# Stemming the Tide:
## Land-based strategies for a plastic-free ocean

Ocean Conservancy

McKinsey Center for
Business and Environment

# Executive summary

The amount of unmanaged plastic waste entering the ocean—known as plastic-waste leakage—has reached crisis levels and has caused significant economic and environmental damage. The problem warrants a collective global response. The first step should focus on the five countries that together account for between 55 and 60 percent of the total plastic-waste leakage; this report describes an integrated set of measures (or levers) that together could reduce leakage in these five countries by 65 percent and reduce total global leakage by approximately 45 percent by 2025. This is the prerequisite for successfully ending plastic-waste leakage entirely by 2035. For each lever, the report specifies costs and plastic-waste-leakage reduction potential. Total costs of implementing these levers could be contained at an estimated $5 billion a year—an investment with significant returns to the entire economy. That amount could largely be met through typical project-financing mechanisms involving the public, private, and multilateral sectors. Private industry has an important role to play in catalyzing public and private investment by strategically reducing capital costs and investment risk. Assembling the appropriate financing approach, along with the need for political commitment, location-specific data and analysis, and action to align government policies and regulatory environments, will require coordinated action across public and private stakeholders.

Although each set of actions described in the report has a different lead time—with effects in the short, medium, and long term—they all require an immediate start if we as a society are to move toward peaking and then essentially eliminating the leakage of plastic into the ocean. The agenda described in this report recognizes ongoing efforts such as capital-light improvements to uncontained dump sites located near waterways and heavy penalties for dumping of waste into waterways by waste-transportation systems. But it also suggests new priorities, acceleration of existing initiatives, increased private-sector commitment, and a focus on "ocean-smart" measures geared primarily toward reducing leakage of plastic to the ocean. And while this report focuses on five countries with especially high levels of plastic-waste leakage, we believe it also sets forth a replicable model that can be applied in other countries that would benefit from improved waste-management systems.

An article in the February 13, 2015, issue of the journal *Science* added to an already robust body of research suggesting that the volume of plastic leaking into the sea—estimated at approximately eight million metric tons a year—greatly exceeds any previous estimates.[5] Evidence of the environmental and economic damage is mounting. In a business-as-usual scenario of unchecked plastic-waste leakage, the global quantity of plastic in the ocean would nearly double to 250 million metric tons by 2025.

A broad range of stakeholders from the public and private sectors is aligning on ocean plastic as a major global issue. Capitalizing on this momentum requires a global agenda, underpinned by a strong understanding of the possible solutions and their economics. This report is meant to provide a basis for global action. It is the result of corporate and nongovernmental-organization (NGO) parties coming together on this issue and represents emerging collaborative action across the consumer-goods value chain and between the private, public, and social sectors.

To arrive at our recommendations, we looked at five key questions:

