Zero Waste Systems:

Small Investment, Big Payoff

gaia

#Beyond Recovery


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Introduction

With the COVID-19 pandemic, the need to build a resilient economy is more pressing than ever. Today, waste management is a sector that typically uses up to 4-19% of municipal budgets.[1] While zero waste systems are known for their wide-range of environmental benefits, they are also an affordable and practical strategy to waste management that is greatly economically advantageous.

In many cases, zero waste is the cheapest way for cities to manage waste. Strategies for saving money through zero waste can vary depending on the current state of waste management conditions, but existing data and case studies present three clear messages:

1. **The more waste a city reduces, the higher its cost savings.** Savings typically come from reduced costs of hauling of waste to disposal/incineration sites (which are themselves cost-intensive), and by capturing the value of materials through reuse and recycling. By banning non-recyclable materials such as single-use food packaging (and implementing reusable foodware containers), for example, the U.S. could save up to USD 7.7 billion in litter cleanup costs as food packaging waste represents 67% of the street waste that normally costs USD 11.5 billion in total to clean up.

2. **Implementing material recovery strategies**—such as a better collection system that separates material at the source (i.e. separate collection), recycling, and composting—**to deal with current waste levels is still more affordable and economically sound than relying on waste incineration and landfilling**. While there may be an upfront cost to implementing these strategies, data show that they would typically cost municipalities between USD 8 and USD 119 per person per year, costs that would be greatly offset by the value these strategies would generate by diverting waste from incinerators and landfills.

3. **All municipalities can benefit from the implementation of zero waste strategies, regardless of where their current waste management system stands.** Municipalities with separate collection, recycling and composting in place can extend the cost-saving potential by reducing the overall amount of waste and diverting waste from cost-intensive disposal practices. Prioritizing reuse and redesign, and then recycling and composting is the most effective way to cut down waste management costs and unlock economic and environmental health benefits. Municipalities with an inadequate waste management system can avoid investing in quick and capital-intensive technological fixes such as waste incineration and so-called "plastic-to-fuel" that would pose new challenges to the environment and the local economy in the long run, Instead, they can save money longer-term by investing in zero waste systems, such as a separate collection and better recycling and composting infrastructure. Remaining in the status quo, however, would only mean more economic loss, including health costs associated with open dumps and open burning.

Key Findings:

- By implementing a better collection and recycling/composting system, municipalities can, on average, reduce waste management costs per tonne of waste by 70%[2]
- The experience within GAIA's network in cities around the world shows that municipalities across population-size and income levels have benefited from cost savings through zero waste, including:
  - Cities in the Philippines have already saved between USD 392,000 - USD 413,000 a year
  - Cities in Italy, Spain, and France have already saved between USD 43,000 - USD 2.4 million a year
  - Cities in Bolivia and Chile have already saved between USD 270,000 - USD 2.3 million a year

Part 2 – The cost-effectiveness of zero waste interventions vs. traditional waste management

Improving waste collection and waste management systems is one of the first steps toward creating a zero waste city, but it is also a strategic and cost-effective approach to overall waste management that municipalities can take. Waste management costs may vary widely across countries—depending on location, income levels, and amount and types of waste generated, among many factors—but clear patterns emerge across the board.

The table below estimates the operational costs of the basic zero waste system interventions (separate collection, recycling, and composting) and those of a waste disposal system (waste-to-energy incineration and landfills).

Regardless of the income bracket the countries belong to, recycling and composting costs per tonne are consistently lower than that of landfilling and strikingly lower than that of waste incineration.

