553.
Iraq	Ministry of Construction and Housing and Municipalities and Public Works. 2022. *Data Collection Study on Solid Waste Management in Iraq: Final Report*. https://openjicareport.jica.go.jp/pdf/12367256.pdf.
Jordan	Aldayyat, E. A. A., Saidan, M. N. S., Abu Saleh, M. A. A., Hamdan, S. H., and Linton, C. L. 2019. "Solid Waste Management in Jordan: Impacts and Analysis." *Journal of Chemical Technology and Metallurgy*, 54(2), 454–462. https://www.researchgate.net/publication/330925093_Solid_Waste_Management_in_Jordan_Impacts_and_Analysis.
Kuwait	The Business Year. 2023. "Recycling in Kuwait." Online article. https://thebusinessyear.com/article/recycling-in-kuwait/.
Lebanon	United Nations Development Programme. 2020. *Lebanon State of the Environment and Future Outlook: Turning the Crises into Opportunities*. https://www.undp.org/lebanon/publications/lebanon-state-environment-and-future-outlook-turning-crises-opportunities.
Libya	Hamad, T. A., Agll, A. A., Hamad, Y. M., and Sheffield, J. W. 2014. "Solid Waste as Renewable Source of Energy: Current and Future Possibility in Libya." *Case Studies in Thermal Engineering*, 4, 144–152. https://www.sciencedirect.com/science/article/pii/S2214157X1400032X.
Morocco	WWF. 2019. *Stop the Flood of Plastic: A Guide for Policy-Makers in Morocco*. https://wwfeu.awsassets.panda.org/downloads/05062019_wwf_marocco_guidebook.pdf.
Oman	Environment Authority (Oman). n.d. "Waste Management." Webpage. https://www.ea.gov.om/en/e-participation/responsible-community/waste-management/.
Qatar	Justin, J. 2023. "Qatar's Waste Management System: A Sustainable Solution for a Growing Nation." https://www.qatarday.com/qatars-waste-management-system-a-sustainable-solution-for-a-growing-nation. MEED. 2011. "Qatar: A Model for Waste Management in the Gulf." https://www.meed.com/qatar-a-model-for-waste-management-in-the-gulf/.
Saudi Arabia	General Authority for Statistics. 2023. "Environmental Statistics Publication 2022." https://www.stats.gov.sa/en/1182.

Table G.1 Data sources used by country and theme (continued)

Country	Reference
Waste treatment and disposal (continued)	
Syrian Arab Republic	Correspondence with ELARD.
Tunisia	Hassen, A. B., Zaafouri, K., and El Asmi, A. M. 2021. "Waste and Biomass Management in Tunisia: Current Situation and Opportunities for Renewable Fuels Production." Conference Paper. https://www.researchgate.net/publication/350278391.
United Arab Emirates	Federal Competitiveness and Statistics Centre. n.d. Waste Statistics 2022. https://fcsc.gov.ae/en-us/Pages/Statistics/Statistics-by-Subject.aspx#/%3Ffolder=Agriculture%20Environment%20and%20Energy/Environment/Waste&subject=Agriculture%20Environment%20and%20Energy.
West Bank and Gaza	MoLG-JICA. 2022. *Data Book on Solid Waste Management in Palestine Version 3. Capacity Development in Solid Waste Management in Palestine–Phase III*. https://openjicareport.jica.go.jp/pdf/1000054032_05.pdf.
Yemen, Rep.	GIZ, SweepNet, and ANGed. 2014. *Country Report on the Solid Waste Management in Yemen*.
Waste sector jobs	
Algeria	**Formal:** Rijksdienst voor Ondernemend Nederland. 2018. "Business Opportunities in Waste Management in Algeria." https://www.rvo.nl/sites/default/files/2018/06/Business-opportunities-in-waste-management-in-Algeria.pdf.
Egypt, Arab Rep.	**Formal:** CAPMAS. 2018. *The Results of the Fifth Economic Census 2017/2018: The Total Egypt to Economic Activity and Governorates*. https://www.capmas.gov.eg/Admin/Pages%20Files/202041411564PART%201%20TKRIR.pdf.
Jordan	**Formal and informal:** ACTED. 2021. *Circular Economy National Study in Jordan.* https://www.acted.org/wp-content/uploads/2018/01/circular-economy-national-study-final.pdf.
Tunisia	**Informal:** Blaise, L. 2020. *L'unité de Recyclage des Barbechas a Ettadhamen*. https://www.international-alert.org/app/uploads/2021/09/Tunisie_RecyclagedesBarbechas_FR_2020.pdf.pdf.
Lebanon	**Formal:** International Labour Organization. 2022. *Lebanon Follow-up Labour Force Survey – January 2022: Fact Sheet*. http://www.cas.gov.lb/images/Publications/LFS_2022/Fact%20Sheet%20-%20Follow%20Up%20LFS%20Lebanon%202022.pdf.
	Informal: Personal correspondence.
Iraq	**Formal:** United Nations. 2022. *Iraq Labour Force Survey 2021*. https://iraq.un.org/en/189026-iraq-labour-force-survey-2021.
	Informal: Ministry of Construction and Housing and Municipalities and Public Works. 2022. *Data Collection Study on Solid Waste Management in Iraq: Final Report*. https://openjicareport.jica.go.jp/pdf/12367256.pdf.
West Bank and Gaza	**Formal:** MoLG-JICA. 2022. *Data Book on SWM in Palestine Version 3. Capacity Development in Solid Waste Management in Palestine – Phase III*. https://openjicareport.jica.go.jp/pdf/1000054032_05.pdf.
	Informal: Comprehensive Assessment and Roadmap for Sustainable Solid Waste Management in the West Bank Report IV.
Bahrain	**Formal:** Jamal, H. F. and Abd El-Fattah, A. 2023. "An Overview of Solid Waste Management and Privatization in the Kingdom of Bahrain." *Frontiers in Environmental Science*, 11, 1302711. https://doi.org/10.3389/fenvs.2023.1302711.
Kuwait	**Formal:** Kuwait Environment Public Authority. 2023. *Waste Management Atlas of Kuwait*. https://epa.gov.kw/Portals/0/PDF/Atlas_En.pdf.
Oman	**Formal:** National Centre for Statistics & Information. n.d. Oman – Number of Workers – Private, Family, Communal and Other Sector – Water Supply, Sewerage, Waste Management and Remediation Activities. https://data.gov.om/byvmwhe/labour-market?tsId=1038010.
Qatar	**Formal:** Planning and Statistics Authority. 2022. *Environmental Statistics in the State of Qatar*. https://www.psa.gov.qa/en/statistics/Statistical%20Releases/Environmental/EnvironmentalStatistics/Environment_Statistics_bulletin_2020_En.pdf.
Cost of environmental degradation	
Algeria	Ministère de l'Aménagement du Territoire et de l'Environnement. 2002. *Plan National d'Actions pour l'Environnement et le Développement Durable*. https://faolex.fao.org/docs/pdf/alg151386.pdf.
Bahrain	Based on engagement with national experts.

