CLEAN CITIES, BLUE OCEAN

Funding Options for Solid Waste Systems in Low- to Middle-Income Countries

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Acronyms and Abbreviations

3R	Reuse, Reduce, and Recycle
AD	Anaerobic Digestion
ADB	Asian Development Bank
CCBO	[USAID] Clean Cities, Blue Ocean
ESCAP	[United Nations] Economic and Social Commission for Asia and the Pacific
GC	Greenfield Crops
GSWA	Guam Solid Waste Authority
HDPE	High Density Polyethylene
ISWA	International Solid Waste Association
LFG	Landfill Gas
LDPE	Low Density Polyethylene
LMIC	Low- and Middle-income Countries
MDB	Multilateral Development Banks
MRF	Materials Processing Facility
MW	Megawatts
NGO	Non-governmental Organization
PET	Polyethylene Terephthalate
PP	Poly Propylene
PPP	Public-Private Partnership
RDF	Refuse Derived Fuel
SBC	Social Behavior Change
SWM	Solid Waste Management
USAID	United States Agency for International Development
USEPA	United States Environmental Protection Agency
WtE	Waste to Energy

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I. Introduction

On August 28, 2019, Tetra Tech was awarded the Clean Cities, Blue Ocean (CCBO) Program, a five-year, $48.7 million contract from the U.S. Agency for International Development Bureau of Economic Growth, Education, and Environment. CCBO is the Agency's flagship program to respond to the global crisis of marine plastic pollution, designed to target marine plastics pollution directly at its source in cities and towns, specifically in rapidly urbanizing areas throughout many low- and middle-income countries (LMICs). The objectives of CCBO are to:

Objective 1: Promote reduce, reuse, recycle (3Rs) and strengthen local and regional markets for recycled plastics;

Objective 2: Build social and behavior change (SBC) for 3Rs and sustainable solid waste management (SWM);

Objective 3: Increase capacity and effective governance of SWM and recycling systems; and

Objective 4: Support international fora, public-private partnerships (PPPs), and multi-stakeholder alliances.

As a cross-cutting objective, CCBO also works to support and enhance the livelihoods of those working in the waste and recycling sectors, as well as advance women's economic empowerment.

Many LMICs around the world have begun to tackle the huge task of improving 3R and SWM systems to prevent plastics from making their way into the ocean. To continuously improve the environment and the economy, national and sub-level governments must bring lagging 3R/SWM infrastructure and programs up to a set standard. Local governments often bear the main responsibility of making the changes that will improve these 3R/SWM systems; unfortunately, the funds allocated to the local governments to accomplish these goals are often insufficient. This leaves the local governments to operate their systems at a level which they can afford (potentially doing so at a substandard level) or to look to alternative ways to obtain 3R/SWM revenues to cover the full cost of their system.

The issue of improving 3R/SWM systems and identifying funding for such improvements in LMIC countries is not new. International donors and agencies have developed several forms of information and guidance for 3R/SWM system development that may lead to diversifying funding for low- to middle- income countries, including: *(1) The Asian Development Banks ISWM for Local Governments Guide; (2) The USEPA's Best Practices for Solid Waste Management in Developing Countries; and (3) USEPA's Funding Mechanisms for Waste Disposal and Recycling Programs.* Additional information may also be found in USAID's report *Revenue Management Manual for Municipalities/Cities in the Philippines,* developed under the Strengthening Urban Resilience for Growth with Equity (SURGE) Project.

CCBO believes there is a need, however, for local governments in LMICs to have specific, more tailored guidance around funding of their 3R/SWM systems that can be customized to their local circumstances and opportunities. It is envisioned that this would involve a series of resources and hands-on technical assistance:

1. **Funding Options:** Understand the potential menu of funding options that have been used by other LMIC local governments around the world and what it took for them to build new revenue sources;

2. **Local Circumstances:** Understand local need/constraints and reach out to stakeholders to identify opportunities; and
3. **Local Facilitation:** Work collaboratively across local government departments to analyze and assess a variety of funding options that could address the long-term needs of the 3R/SWM system.

The purpose of this document is to address the first item in this approach: **Funding Options**. The aim of this report is to provide local government officials and staff with information on how other local jurisdictions have addressed the issue of funding for their 3R/WSM system and to find inspiration and ideas that can be adapted to their own circumstances. It is hoped that this will enable local governments to take concrete steps toward establishing new funding that will support an economically sustainable 3R/SWM system.

2. Context and Approach for Exploring 3R/SWM Funding Options

Local governments have a responsibility to establish an economically and environmentally sound 3R/SWM system. This section provides some context for approaching ways to raise revenues to pay for the 3R/SWM systems.

2.1 Funding vs. Financing

There is no doubt that funds are needed to invest in improved or expanded 3R/SWM systems. Not all sources of monies, however, are alike. Some monies are generated by the local governments through taxes or fees (or are allocated to local governments from higher level governments) and others are loaned to the local government. Loans to local governments (especially from private investors), however, will have to be paid back – and most likely, with interest (additional cost).

