



WASTE TO



EMISSIONS

How reducing waste is a climate gamechanger

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Executive summary

As the climate crisis deepens, urgent action on all fronts is required to both eliminate greenhouse gas (GHG) emissions and adapt to a rapidly changing climate. The waste sector offers a prime opportunity for cities to take action that will dramatically reduce emissions, strengthen resilience, and provide substantial public health and economic benefits. The waste sector is the third largest source of anthropogenic methane emissions, whose reduction will deliver rapid benefits through avoided warming. In fact, good waste management practices can reduce emissions in other sectors, delivering more than 100% emissions reductions. Simultaneously, this approach, known as zero waste, can reduce flooding, deter disease transmission, improve soil health, and deliver economic opportunities. This report explains how zero waste is an essential part of any climate plan.

Seventy percent of global greenhouse emissions come from the material economy, from extraction through disposal. In national inventories, these emissions are tallied in the industrial, agricultural, transportation, and energy sectors, as well as the waste sector. Yet curbing waste generation and implementing better waste management strategies avoids emissions throughout the lifecycle of material goods—from extraction to end of life. The mitigation potential of the waste management sector is therefore largely underestimated.

Zero waste systems are versatile strategies that aim to continually reduce waste through source reduction, separate collection, composting, and

recycling. Over 550 municipalities around the world are already implementing zero waste, in a wide range of economic, social, climatic, and legal contexts. Furthermore, these systems are cost-effective to implement and produce fast results.

This report is organized around the three overarching positive impacts of incorporating zero waste systems into current waste management methods: climate mitigation, climate adaptation, and additional societal benefits (also referred to as co-benefits). The final chapter of the report offers case studies that model the effects of zero waste strategies in eight different cities, demonstrating that zero waste is a powerful mitigation strategy that is highly adaptable to different needs and circumstances. Cities around the world have already implemented zero waste systems; with these eight case studies, this report offers a new quantitative assessment of the mitigation benefits of such programs.



Climate mitigation

Zero waste systems contribute to greenhouse gas emissions reductions in three ways: **source reduction and separate collection and treatment of organic waste** avoids landfill methane emissions; **land application of compost** or digestate enhances the carbon uptake of the soil; and **source reduction and recycling of all municipal waste streams reduces “upstream”** emissions from natural resource extraction, manufacturing, and transport;

Key takeaway 1

Composting is a climate game changer.

- Separate collection of different waste streams is critical to avoid cross-contamination; the most readily implementable treatment option for organic waste is composting.
- Source-separated collection and treatment of organics can reduce methane emissions from landfills by 62%, even with moderate ambition.
- Mechanical recovery and biological treatment of residual waste and biologically active landfill cover are good complementary measures to source separated organic waste collection; in tandem, these strategies can reduce methane emissions by an average of 95%.

Key takeaway 2

The zero waste model can transform the waste sector into a net negative source of GHG emissions.

- Introducing better waste management policies such as waste separation, recycling, and composting could cut total emissions from the waste sector by 84% or more than 1.4 billion tonnes, equivalent to the annual emissions of 300 million cars – or taking all motor vehicles in the U.S. off the road for a year.
- Separate collection and treatment of organic waste is key to deep cuts in waste-sector GHG emissions.
- Aggressive recycling programs reduce emissions in mining, forestry, manufacturing, and energy.

Increased recycling would reduce annual GHG emissions in the waste sector by 35% in Detroit, 30% in Sao Paulo, and 21% in Lviv by 2030

- Combined, these two approaches can produce deeper emissions reductions than waste sector emissions. Detroit, São Paulo, and Seoul would all achieve net-negative emissions under the ‘road-to-zero-waste’ scenarios.
- This is true even for relatively modest programs; full implementation of zero waste would produce even greater emissions reductions.

Key takeaway 3

Source reduction of waste is the best way to reduce GHG emissions, especially for food and plastic (better than recycling).

- Source reduction is a critical strategy for addressing food waste, which currently comprises one-third of all food production and is responsible for 10% of global GHG emissions.
- Other strategies for source reduction include restrictions on the production and distribution of single-use items and packaging.
- Source reduction is especially important for plastic, most of which is not recyclable and whose production is doubling every 20 years.

Key takeaway 4

Energy recovery is not an effective mitigation strategy

- Landfill gas capture is unreliable, allowing large quantities of fugitive methane emissions to escape.
- Incineration is a major source of GHG emissions: each tonne of plastic burned results in the release of 1.43 tonnes of CO₂, even after energy recovery.
- Insufficient energy is recovered to offset the carbon footprint of these technologies.

Climate adaptation

Zero waste systems help cities build resilience against the increasingly frequent extreme weather events and health hazards brought by climate change. Poor waste collection and management are among the factors that leave cities particularly exposed to these events. Zero waste systems help cities become more resilient by: **mitigating floods, reducing disease transmission, and improving soil quality.**

Key takeaway 1

Bans on single-use plastic (SUP) are necessary as plastic waste exacerbates flooding.

- Plastic bans and universal collection systems are key to flood prevention as improperly managed waste— especially plastic bags —lead to clogged drainage systems.
- After tragic flood events, many cities have successfully and swiftly adopted plastic bans.

Key takeaway 2

Banning SUPs and better waste collection will keep disease vectors at bay.