## 1. What are the origins of ocean plastic debris, and how does it leak into the ocean?

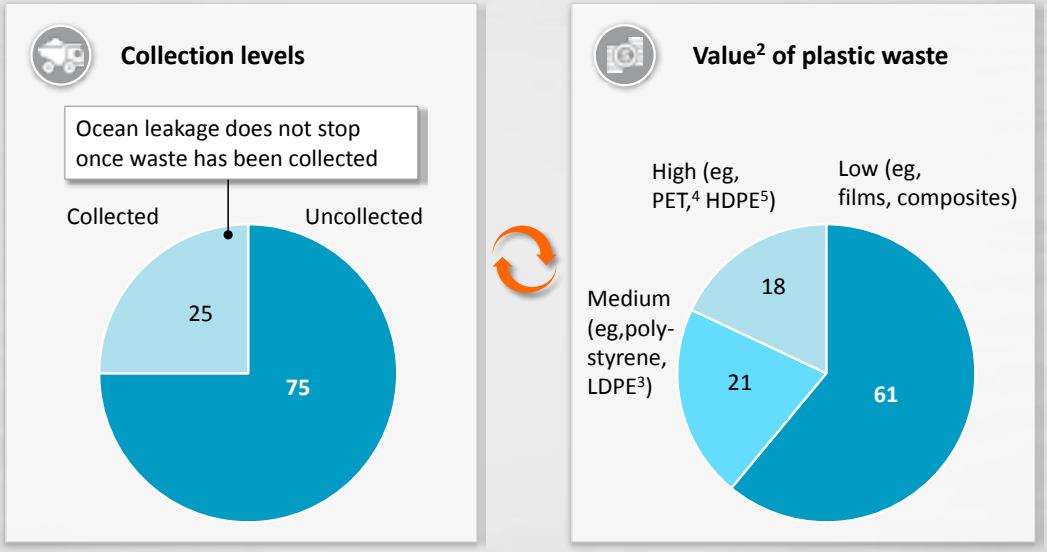
Less than 20 percent of leakage originates from ocean-based sources like fisheries and fishing vessels. This means over 80 percent of ocean plastic comes from land-based sources; once plastic is discarded, it is not well managed, and thus leaks into the ocean. Over half of land-based plastic-waste leakage originates in just five countries: China, Indonesia, the Philippines, Thailand, and Vietnam,[6] referred to in this report as the five focus countries for action. These countries have all succeeded at achieving significant growth in recent years, and they are at a stage of economic growth in which consumer demand for safe and disposable products is growing much more rapidly than local waste-management infrastructure. This creates a dual problem: the scale of collection and the retention of waste within the system itself. Our field research and interviews with public officials have also shown that these countries acknowledge the problem and are actively looking for collaborative solutions.

Of the leakage that comes from land-based sources, we found that 75 percent comes from uncollected waste, while the remaining 25 percent leaks from within the waste-management system itself (Exhibit 1). Postcollection leakage can be caused by improper dumping, as well as formal and informal dump sites that are poorly located or lack proper controls.

**Exhibit 1**

There are two drivers of plastic leakage: waste that remains uncollected, and low residual value of some plastic waste.

**% contribution to ocean plastic, by driver[1]**




1 Average, 5 focus countries: China, Indonesia, Philippines, Thailand, Vietnam; 2 "Value" is a quantitative function of price at secondary dealers and time taken to collect, combined with a qualitative function of homogeneity and likelihood of rejection by secondary dealers; 3 Low-density polyethylene; 4 Polyethylene terephthalate; 5 High-density polyethylene.

Source: McKinsey analysis

Plastic that has low residual value is more likely to leak into the ocean. Formal recycling systems generally do not exist in the five priority countries, but informal systems—namely, waste picking—do and must be considered in the design of any intervention. Waste pickers—individuals who collect materials from waste and then sell those materials to recyclers—tend to focus their efforts on high-value plastic. Waste pickers face many health risks and are often part of vulnerable communities. Their inclusion and empowerment, along with recognition of their working conditions and long-term plans to upgrade those conditions, should be an explicit goal of any solution. Only about 20 percent of the municipal plastic-waste stream has enough value to incentivize waste pickers to collect it; what remains is therefore more likely to leak into the ocean.

## 2. Are there significant differences across regions that require different types of solutions?

Existing leakage pathways and resolution mechanisms vary among countries, depending on the urban/rural makeup (for instance, population levels, the amount of waste generated per square kilometer, and the degree to which waste is aggregated at dump sites), the level of existing investment in waste systems and infrastructure (as it stands, collection rates vary widely), and local incentive policies (for instance, electricity feed-in tariffs). So any portfolio of solutions must take these regional differences into account. For example, in low-collection countries, the priority should be to push collection levels to 80 percent over the next decade (the current average in these countries is about half that). In places that already have high collection rates, post-collection leakage should be reduced to about 1 percent.