The benefit of loans is that they provide the upfront cash needed to start projects that will generate net revenues in the future (to pay back the loan). Because these funds are paid back overtime in the future, however, this enables local governments to build projects without having their own money at the start of the project. This is known as **financing a project**.

3R/SWM financing is generally used for capital expenditures that build infrastructure (assets) that are often one-time purchases (landfills, recycling facilities, equipment, etc.). The costs of the loan are paid back according to a fixed (usually monthly) schedule that may span over years. The monthly payments, however, are included as operating expenses. Note, that there is a cost to financing – it creates a debt; the money needs to be paid back along with the added interest expense.

Funding refers to the source of revenue (cash flows) necessary to continue operating the local government's 3R/SWM infrastructure (operating expenditure) to consistently provide day-to-day service. These funds need to cover all the costs of operating a local government's 3R/SWM system (including the financing).

Although **financing options** may be critical to the improvement of a local government's 3R/SWM system, the purpose of this document is to focus on **funding options**. The main rationale to address funding first

is that financing is not feasible if local governments do not have adequate and reliable funds for current operations and/or paying back debt.

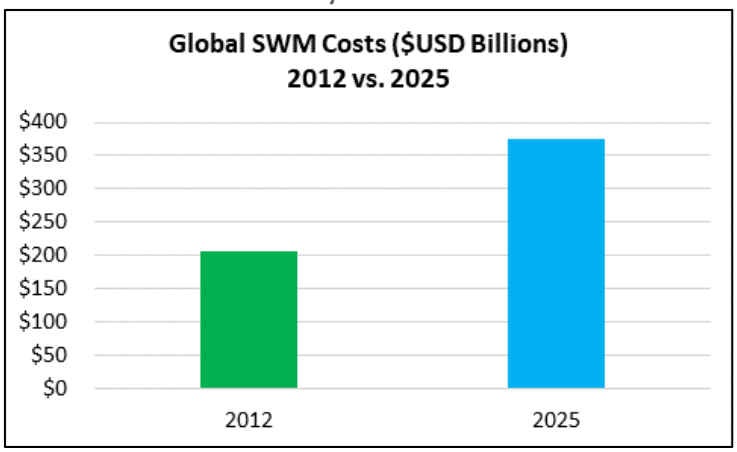
2.2 The Importance of Funding Option Planning

The dynamics and factors influencing 3R/SWM systems in LMICs can be substantial (such as population increases, packaging technology advancements, climate change, etc.). This means that regular changes to the 3R/SWM system may be the norm rather than the exception. It is likely, too, that these changes will increase the demand on the 3R/SWM system. A local government must be prepared to assess and potentially change the type and quantity of funds required to keep up with these changes. Below are some of the common reasons why preparing to increase funding is so important.

Quantities of waste are increasing - By the year 2050, the amount of waste generated within low-income countries is expected to more than triple.[1] As populations grow and the amount of waste increases, so too does the importance of having an effective and self-sustaining solid waste management system in place.[2] Unfortunately, cities and local governments face significant challenges in properly managing their solid waste infrastructure. As a result, an estimated two billion people or more currently live in areas that lack waste collection and instead rely on uncontrolled dumpsites or littering to dispose of their refuse.[3] While the World Bank states that operating essential municipal solid waste collection and disposal service requires integrated systems "that are efficient, sustainable, and socially supported,"[4] successfully accomplishing this can be expensive. For example, according to the World Bank and USAID, it is not uncommon for municipalities in developing countries to spend 20 to 50% of their budget on 3R/SWM expenses. However, this amount may only be enough to serve under 50% of the municipality's population.[5]

Costs of 3R/SWM are Increasing - Unfortunately, LMIC local governments are facing exponentially increasing costs to manage their solid waste. According to the World Bank's Urban Development and Local Government Unit of the Sustainable Development Network, globally, solid waste management costs were projected to increase from $205.4 billion in 2012 to approximately $375.5 billion by 2025 (see Figure 1). These cost increases are projected to be highest in low-income countries (more than five-fold increases)

Figure 1. Graph Comparing Global Waste Costs in 2012 to What it is Projected to be in 2025



[1] What a Waste 2.0. A Global Snapshot of Solid Waste Management to 2050. 2018 International Bank for Reconstruction and Development / The World Bank.
[2] EPA Best Practices for Solid Waste Management: A Guide for Decision-Makers in Developing Countries. October 2020. EPA 530-R-20-002.
[3] Ibid
[4] Solid Waste Management (worldbank.org)
[5] Financial sustainability in municipal solid waste management – Costs and revenues in Bahir Dar, Ethiopia - ScienceDirect.

and lower-middle income countries (more than four-fold increases).[6] Having strong and dedicated revenue sources is critical for developing nations to properly manage what will inevitably be an expanding solid waste stream.