Cost estimates for discrete waste operations (USD/tonne)

	collection		recycling		composting		incineration/WTE		landfills	
	low	high	low	high	low	high	low	high	low	high
Lower Income Countries	20	50	0	15	5	30	N/A	N/A	10	30
Lower-middle Income Countries	30	75	5	30	10	40	40	100	15	40
Upper-middle Income Countries	50	100	5	50	20	75	60	150	25	65
High Income Countries	90	200	30	80	35	90	70	200	40	100

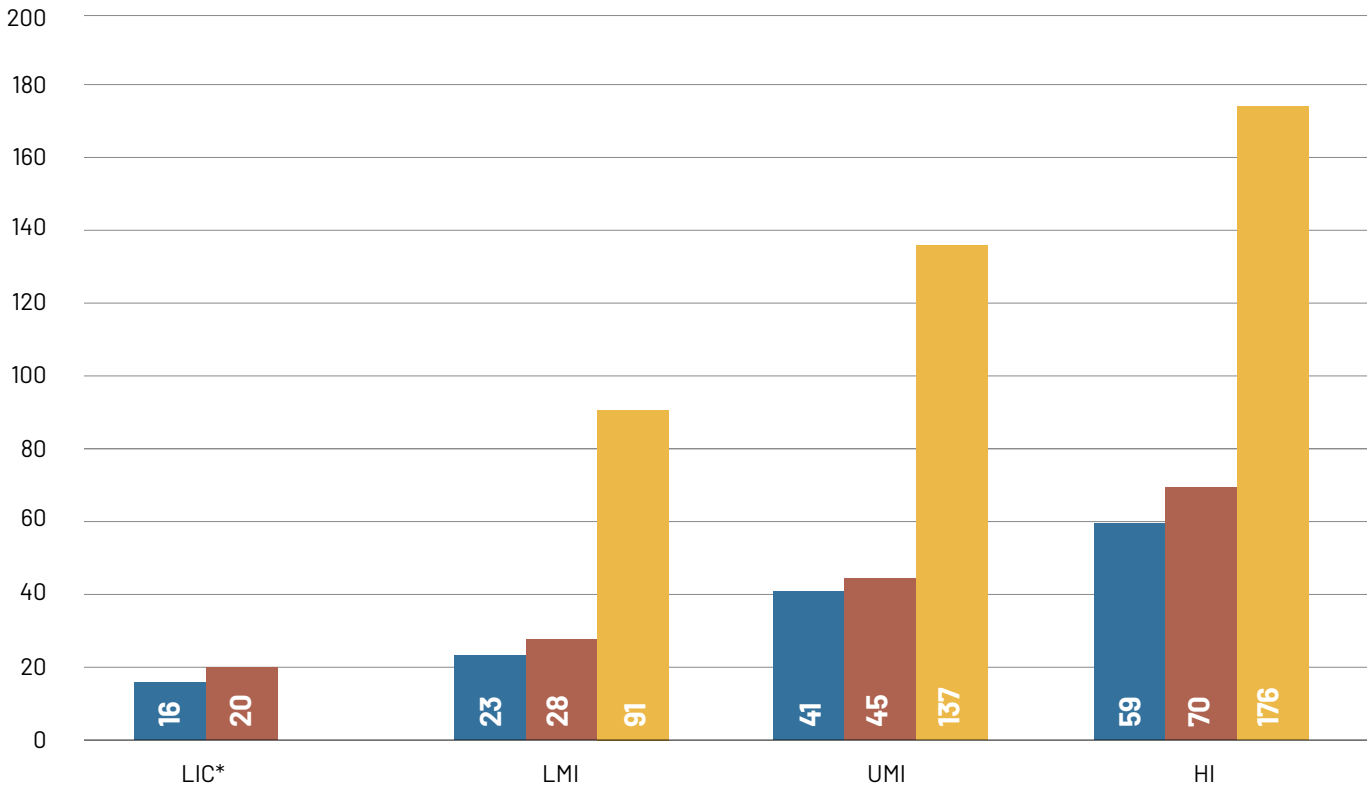
Source: World Bank (2018). What a Waste 2.0

While collection costs remain relatively high in the liberal estimate, optimal collection plays a key role in facilitating recycling and composting, and diverting recuperable materials from incineration and landfills.