Table G.1 Data sources used by country and theme (continued)

Country	Reference
Cost of environmental degradation (continued)	
Djibouti	Based on engagement with national experts.
Egypt, Arab Rep.	Sarhan, A. 2022. "Economic Costs of Environmental Degradation of Air and Water in Egypt." *Journal of Environmental Science*, 51(3),134–151. https://www.researchgate.net/publication/365693709_ECONOMIC_COSTS_OF_ENVIRONMENTAL_DEGRADATION_OF_AIR_AND_WATER_IN_EGYPT.
Iran, Islamic Rep.	World Bank. 2005. *Iran, Islamic Republic of – Cost Assessment of Environmental Degradation (English).* https://documents.worldbank.org/en/publication/documents-reports/documentdetail/401941468284096627/iran-islamic-republic-of-cost-assessment-of-environmental-degradation.
Iraq	World Bank. 2012. *Country Partnership Strategy for the Republic of Iraq for the Period FY13–FY16*. Washington, DC: World Bank. https://documents1.worldbank.org/curated/en/186221468263335393/pdf/NonAsciiFileName0.pdf.
Jordan	World Bank. 2009. *Jordan – Country Environmental Analysis (English)*. https://documents.worldbank.org/en/publication/documents-reports/documentdetail/315631468284337239.
Kuwait	Al-Ahmad, M., Dimashki, M., Al-Duaij, S., and Roundell, T. 2013. *Harnessing the Potential for Green Growth in Kuwait*. MENA Knowledge and Learning Quick Notes Series. https://documents.worldbank.org/pt/publication/documents-reports/documentdetail/392351468089124747/harnessing-the-potential-for-green-growth-in-kuwait.
Lebanon	United Nations Development Programme. 2020. *Rapid Cost of Environmental Degradation 2018*. https://www.undp.org/lebanon/publications/rapid-cost-environmental-degradation-2018.
Libya	Based on engagement with national experts.
Morocco	Croitoru, L., and Sarraf, M. (eds). 2017. *Le Coût de la Dégradation de l'Environnement au Maroc*. Environment and Natural Resources Global Practice Discussion Paper #5. https://documents1.worldbank.org/curated/en/741961485508255907/pdf/105633-WP-P153448-FRENCH-PUBLIC-Maroc-Etude-CDE-Final-logo-Janv-2017.pdf.
Oman	Based on engagement with national experts.
Qatar	Based on engagement with national experts.
Saudi Arabia	Based on engagement with national experts.
Syrian Arab Republic	Based on engagement with national experts.
Tunisia	World Bank. 2004. *Tunisia: Country Environmental Analysis (1992–2003): Final Report*. World Bank Group Report Number 25966-TN. https://documents1.worldbank.org/curated/en/765701468123549587/pdf/259660TN.pdf.
United Arab Emirates	Based on engagement with national experts.
West Bank and Gaza	Based on engagement with national experts.
Yemen, Rep.	Based on engagement with national experts.

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