Traditional Funding is Not Enough - In many LMICs, funding for 3R/SWM systems mainly comes from general funds that are generated through taxes that may be apportioned to local governments from higher levels of government. This creates an annual competition for budgeted funding against all other government-provided services from what may be a fixed pool of money. This can create instability because 3R/SWM operations may demand consistently increasing funds to keep up with a growing population and waste generation per capita. Most communities do not regularly look at their cost of service and annually adjust rates to reflect cost changes and needed equipment replacements or upgrades.

Stable Funding is Needed to Secure Financing - As mentioned previously, local governments may not have immediate access to the cash needed to expand their 3R/SWM. For that, they will need to finance their projects. To secure financing for 3R/SWM projects, however, local governments will need to convince investors that they not only have a worthwhile plan, but that they can assure investors that they will be paid back (perhaps with interest.) Whether appealing to private investors or international banks and Non-governmental Organizations (NGO)s, a local government needs to prove that it has a stable influx of revenues that cover current day-to-day operation expenses, and the capacity to expand these operations in order to convince investors that they are a reliable partner.

2.3 Know What Funds are Needed and When to Seek New Funding Options

New funding options that benefit the community should be considered when existing revenues or resources are either not adequate to sustain the local government's programs or constrain its ability to improve the existing 3R/SWM system. Before plans can be made to adjust 3R/SWM funding options, however, a local government must first understand what funds are needed—in other words, what it costs to operate the 3R/SWM system in its current form and estimate what is likely to be needed in the foreseeable future.

Although, this sounds like this might generally occur through the annual budget process, some local governments have multiple agencies involved in 3R/SWM or have not gone through the process of analyzing the true costs for the whole system. There are also some local governments that simply base system costs on previous year budgets or anticipated revenues.

A more accurate approach is to conduct a solid waste cost of service analysis. This cost of service analysis is a detailed accounting of all the costs associated with every aspect of a 3R/SWM system which itemizes the cost of each function undertaken to provide 3R/SWM services.

Figure 2[7] is a graphic that shows the wide variety information that a cost of service analysis explores.

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[6] What a Waste. A Global Review of Solid Waste Management. Urban Development Series Knowledge Papers. Daniel Hoornweg and Perinaz Bhada-Tata. March 2012, No. 15.
[7] Source: Geosyntec: https://geosyntec.com/pdf/solid-waste/Solid-Waste-Rate-Advisory-Services.pdf

Figure 2. Cost of Service Elements

Once the total annual costs of the system are known, this indicates the bare minimum amount of funds that will be needed to run the system. This can be compared to existing revenues and general fund allocations. If revenues and allocations are not sufficient to cover expenses, then other funding options should be explored.

This baseline analysis also has an additional purpose. The data and computer models generated from this process can support long term 3R/SWM planning, budgeting, and financing. The baseline analysis can be used as a foundation to identify the funding requirements of an optimal 3R/SWM system. This modelling should reflect a local government's 3R/SWM long-term plan. Once programmatic improvements have been determined through this process, financial estimates of the changes to any aspect of the system can be developed using the cost of service analysis approach. The estimated costs of the future system, when combined with the baseline cost estimate of the system, provides a full cost of the future system. Should current funding projections fall short of covering the costs described for the upgraded system, further exploration of funding options should be conducted.

2.4 How to Determine the Best Funding Options

There is no one definitive way that all LMIC local governments should approach funding 3R/SWM systems. Funding plans will be unique. Success will depend on the conditions and opportunities available to the local jurisdiction. Circumstances that are often factors are: political will, the economics of the local community, the expectations of citizens regarding their service levels and revenue limitations from higher levels of government. A strong funding system will consist of funding options that are a mix of those that cover all the costs of the 3R/SWM system, are enforceable through administrative or financial penalties and the majority of payers into that system generally agree that the value they receive for what they pay, is fair.

Understanding Constraints and Opportunities

Finding the right mix of funding opportunities begins with some critical understanding of constraints and opportunities that are unique to a local government's jurisdiction as described in the section below.

Constraints -

There are two categories of constraints to investigate when considering various funding options: legal authority and administrative capacity.

Pertaining to funding, the relevant legal authorities are what types of revenues a local government can generate, what rates they can charge, and penalties they can use for enforcement, as well as the financial management tools they can utilize. Lacking the appropriate **legal authority** may limit a local government's ability to raise certain revenues. In some LMICs sources of revenue and rates may be defined only by higher levels of government. Before considering potential new funding options, research should be conducted to determine what the local government is currently legally able to do and what process(es) must be used to allow these funding approaches to be put in place. Keep in mind that just because the local government does not currently have the authority for a certain funding option does not mean that it should not be considered. Understanding the legal framework and its regulations is particularly important. There may be latitude within the legal framework that enables alternative revenue generation without national government authorization.