## 3. What leakage-reduction solutions are available, and what are the relevant economics of each?

Programs and interventions in the five high-opportunity countries would require a ten-year effort that starts immediately and takes advantage of the economic leverage points identified in this report. Specifically, we compiled and evaluated 33 different solutions, creating—for the first time—an approximate ocean-plastic-mitigation cost curve. This cost curve measures solutions in terms of estimated cost (dollars per metric ton of leakage avoided) and potential impact (metric ton of leakage avoided), and is accompanied by further analysis on ease of implementation.

Based on this analysis, several levers are most effective:

- **Closing leakage points within the collection system** by optimizing transport systems to eliminate illegal dumping, and closing or improving dump sites located near waterways.
- **Increasing waste-collection rates by expanding collection service,** as plastic waste is more than twice as likely to leak into the ocean if it remains uncollected. Stopping the growth in absolute metric tons of leaked plastic would require that the weighted average collection rate in the five focus countries be doubled, from roughly 40 percent to nearly 80 percent.
- **Using a variety of waste-to-fuel (e.g., gasification) or waste-to-energy (e.g., incineration with energy recovery) technologies to treat waste** in areas with high waste density. The choice of waste treatment should, of course, align with local priorities, local regulations, and electricity tariffs. (Using these technologies does not preclude a portion of high-residual-value plastics being recovered by the informal sector for recycling.) Pyrolysis also is an option in the medium term; if the cost structure for this technology improves by 25 to 35 percent over the next five years, it could become even more widely used as a substitute treatment option.
- **Manually sorting high-value plastic waste and converting much of the remainder to refuse-derived fuel (RDF).** This lever, which is specific to areas with low waste density, entails extracting for recycling the 20 percent of plastic waste that has high residual value and converting a substantial portion of the remaining 80 percent to refuse-derived fuel for use in the cement industry. This RDF could replace 3 percent of total coal consumption.

The results of these analyses dispelled some commonly held misconceptions. For example, analysis suggests that recycling alone is not a solution, as about 80 percent of the plastic-waste stream is too low in value to incentivize extraction, and almost 30 percent cannot be distinguished at a polymer level without additional investment in optical sorting equipment.

Bans on plastic bags can be effective, but only in specific retail channels and heavily regulated locations. Lightweighting, or reducing the quantity of plastic in packaging, reduces the growth rate of plastic consumption by only a few percentage points while also reducing the incentive for waste workers to manually extract some items, since items will contain less material that can be resold.

## 4. What can be done to trigger the implementation of leakage-reduction measures in the short, medium, and long term?

Based on our findings, three sets of actions are needed. The first two will help reduce plastic-waste leakage in the five focus countries by 65 percent over ten years of implementation (i.e., by 2025, assuming a launch in 2015), which is roughly equivalent to reducing global leakage by 45 percent), and together with the third would help ensure that plastic-waste leakage peaks before 2030 and then continues to decline until the problem is essentially eliminated.

1. **Short term.** Accelerated development of collection infrastructure and plugging of postcollection leakage to create an almost 50 percent annual leakage reduction by 2020, which would also help ensure availability of sufficient waste feedstock to support waste treatment at scale.
2. **Medium term.** Development and rollout of commercially viable treatment options to convert over 60 percent of plastic waste to material or energy, using technologies that are already viable or can be developed at an accelerated pace. This would reduce leakage by nearly 16 percent by 2025, for a total reduction of 65 percent by that year.
3. **Long term.** Innovations in recovery and treatment technologies, development of new materials, product designs that better facilitate reuse or recycling, adoption of alternative food- and beverage-dispensing concepts, and adherence to the broader principles of circularity to ensure a more sustainable plastic life cycle. Together with the short- and medium-term initiatives, these longer-term actions have the potential to essentially eliminate plastic-waste leakage from the priority countries by 2035.

Time to impact will differ significantly, but all three sets of actions should be initiated now to achieve the full potential impact by 2035. The first set, which focuses on improving collection and plugging postcollection sources of leakage, can be done fastest, as the mechanisms to do so are well established. Given the high economic growth and the emergence of a consuming class in the focus countries, we believe it is critical to get this first set of actions to deliver outcomes soon. The solutions will need to move faster than the growth in the problem.