- Uncollected waste, especially plastic, creates habitat (e.g., stagnant water) for disease vectors, while food waste provides a food supply for vermin.
- Reducing waste through bans on SUPs and minimizing discarded food can help to interrupt the chain of disease transmission.

Key takeaway 3

Composting does wonders to improve soil resilience.

- Land application of compost helps nutrient-deficient soil by increasing nutrient storage capacity, biochemical properties, crop production, and water retention.
- Better soil quality prevents floods, mudslides, and loss of food crops.

Additional benefits

Well-implemented zero waste strategies benefit societies in ways that go beyond their ability to curb the impacts of climate change: they improve many of the most fundamental ways in which society functions— through associated **environmental, economic, social, and political and institutional benefits.** These additional benefits include improving public health, reducing environmental pollution, incentivizing job creation, supporting community development, and addressing inequalities and societal injustices. Furthermore, waste solutions at the top of the waste hierarchy not only have the greatest additional benefits, but also score highest on emissions reductions.

Key takeaway 1

Zero waste systems do more for our health and the environment than lower GHG emissions. Zero waste systems:

- Lower the risk of cancer and illnesses associated with the spread of toxic ash from incinerators and landfills by rendering them redundant;
- Save natural resources by decreasing the need and demand for virgin materials;
- Protect ecosystem health by decreasing plastic pollution, which currently affects all living organisms;

Key takeaway 2

Zero waste systems contribute to a thriving economy. Zero waste systems:

- Are more economical than traditional waste management strategies;
- Offer more and better employment opportunities than traditional waste management jobs;
- Spur business development: bans of single-use plastic have opened the door to innovative businesses.

Key takeaway 3

Zero waste systems provide a wide range of social benefits. Zero waste systems:

- Reduce poverty and inequality through the inclusion of informal waste pickers; .
- Improve public health by decreasing the amount of toxic chemicals in the environment;
- Improve food and water security via the application of compost and biodigestate, which support food and water ecosystems;
- Reduce environmental stressors associated with waste disposal facilities.

Key takeaway 4

Zero waste systems strengthen the quality of governance itself

- Bringing together a wide range of stakeholders, zero waste systems are more collaborative and demonstrate high performance rates as a result.

Case Studies

Modeling a business-as-usual versus a road-to-zero-waste scenario for eight cities revealed several commonalities regarding the efficiency and impact of zero waste systems. Source-separated collection and treatment (usually through composting) of organic waste is key to deep emissions reductions, as landfill methane is the primary source of GHG emissions in the waste stream in every city but Seoul. This is also the only effective method to fully address these emissions, and it is relatively easy and inexpensive to implement. Recycling is also key, as increased recycling reduces emissions, and can, in some cases, be enough to make a city's waste sector net negative. While source reduction strategies are underutilized across the board, all zero waste policy and programs, even when incompletely implemented, lead to major mitigation benefits everywhere. The 'road to zero waste' scenarios modeled here are conservative, realistic scenarios; many cities have already exceeded the benchmarks in these scenarios, and the results are thus indicative of moderately ambitious programs. Deeper emissions cuts can be expected from more ambitious zero waste implementation.

Recommendations

- **Incorporate zero waste goals and policies into climate mitigation and adaptation plans.**
 - Cities, which have the primary responsibility for waste management, should adopt comprehensive zero waste programs, with emphasis on source separation, organics treatment, and informal sector integration.
 - Funders and financial institutions should support city transitions to zero waste with financial and technical measures.
 - National governments can incorporate zero waste into their Nationally Determined Contributions (NDCs) and relevant national climate policies.
- **Prioritize food waste prevention and single-use plastic bans.**
 - Food waste prevention requires a dedicated strategy that integrates the entire supply chain, with interventions from field to fork.
 - Bans on single-use products and packaging, particularly plastic, can be adopted at the local or national level.
- **Institute separate collection and treatment of organic waste.**
 - Cities should develop clear, easy-to-use systems with uniform signage and dedicated outreach programs to ensure high compliance rates.
 - Composting is the easiest, least expensive, and most scalable treatment option for organic waste.
- **Invest in waste management systems, recycling and composting capacity.**
 - Relatively small capital inputs are required for source separated collection, material recovery facilities, organics treatment, etc.
 - Municipalities should create a plan to meet ongoing operational costs, which may be lower under zero waste.
- **Establish appropriate institutional frameworks for zero waste including regulations, educational and outreach programs, and provide financial incentives through subsidies to recycling and composting.**
 - Regulations to set up a comprehensive zero waste system are key, with strong emphasis on aligned economic incentives that promote a virtuous system, continuously improving its waste reduction rates.
 - Subsidies and other incentives to compost production and use are instrumental in developing these virtuous systems that can counter the heavily subsidized synthetic agrochemicals.
 - Education, communication and outreach programs which ensure all stakeholders are included are needed for high participation and compliance rates.
- **Recognize the role of waste pickers and fully integrate them into the waste management system.**
 - Create a consultative mechanism through which waste pickers can actively collaborate in the design of zero waste and take advantage of new opportunities, whether as employment or as entrepreneurs.
 - In cities where informal recyclers come from historically excluded populations, this may require ending long-standing discriminatory practices.

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