In order to put these discreet figures into context, the graph below shows the costs for three different waste management scenarios*:

1. **a zero-waste optimized scenario** (in which the potential for source-separated collection, recycling, and composting is maximized)
2. **a landfill-heavy scenario** (in which 100% of waste is sent to landfills)
3. **a WTE-heavy scenario** (in which 100% waste is sent to WTE, and 30% of waste still required to be landfilled as incineration ash)[3]

Waste management costs in three scenarios (USD/tonne)[4]



Source: Analysis based on World Bank (2018). What a Waste 2.0 (data table)

* These scenarios are based on per tonne costs for collection, recycling, composting, incineration, and landfilling, in proportion to the ratio of the current waste management structure in four country income categories.

ZW based on current waste diversion rates

Landfills (all waste sent to landfills)

WTE (all waste sent to WTE)

*Data are not available due to low technical and financial viability of waste incineration in lower-income countries

Both the WTE scenario and the landfill scenario show a drastic increase in expenditures per tonne of waste processed compared to the zero-waste optimised scenario. Heavy reliance on WTE incineration is the most expensive waste management approach, with estimated costs amounting to three times the costs of landfill operation and up to five times the costs associated with recycling and composting.

Implementing a better collection and recycling/composting system would reduce per tonne waste management costs by 66-75% across three country income categories; 66% in high income countries compared to the WTE-heavy scenario; 70% in upper-middle income countries; and 75% in lower-middle income countries.[5]

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Part 3 – Case studies: living examples that showcase the economic benefits of zero waste

Across the globe, a growing number of municipalities have undertaken efforts toward a systemic transition to zero waste. Data show that zero waste schemes such as recycling and composting are more affordable compared to capital-intensive disposal infrastructure, but they also bring additional revenues generated by capturing the material value of these rescued items. Municipalities are further able to achieve greater cost savings by reducing the overall amount of waste they produce, especially in countries with high waste generation. Both waste reduction and rescue bring additional benefits, which include high job creation potential and reduced pollution.

Following are living examples from GAIA's network[6] that show how zero waste systems have reduced overall waste management costs by implementing strategies that either primarily prioritize waste reduction or prioritize source separation and reuse strategies.

Cities that benefit from waste reduction:

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Case study – San Fernando

San Fernando cut down landfill costs by 25 times and hauling costs by half by implementing bans on plastic bags and styrofoam food packaging,[7] significantly reducing waste, and by implementing source separation programs that divert waste from disposal systems.

Before	After	How	Cost and savings
12% diversion rate	Over 80% diversion rate achieved. The city is planning to increase the diversion rate to 91% by 2024, the maximum rate that can be achieved through recycling and composting.	Strong political will that enacted Plastic Free Ordinance Leading an intensive public information, education, and communication (IEC) campaign for residents, which targets business establishments and aims to gradually phase out the use of plastic bags and styrofoam packaging for food products. Waste analysis and characterization study No-segregation, no collection Partnership with waste pickers; currently 160 waste workers are fully integrated into the solid waste management program at the barangay and city levels.	With less waste, the city now only spends PHP 34.6M (USD 677,404) annually on waste hauling, about half compared to PHP 70M (USD 1.4M) in previous years. With proper segregation and management, and reduction on the use of plastics, the city was able to reduce 58% on the disposal of residual wastes, from PHP 156M to PHP 65M.

Cities that benefit from waste reduction:


© Zero Waste Europe

Case Study – Parma

Parma, a city with a population of approximately 193,000, was able to reduce waste generation by 15%, and the volume of the waste sent for disposal decreased by nearly 60%. This was accomplished within just 4 years of implementing a door-to-door separate collection with a pay-as-you-throw (PAYT) system.[8] The annual cost savings were €450,000.[9]

Before (2011)	After (2015)	How	Cost and savings
Separate collection rate: 48.5%	Separate collection rate: 72% Reduced total waste generation by 15% Residual waste decreased by 59% (annual per capita waste generation decreased from 313 kg to 126 kg).	**Door-to-door separate collection with PAYT system and incentives for home composting.**	**Reduction in the overall annual costs of €450,000.** **An increase in collection costs was covered by revenues from selling high-purity materials and the annual disposal costs that dropped by almost €3.5 million.** Door-to-door collection system has significantly **increased the number of direct jobs created in collection,jumping from 77 before the change of the system to 121 operators in 2015.**