This study focuses on the first two sets of actions because we believe they make it possible to achieve dramatic improvements in the short and medium term. Moreover, these two sets of levers are not plastic specific; they target the entire waste stream and as such can be a solution for land-sourced marine debris in general. If executed today, the total program would cost about $5 billion a year but would largely overlap with existing efforts to improve waste management in these booming economies. (For example, China is already in the process of expanding its capacity for incineration with energy recovery.)

An accelerated program in the five countries, however, will require high-performing public-private partnerships launched in conjunction with appropriate enabling national and local policies and effective enforcement once policies are in place. Capital-investment plans, waste-management budgets, and existing donor/multilateral project spending can be leveraged toward the program's goals; however, private-sector investments will likely be required to reach the reduction targets. The chemical and consumer-goods industries could help catalyze public and private investments by strategically reducing capital costs through, for example, equity participation, first-loss positions, offtake agreements, and price guarantees. The third set of actions is critical to sustaining decreased plastic-waste leakage in the long term, but as the impact would be predominately beyond 2025, these actions have received less focus in this report.

## 5. What are the cornerstones of a concerted program for global action?

Because of the scale of the problem, the next ten years will be critical. Current international momentum around this issue has created a window of opportunity for developing a global agenda that can resolve this tremendous challenge. The architecture of such a global program will have to reflect the local nature of waste management, secondary material markets, and consumer and waste-worker communities. It will also have to recognize the role of the largest producers of resin, packaging, and consumer goods.

Bringing together these different stakeholders and interests will require a coalition, which must have a central mechanism for creating alignment and harnessing the unique abilities of each constituency to contribute to the global solution. This coalition should develop and execute an implementation plan along the following six areas for action:

1. **Political leadership and commitment.** Obtain real and meaningful commitments from national governments, governors, and mayors to set and achieve ambitious waste-management targets.
2. **On-the-ground wins.** Provide local "proofs of concept" for integrated waste-management approaches in carefully selected beta cities (chosen based on the joint economics of good waste management and local co-benefits). This will require global expertise in waste-management engineering, innovative on-the-ground delivery mechanisms, and formal project financing.
3. **Critical mass.** Using lessons learned in beta cities, build a best-practice transfer mechanism that can accelerate the transfer of global expertise to high-priority cities and regions.
4. **Prerequisites for funding.** Ensure that required project-investment conditions are met in the private, public, and multilateral sectors alike. Work with industry (likely the plastic-resin, packaging, consumer-goods, retail, and waste-management sectors) on mechanisms to de-risk waste-management project-finance investments.
5. **Technology-implementation support.** Provide state-of-the-art waste-management technology providers with detailed data on waste composition, volume, and pathways; local infrastructure; wage structure; waste-picker systems; feedstock-supply security; energy prices; feed-in tariffs; and offtake agreements.
6. **Issue prioritization.** Bring leadership and strategic focus on solutions to the ocean-plastic challenge as part of the global policy agenda on the ocean.

Increasing clarity about plastic-waste leakage volumes and the waste's effects on the ecosystem, as well as new information about solution economics and action levers—together with emerging private-sector, government, and multilateral support—makes this a good time to elevate the agenda for reducing leakage from the global plastic value chain.

This study outlines a path that can generate considerable benefits to communities, preserve the bioproductivity of the ocean, and reduce risks for industry. It shows that, over the next ten years, concerted action in the form of a $5 billion annual ramp-up in waste-management spending could create a vibrant secondary resource market, trigger investment in packaging and recovery systems, and let the ocean thrive. The drivers of the ocean plastic-reduction agenda should convene and jointly define the architecture of such a global program, the actors who should be involved, and the funds required to drive a flagship initiative that stands for a new, collaborative, and effective way of addressing this global challenge.