An additional legal authority that may be needed is the ability to "ring-fence" revenues that are generated for 3R/SWM activities and may only be used for 3R/SWM expenses. Ring-fencing occurs when a portion of a government's assets are financially separated without necessarily being operated as a separate entity. To ensure the sustainability of its 3R/SWM system a local government should have the ability to establish a financial trust fund for 3R/SWM revenues to ring-fence them. This trust fund, sometimes referred to as an enterprise fund, are monies set aside from the local government's general fund budgeting process and may only be used for an explicit purpose – in this case, for 3R/SWM expenses. Once established, the local government will account for these funds separately from the general fund and debt service (capital budget).

Another constraint to evaluate prior to investigating a new funding option is the local government's **administrative capacity**. To obtain each new revenue source may require additional administrative functions that will add cost if the capacity to do that function is not currently available. When considering a revenue source, attention should be given to the additional administrative capacity that will be required to implement it. A few items that may be worth considering include adequate staffing, contracting or technology to:

- Know who (and how many) the potential payers are;
- Issue any new billing;
- Collect any new funds;
- Enforce compliance;
- Handle an appeal process; and
- Record and track data history.

If a constraint for a local government is a limit to the number of personnel it may hire, contracting out for services may be an option.

Opportunities -

A similar approach can be taken to consider opportunities to raise funds. Each LMIC jurisdiction has unique conditions or circumstances that might make choosing certain funding options easier to implement, less costly or more likely to be accepted by payers. Here are a few situations to look for:

- Could the existing waste collection fee rates be increased so that more revenues could be collected without incurring additional administration costs?
- Is there a fee system in place where those in arrears could be identified and the fees collected?
- Are there key businesses or industries with a shared interest in improving the 3R/SWM system and an ability to contribute toward this goal? Potential parties could be business districts or those that rely on tourism where a clean environment would improve business prospects.
- Does the local government control other functions (i.e., electricity, drinking water, business licensing, property taxing, etc.) where a billing system already exists, and a solid waste fee could be included?
- Are there large users of single use plastic items such as stores, and restaurants, that can be taxed on the value or use of these items?
- Is there a local demand for products that could be made from the local jurisdiction's waste?
- Are there residents or organized stakeholders whose interests support 3R/SWM improvements who could be rallied to support levying new fees or taxes?
- Does a local bank provide billing and tracking services that could be contracted for by the local government?

2.5 Political Will of Decision Makers

A key component to moving forward with any funding option is to have the political support to levy a new revenue source. Imposing additional fees can be a difficult, but necessary, task that requires commitment (and often courage) of elected officials. To support decisionmakers to embrace a new revenue source, it is important to include them in the process from the start and have them understand the value and need for the funds that will be raised so that they can champion the initiative. It is often helpful to have their key supporters present the case for funding options so that decisionmakers sense that there are members of the community that support the initiative even if not everyone is happy with the changes. In the end, any funding option will require decisionmakers' votes for approval. Without building political momentum there may be little chance of raising additional revenues.

3. Local Government Funding Options for 3R/SWM Systems

This section of the report provides summaries of potential funding options that may be considered by local governments. It is divided into two sections: 1) those **self-generated by a local government**; and 2) **third party funding**.

The options described are general but are intended to spark ideas, research, and conversations among those looking for new ways to generate revenues for their local communities. It is hoped that local governments will be inspired by the examples provided and will consider whether these options may fit their local conditions, including laws, practices, customs, and political economy.

Funds for solid waste management improvement need not come from one single source. If possible, small incremental charges from several options might generate adequate resources without unfairly impacting any segment of the community.

3.1 Self-Generated Funding Options for 3R/SWM by Local Governments

As mentioned previously, it is common in LMICs for funding that is used for 3R/SWM systems to come from the national government or sources outside the local jurisdiction. Unfortunately, these funds all too often fall short of the needs that local governments have to effectively and sustainably operate 3R/SWM systems. Therefore, local governments need to find new sources of funding that they control and can direct to 3R/SWM expenses. By generating their own revenues, local governments can have more control on the use of the funds, ensuring that funds that they support priority 3R/SWM system improvements that are needed.

This section describes a number of ways in which local governments may self-generate the funds they need. The categories for these funding options are:

- **Freeing Up Funds by Improving Existing Systems**
- **Waste System Fees and Taxes**
- **Sale of Products Generated from Waste**

Freeing Up Funds by Improving Existing Systems

Before seeking to create new funding options, a local government may be surprised to discover how much of its existing funds can be recovered based on cost avoidance measures and finding efficiencies and in the existing 3R/SWM system. These efficiencies may free up resources for implementing 3R/SWM improvement plans. By rethinking service delivery methods and focusing on customer experience it is possible to free significant resources.