Cities that benefit from waste diversion:

© Francisca Faundez/Plataforma Urbana

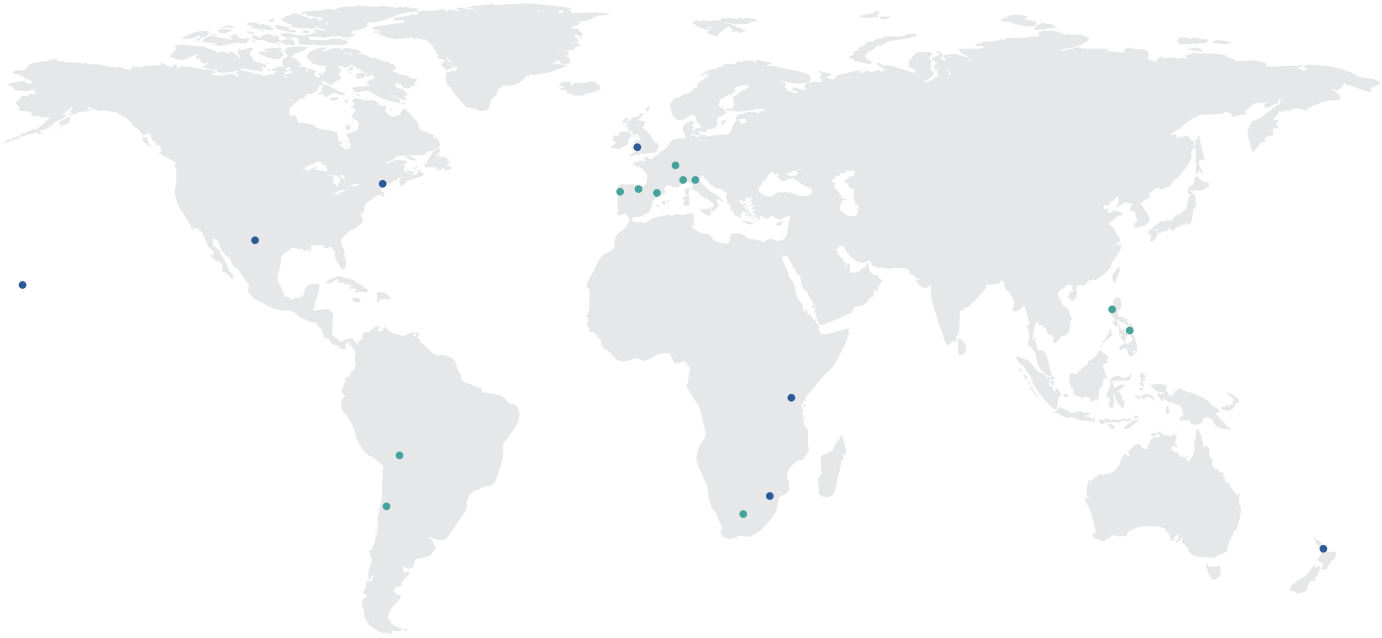
Case study – La Pintana

La Pintana's impressive composting schemes have efficiently diverted organic waste from landfills with a small budget, by building a vermicompost site using existing infrastructure.[10] In addition to daily savings of USD 754 in waste management costs, the residents have enjoyed agricultural and recreational services provided by the composting site.

Before	After	How	Cost and savings
All organic waste was sent to landfills.	44 tonnes of organic waste were recovered per day, y, the equivalent of 20.5% of all organic waste in La Pintana. Only 0.04% contamination rate through effective source separation. Residents receive free compost and benefit from a mulching plant, a nursery, and an "urban silviculture" program that includes a wood shop. about 1,000 liters of used kitchen oil is recovered daily.	Conducted waste audit and characterization analysis Organic waste collection and composting program based on existing infrastructure Developed a site consisting of a small compost pile and worms into a compost facility equipped with worm beds and a vermiculture area.	Reduction in transport and disposal costs Per tonne costs: USD 3 for composting, USD 19 for landfills Daily savings in disposal costs estimated to be USD 754. Compost and vermiculture plant operation costs USD 31,036 a year Environmental education costs USD 69,000 a year Municipal solid waste collection USD 1,632,683 a year

Part 4 – Zero waste works: savings & earnings by city

All over the world, municipalities have enabled cost savings by sending less waste to landfills or incinerators, and by increasing their rate of recycling and composting.