- ***Cost Avoidance***

Cost avoidance, which differs from cost savings, refers to strategies that prevent a local government from spending unnecessary money in the future. Since the expenses saved using cost avoidance are usually hypothetical, they don't typically appear in documents such as a budget or financial statement. How this may apply to 3R/SWM, however, can be very significant.

As previously mentioned, 3R/SWM costs can constitute a very large portion of a local government's budget. Cost avoidance is a way of decreasing costs by lowering potential future expenses. In 3R/SWM situations, cost avoidance primarily refers to finding ways to reduce the quantity of waste that is delivered to a disposal facility. When this is accomplished, for every ton "avoided" the tipping fees (facility cost) and transportation costs are eliminated. The way to "avoid" costs is to introduce programs for diverting waste from disposal by reducing, reusing and recycling portions of the waste stream so that they never have to be transported to or tipped at a disposal facility. The money that would have been paid for the avoided

tons disposed are then available to build and develop other improvements to the 3R/SWM system that are more economically and environmentally sustainable.

Cost avoidance may also be obtained for problematic and low-value waste if greater benefits can be achieved when the low-value waste is removed. One example of this could be the benefits of limiting the use of plastic shopping bags which, if they become litter, end up clogging canals, drains, etc. leading to enormous economic costs due to flooding or in the labor and disposal required to clean these materials from waterways and drains. Cost data estimates in the APEC region for clean ups can be about $100/metric ton.[8] Policies that either ban or charge for the use of these bags have been successful in reducing the quantity of plastics that require government funds to clean from public areas. South Australia, for example, banned plastic shopping bags in 2009. Surveys showed that this resulted in a 45% decrease in plastic bag litter count from 2008-09 to 2011-12. Reductions of this magnitude could reduce local government costs for litter clean up.

Source: EcoWaste Coalition, Philippines

In 2009, a tropical storm brought heavy rains to the Philippines that caused flooding and approximately 400 casualties. Cleanups after the disaster revealed that garbage—primarily plastic bags—was responsible for blocking the drainage systems. *Source: Earth Justice, Philippines: Plastic bag bans to reduce land-based marine pollution*

Avoided costs, therefore, could be significant. Looking at what Jakarta, Indonesia budgeted in 2019 for its canal clean up unit illustrates this. In 2019, 659 billion[9] Rupiah (about $45 million USD) was budgeted for the year and about 6.5 million[10] cubic meters of waste were removed. If this quantity could be reduced by even .5% (~ 33,000 cubic meters) by eliminating shopping bags, as much as $225,000 USD could be avoided annually.

Considerations in Cost Avoidance:

- Are the costs to create the avoidance less than the avoided costs? Facility development and operation costs should be estimated with the goal to have the total cost per metric ton for waste diversion to be less than the cost per metric ton for transportation and disposal of the waste.
- Works best if large portions of high-value materials can be removed. For example, the portion of the waste streams in LMICs is usually over 50% biodegradables. These "wet" tonnages are heavy and cost more to transport (fuel costs) and dispose (tipping fee). Diverting this waste by using its as animal feed or implementing composting or anaerobic digestion projects would recognize significant cost savings which could be invested in other waste system costs.
- Cost avoidance may not be as high if a local government owns its disposal site. Transportation and operational costs might be lower. The long-term savings from a local government from owning or operating its own landfill, however, could be very cost-effective.

[8] Hwang, S.T. and Ko, J.P., (2007) Achievement and progress of marine litter retrieval project in near coast of Korea - based on activities of Korea Fisheries Infrastructure Promotion Association. Presentation to Regional Workshop on Marine Litter, Rhizao, China, June 2007. North West Pacific Action Plan.

[9] Bestari Sebut Anggaran Pengelolaan Sampah DKI Rp 3,7 Triliun, Bagaimana Faktanya? Halaman all - Kompas.com

[10] Jakarta Open Data, August 25, 2021

Expected Yield from this Funding Option:

Significant funds can be made available by using this option. The larger the quantities avoided the larger the yield will be from using this funding approach. For many LMIC local governments this suggests that targeting removal of biodegradables and redirecting it as animal feed or feedstock for composting should be considered since biodegradables are often 50% or more of the generated waste stream.

When to Consider this Funding Option:

This option should be considered when a local government has high disposal costs from high tipping fees or long transportation distances to reach their disposal site and/or can implement 3R projects at a cost that is lower than the cost per ton for transport and disposal.

Example of this Funding Option Being Used:

Assume a local government doesn't own its own landfill. It must transport its waste (30,000 tons annually) at a cost of $5 US per ton and it pays $10 US per ton tipping fee—for a total payment of $450,000 US annually. To limit this expense, it developed an integrated processing facility within its jurisdiction to handle processing of segregated waste (including biodegradables) and now diverts about 20% of the waste generated at a cost of $5 US per ton. They divert 6,000 tons of segregated waste to this facility annually. While this costs $30,000 US each year to process, it avoids $30,000 per ton in transportation and $60,000 US in tipping fees—resulting in an annual net avoidance of $60,000 US and a total 3R/SWM system cost of $390,000. This reduces 3R/SWM system costs by 15%.