Proven cost savings

Asia

- **San Fernando, Philippines:** After implementing source separation programs and bans on plastic bags and styrofoam food packaging, San Fernando's waste diversion rate jumped from 12% to 80%, saving approximately PHP 20 million (USD 392,000) annually in the solid waste management budget.[11]
- **Tacloban, Philippines:** With a source separation program being rolled out and landfilled waste down by 31%, the city is saving PHP 21.6 million (USD 413,000) in its annual budget.

Europe

- **Capannori, Italy:** The savings from waste diversion from landfills and earnings from the increased volume of materials recovered through zero waste strategies amounted to €2 million (USD 2.4 million) in 2009, which was partially used to hire 50 employees.[12]
- **Argentona, Spain:** The implementation of a Pay-As-You-Throw program generated annual profits of €35,000 (USD 43,000) from the sales of recyclables and sending less waste to landfills, while being largely self-funded.[13]
- **Pontevedra, Spain:** the costs of local composting systems went down as the city diverted more organic waste. Per tonne of organic waste, incineration costs €235.5 (USD 285) whereas individual composting, community composting, and municipal composting respectively cost €95 (USD 115), €110 (USD 133) , and €140 (USD 169).[14]

- **Parma, Italy:** Through Pay-As-You-Throw programs, Parma's residual waste generation was cut by nearly 60% in 4 years, reducing annual costs by €450,000 (USD 546,000).[15]
- **Gipuzkoa, Spain:** Usurbil (city in Gipuzkoa province) saved €25 per capita per year through achieving higher recycling rates.[16]
- **Besançon, France:** Diverting organic waste through home and community composting programs yielded savings of at least €792,900 (USD 962,900) in 2016.[17]

Latin America

- **La Paz and other cities in Bolivia:** The Eco-Vecindarios project generated over USD 2.3 million by preventing recyclables from ending up in landfills, through a program on source separation by households.[18]
- **La Pintana, Chile:** Composting costs USD 3 per tonne of vegetable waste while landfills cost USD 19 for the same amount. By diverting vegetable waste, the largest fraction in the waste stream, from landfills to a composting site with worm beds, La Pintana is saving over USD 275,000 every year.[19]

Africa

- **South Africa:** Waste pickers in South African municipalities divert 80% to 90% of discarded items from disposal, saving municipalities up to R750 million (USD 51 million) in annual disposal costs.[20]

Projected cost savings

Asia Pacific

- **Auckland, New Zealand:** Efficient use of curbside collection systems for recycling and organic waste separation can save around USD 12 per household per year.[21]

USA/Canada

- **Hawaii, USA:** By diverting materials that are recoverable through reuse, composting, and recycling from landfills, the County of Hawaii can add nearly USD 11 million in revenues.[22]
- **Austin, USA:** Efforts toward 75% waste diversion are estimated to save USD 4.2 million per year through a decrease in landfill costs.[23]

Europe

- **London, UK:** Solid waste disposal currently costs £2 billion (USD 2.4 billion) per year, which can be reduced by zero waste programs. Cutting single-use plastic and food waste by 20% would yield £42 million (USD 56 million) in savings; £10M million (USD 13 million) with reuse and repair; £120 million (USD 160 million) with anaerobic digestion of organic waste.[24]

Africa

- **Dar es Salaam, Tanzania:** The potential revenues from currently-uncaptured plastic scrap in the city add up to USD 28 million per year.[25]
- **Durban, South Africa:** The removal and rehabilitation of illegal dumping sites costs the waste management sector of eThekwini Municipality (DSW) R180,000,000 (USD 12 million) a year, which can be saved by implementing collection and recovery of discarded materials.[26]

Part 5 — Conclusion

While the goal of diverting all waste from disposal might seem distant, improving existing systems for waste collection, recycling, and composting — which is a crucial and effective step toward a complete zero waste system — would only require modest budget investments, with the potential for substantial savings, particularly through waste reduction mechanisms. As shown in the featured case studies, municipalities all across the globe have already transitioned toward zero waste and present living examples of economically sound and effective solutions to the waste problem.

Implementing zero waste schemes are affordable, as they do not involve cost-prohibitive and polluting disposal options such as incineration and landfilling. In some cases, revenues and saved disposal costs were enough to cover the bulk of waste collection and management costs, while bringing in other direct and indirect economic benefits. Cutting down waste, recovering materials, keeping toxins out of air, water, and land, reducing greenhouse gas emissions, providing nutrients through composting, and creating good jobs are just some of the additional advantages that zero waste brings as it lays at the foundation of a circular and resilient economy.

Appendix

Based on the best available data, the required operational costs for collection and management of all waste are estimated to range from USD 8 (lower income countries) to USD 119 (high income countries) per person on a yearly basis.[27] The table below estimates these figures, suggesting what waste management systems would cost *if* municipalities unlocked the potential for 100% separate collection, *and* maximized recycling and municipal composting based on the current waste generation and proportion of recyclable or compostable materials in the current waste composition.

Annual per capita cost estimates for waste operations (USD/resident/year)

	Average per capita waste generation (kg/year)	Recyclable fraction**	Compostable fraction	Disposal fraction***	Waste management costs (USD/person/year)
Lower Income Countries	146	17%	56%	27%	8
Lower-middle Income Countries	193	30%	53%	17%	15
Upper-middle Income Countries	251*	31%	54%	15%	29
High Income Countries	577	57%	32%	11%	118

* High per capita costs in high income countries are attributable to large amounts of waste generated per person as well as higher prices and labor costs.

** Materials that are potentially recyclable: paper, plastic, metal, glass, etc.

*** The disposal fraction is smaller in zero waste cities with waste reduction strategies.

These figures show that municipalities can operate waste management systems with a modest investment. With a prerequisite that waste management should be implemented with a zero waste philosophy, these estimates include disposal costs at landfills based on the current residue generation rates in order to provide an indication of budget requirements.

SWaCH Pune Seva Sahakari Sanstha Ltd. is a collective of self employed wastepickers that provides waste collection and management services. It is authorised by the Pune Municipal Corporation. © Brodie Lewis

A zero waste system can be described as a circular loop in which used materials are put back into the cycle of production and consumption in order for them to become resources again, instead of being discarded in landfills or incinerators. Key stepping stones for a successful shift toward zero waste include rethinking the way we produce and consume materials, banning packaging and products designed to be dumped, redesigning products to be less wasteful, reusing and repurposing materials, and recycling and composting as much as possible.

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Note

All currency exchange rates applied in this factsheet are as of December 2020.

Endnotes

1 Kaza, S., Yao, L., Bhada-Tata, P., & Van Woerden, F. (2018, September). What a Waste 2.0 : A Global Snapshot of Solid Waste Management to 2050. World Bank Group. https://openknowledge.worldbank.org/handle/10986/30317

2 An average of three national income groups. Please see Part 2 for more details.

3 These calculations are underestimated as the capital expenditure for incinerators is a bigger source of financial needs than operational costs.