	Tons	Transport	Tipping Fee	Total
Total Without Diversion	30,000	$150,000	$300,000	$450,000
Diversion Cost Avoided	6,000	-$30,000	-$60,000	-$90,000
Diversion Processing Costs	6,000			$30,000
Total Avoided Costs				**$390,000**

- ***Service Efficiency Cost Savings***

Cost savings is the process of reducing expenses without reducing service quality. This is accomplished by creating efficiencies. All aspects of a 3R/SWM operation can be evaluated for efficiency improvements (waste collection (segregated or unsegregated), transfer, transport, processing, treatment, or disposal).

To search for those areas that are most likely to yield potential efficiencies, a local government may wish to first conduct a benchmarking study of its 3R/SWM operation areas against a community considered to be using best practices for its 3R/SWM system. The government could also conduct a collection efficiency assessment.

Figure 3 provides examples of indicators that can be used in a benchmarking study and collection efficiency assessment. There are many other benchmarking questions that can be asked to narrow in on any specific operation that is suspected of benefitting from efficiencies. Because these efficiencies can be found in almost any component of a 3R/SWM system, CCBO has chosen one component to illustrate this concept: costs of collection, as these are often one of the high budget items within a 3R/SWM system.

There are many ways in which efficiencies are lost during the collection of waste. This is because the process of waste collection depends on many variables. This includes such things as whether employees start the day on time, the mode of transportation (and collection) used, the frequency of pick up, reduction of missed pickups, whether routes are efficiently determined and effectively followed, whether trucks are rented or purchased, etc.

Figure 3. Illustrative Indicators for Benchmarking Study and Collection Efficiency Assessment

- Number of fulltime/parttime workers (or hours of laborer used) in collection or specific facility operations per kilo handled annually;
- Number of enforcement officers with 3R/SWM compliance responsibilities per 10,000 in population;
- Number of households within one kilometer of each transfer site (segregated or unsegregated);
- Number of households that had waste collected each day per truck;
- Percent of fleet vehicles that are functioning;
- Number of waste collection bills processed per employee, monthly;
- Quantity of waste collected daily per truck; or
- Number of truckloads from transfer points to the disposal/processing/treatment facility.

By **following certain well-established protocols**, a local government may easily increase collection efficiencies. For example, they may re-evaluate sub-routes so that they are based on the number of stops that will fill the collection vehicle; ensure that routes follow the same path, making only right turns (if vehicles drive on the right side of the road); clearly post and provide information in multiple formats to customers so that they know what time they must have waste available for collection; and/or establish standard operating procedures and train employees to follow them.

Local governments that found efficiencies through this process and made appropriate changes reduced their collection costs. This could be in the form of reducing the number of vehicles needed or repurposing equipment to improve other aspects of the operation. Additionally, adjustments to staffing responsibilities to reduce duplication of efforts may allow more tasks to be completed with the existing workforce.

Investing in technology may also bring efficiency savings over the long term. For example: computerizing internal data recording and tracking can dramatically improve administrative functions both for billing and operations management; collection can be made more efficient using GIS and GPS technology, as well as, smart phone applications to reduce missed pick-ups and reduce time spent on the road; radio Frequency Identification Device (RFID) tagging can be used on collection bins distributed to customers to track the inventory and participation; and new sorting equipment technologies can make separation and cleaning of segregated materials more cost-effective.

Considerations in Service Efficiency Cost Savings:

To take advantage of service efficiencies as a funding supplement, time and resources will be needed (upfront) to do research such as a benchmarking study and an efficiency analysis. This investment, however, could yield significant savings for the local government. Upfront capital costs for using new technologies could be substantial and the period to regain the return on the investment should be evaluated in considering technology efficiencies.

Expected Yield from this Funding Option:

The benefits of service efficiencies to a local government will vary widely and depend on the current state of the 3R/SWM system and whether or not a local government has previously conducted efficiency analyses, benchmarking or undergone a strategic planning process that has identified efficiency/effectiveness indicators. In Guam, for example, after conducting an efficiency assessment, the Guam Solid Waste Authority reduced its number of staff from 99 in March of 2008 to 62 in April of 2010. This resulted in a 37% saving in personnel expenses, while improving productivity and increasing customer satisfaction.[1]

When to Consider this Funding Option:

Seeking service efficiencies is something that should be done by all local governments on a regular basis.

Example of this Funding Option Being Used:

Under the USAID project, Transparent Accountable Local Governance (TALG) in Sri Lanka a team worked with 33 local governments to make efficiency improvements to their waste collection and transport systems. Following a collection efficiency review, inefficiencies were discovered in the way collection routes had been established. The random scheduling and routes were so unclear that residents' waste might sit out for long periods of time (inviting animals to go through and scatter the trash before it could be collected.) They revised their routes into zones so all residences in a zone had their collection on the same day(s) of the week and scheduled the collection so that residents knew which two-hour window of their collection day(s) that their waste would be collected. This allowed people to plan when to put their trash out for collection and eliminated the scattering of the trash by animals.

This change resulted in a 40% reduction in labor costs for the same volume of collection, saved fuel cost and collection time by more efficiently using existing resources. This allowed the local authorities to refocus this labor to increase service to areas previously unserved or to other solid waste activities. The changes instituted also made an impact on the cleanliness of the neighborhoods. Residents were more willing to consider fee increases for other improvements because they saw that the local authority had acted on the results of the assessment and improved waste collection.

- ***Better Collection of Payments from Citizens***

Before imposing new fees to help fund a 3R/SWM system it is recommended that a local government conduct a review of its existing payment collection system. While many local governments have well-established systems in place to collect funds that generate revenues for 3R/SWM systems, there are cases where as many as 50% of the people simply do not pay. Whether this is for waste collection fees, property taxes or other taxes and fees, the challenge is not the need to identify a new funding option, but rather to ensure that all those that owe fees pay their fair share.

Considerations in Improving Payment Collection:

This is a relatively straight forward funding option to consider. Given that the funding system is already in place, the key is to identify the root cause of the lack of payment. Here are a few things to consider:

- Have all payers been identified? Perhaps a survey needs to be conducted of the total number of households and billing addresses. It may just be that the billing system needs to be updated to reflect increasing population and number of households.
- While new technologies can bring efficiencies, the substantial upfront costs and potential challenges in adopting these technologies might mean that there will not be a positive return on investment in the near- to mid-term.
- Have all payers been notified of what they owe? If billing notices are done inconsistently, infrequently, or verbally, there is a possibility that the notification is not reaching all potential payers. Creating a systematic approach for billing and establishing reminder notices. It may be helpful to use technology to improve administrative efficiencies. Supporting this system with clear instructions that can be readily found either in writing or online, is also helpful.
- Is it easy for payers to make a payment? Old ways may need to be revisited. For example, many local governments still require that payments be made by coming to the local government offices. This is no longer a viable option, particularly during a pandemic. Local governments should add online payments or mail-in options. Charges for solid waste could be added to existing utility bills like water or electricity, to facilitate payment.
- Are there penalties for not paying the bill? If, for example, the solid waste fees are added to an existing utility bill the penalty could be turning off that service, if payments are not made. Liens could also be imposed on the property if waste fees are included with property tax billing. It may be possible to establish a swift legal procedure (such as an administrative judge hearing) where a positive ruling on a case can be used to garnish a bank account for the past due amounts plus an administrative fee. In small locales, it could also be as simple as what one local authority in Sri Lanka decided to do – post the names of those that did not pay in the local community notice board. In fact, just the discussion of this option prompted many individuals to voluntarily come in to pay off their arrears prior to the list being posted.
- Is human error causing the problem? When workers are relied upon to collect monies during a house-to-house visitation, mistakes can be made regarding records on who has, or has not, paid. Having records that are computerized and tracking payments will bring transparency to the process and reduce errors.

Just by making some minor adjustments a local government can readily increase the level of revenues collected and reduce outstanding payments. Households have also shown an interest in increasing their willingness to pay for waste services, if they feel that the services they are provided are satisfactory. So, providing a quality service in a consistent manner is also an important consideration.

Expected Yield from this Funding Option:

The amount of funds that can be obtained using this approach will depend upon what the number of delinquent payments. If a local government can increase payers from 50% to 100%, the amount of revenues they have will be doubled.

When to Consider this Funding Option:

This option should be considered by every local government before putting new funding options in place. USAID has been very supportive of online payments of fees as a means of reducing administrative costs and improving fee collections that support municipal services. For example, under its Philippine program, Strengthening Urban Resilience for Growth with Equity (SURGE), online payment for solid waste and water

fees were initiated in three cities. These automated payment systems helped in, broadening the means by which citizens could make payments, lowering the burden of staff administration and reducing the need for traveling to local facilities to make payments. While it is believed that this also reduced arrears, the program ended before this data was examined.

Example of this Funding Option Being Used: [11]

When Guam initiated an overhaul of its 3R/SWM system in 2008, the Guam Solid Waste Authority (GSWA) was collecting waste from 15,900 households, but only 12,080 households were being invoiced for service and many were not paying. An assessment of the problem led GSWA to create a registration process to identify all customers, undertake a verification of physical addresses, create a computerized system to track collections and added new software for accurate billing. By March of 2012, the number of households being billed for service had increased to 17,000 and the number of delinquent payments had gone from 15% down to 12% (see Figure 3). By 2012, GSWA had increased its annual revenues from residential fees from $1.1 million US to $6 million US.