4 Collection costs not included

5 Data for lower-income countries are not available.

6 For more information, see our websites no-burn.org and zerowasteeurope.eu

7 GAIA. (2019). Picking Up The Baton: Political Will Key to Zero Waste. https://zerowasteworld.org/wp-content/uploads/San-Fernando.pdf

8 Pay-As-You-Throw (PAYT) program charges households for solid waste collected based on the amount of waste thrown away.

9 Folli, G. (2018, February). Cheaper and more efficient? The positive effects of pay-as-you-throw and kerbside collection. Zero Waste Europe. https://zerowasteeurope.eu/2018/02/cheaper-more-efficient-pay-as-you-throw-kerbside-collection/

10 Allen, C. (2012, June). Prioritizing the Recovery of Vegetable Waste. GAIA. https://www.no-burn.org/wp-content/uploads/ZW-La-Pintana.pdf

11 GAIA. (2019). Picking Up The Baton: Political Will Key to Zero Waste. https://zerowasteworld.org/wp-content/uploads/San-Fernando.pdf

12 Van Vliet, A. (2013, September). The story of Capannori – A Zero Waste champion. Zero Waste Europe. https://zerowasteeurope.eu/2013/09/the-story-of-capannori-a-zero-waste-champion/

13 Vliet, A. (2018). The Story of Argentona. Zero Waste Europe. https://zerowastecities.eu/bestpractice/best-practice-the-story-of-argentona/

14 McQuibban, J. (2020). The State of Zero Waste Municipalities 2020. Zero Waste Europe. https://zerowastecities.eu/wp-content/uploads/2020/12/zwe_report_state-of-zero-waste-municipalities-2020_en.pdf

15 Folli, G. (2018, February). Cheaper and more efficient? The positive effects of pay-as-you-throw and kerbside collection. Zero Waste Europe. https://zerowasteeurope.eu/2018/02/cheaper-more-efficient-pay-as-you-throw-kerbside-collection/

16 Zero Waste Cities. (2020, February). The story of Gipuzkoa, Spain. https://zerowastecities.eu/bestpractice/best-practice-the-story-of-gipuzkoa/

17 Zero Waste Cities. (2020, March). The story of Besançon, France. https://zerowastecities.eu/bestpractice/besancon/

18 Omari, H. "Dar Urban Jobs Solid Waste Market System Analysis" for DFID and UK Aid. Research provided by direct communication.

19 Allen, C. (2012, June). Prioritizing the Recovery of Vegetable Waste. GAIA. https://www.no-burn.org/wp-content/uploads/ZW-La-Pintana.pdf

20 CSIR. (2016, March). Integrating Informal Waste Pickers into the Economy. https://www.csir.co.za/integrating-informal-waste-pickers-economy

21 Auckland Council. (2018). Auckland Waste Management and Minimisation Plan 2018. aucklandcouncil.govt.nz/plans-projects-policies-reports-bylaws/our-plans-strategies/topic-based-plans-strategies/environmental-plans-strategies/docswastemanagementplan/auckland-waste-management-minimisation-plan.pdf

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22 Recycle Hawai'i & Richard Anthony Associates. (2009, March). Zero Waste Implementation Plan for the County of Hawai'i. http://hawaiizerowaste.org/site-content/uploads/3-14-09-Hawaii_Zero_Waste_Plan.doc.pdf

23 City of Austin. (2011, December). Austin Resource Recovery Master Plan. http://austintexas.gov/sites/default/files/files/Trash_and_Recycling/MasterPlan_Final_12.30.pdf

24 Greater London Authority. (2018). London Environment Strategy. Chapter 7: Waste. https://www.london.gov.uk/sites/default/files/waste.pdf

25 Omari, H. "Dar Urban Jobs Solid Waste Market System Analysis" for DFID and UK Aid. Research provided by direct communication.

26 Ethekwini Municipality. (2016, May). eTHEKWINI MUNICIPALITY INTEGRATED WASTE MANAGEMENT PLAN 2016 - 2021 (DRAFT). http://www.durban.gov.za/City_Services/cleansing_solid_waste/Documents/eThekwini%20Municipality%20Integrated%20Waste%20Management%20Plan%202016%202021.pdf?Mobile=1&Source=%2FCity_Services%2Fcleansing_solid_waste%2F_

27 Calculations based on average per capita waste generation, waste composition, ratio of different waste management options, and per tonne processing costs in four different national income-level categories. Data source: World Bank (2018). What a Waste 2.0. (data table)