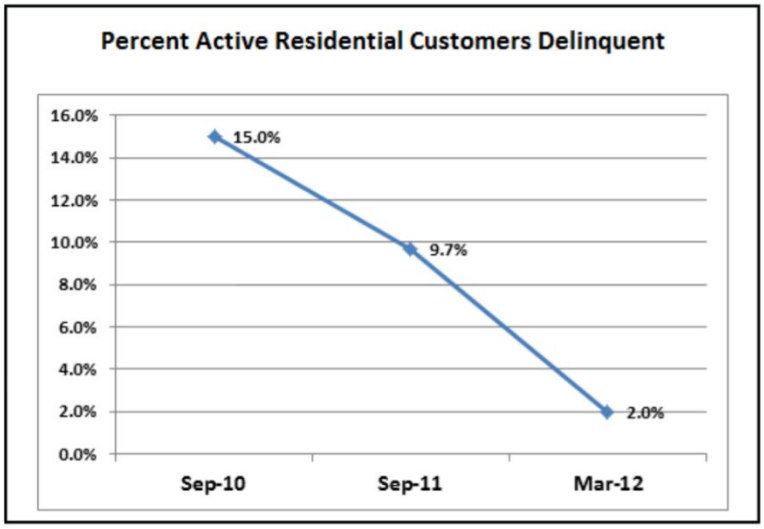

Figure 4. Decreasing Percentage of Guam's Delinquent Payers

Waste System Fees and Taxes

- ***Waste Collection Fees***

Many local governments pay for their 3R/SWM system from their general funds and not from "ring-fenced" funds that are specifically raised to pay for 3R/SWM expenses. This creates ongoing pressure to explain the need for funding and positions required for 3R/SWM. Without stability in 3R/SWM funding, it is difficult to keep up with the fiscal demands of a growing population and waste generation per capita. Using general funds also may make it less transparent to community members how much it costs to provide their 3R/SWM services.

An **alternative funding approach is to establish waste collection fees for all users of the 3M/SWM system that can adjust with the needs and show the true cost of the system to each**

[11] Quarterly Report of Receivership for the Government of Guam Solid Waste Management Division Pursuant to the Order of the United States District Court of Guam Gershman, Brickner & Bratton, Inc. Presented by Gershman, Brickner & Bratton, Inc. April 16, 2009 and July 18, 2012

user. Under this funding option, users of the 3R/SWM system are billed regularly by the local government and the money is used by government to pay for 3R/SWM costs. Monthly fees for waste collection are the most common approach to collecting revenue.

Considerations in Introducing Waste Management Fees:

This may be one of the more challenging funding options to consider, but it has great potential to cover some or all of a local government's 3R/SWM system costs. To implement this funding option, there are several issues to take into consideration. Understand, for example, that a whole new billing service may need to be established (which will have associated costs). Records may need to be improved and a computerized system be put in place.

There may also be a question as to whether the local government has the authority to impose these fees. Enabling legislation may need to be established and policies put in place to implement this funding option.

Understanding the level of willingness to pay by citizens in a jurisdiction is also an important factor when evaluating this funding option. Surveys will help to provide data to support the evaluation process. Such surveys can provide information on what citizens would be willing to pay for different levels of the service.

Determining what to charge is also a significant challenge that requires local deliberation to ensure that equity and fairness are taken into account. To be done properly this will require a rate study to be conducted. Issues to consider for the rate study include the following:

- What is the income mix of the residents?
- What is the mix of user types such as residential, business, industrial/agricultural?
- What is the mix of residential users (apartment buildings, single-family homes, townhouse communities, etc.)?
- How will ability to pay be taken into consideration?
- How should the volume of waste generated by each user type be assessed?

Once these are determined, the factors for allocation must be determined. This could be flat rates per customer or rates based on some determined feature that might be a reasonable approximation such as number of occupants, size of the structure, waste bin/dumpster size, etc.

Choosing waste collection fees as an option may depend upon availability of current data, ease of gathering the data (and maintaining it), the accuracy of the data, and the public acceptance of the methodology. Most jurisdictions use a flat rate for each residential unit. Businesses, Industrial or Agriculture customers present more difficult questions of fairness in rates. As a result, charges for these types of customers typically relate to the size of the collection container used with extra charges imposed for excess waste.

Establishing waste collection fees when there were none previously could create a significant change for local jurisdiction customers. It is likely that some opposition will arise. Local governments that have successfully established waste collection fees often engaged stakeholders in the deliberation process and held public meetings to hear concerns and address issues before finalizing their approach.

When to Consider this Funding Option:

If a local government does not currently have a waste collection fee in place, it is recommended that some consideration be given to this option. As noted previously, however, there are issues that will need to be

taken into consideration before such a fee can be successfully established. When to consider this funding option may depend more on political will than other factors.

Expected Yield from this Funding Option:

This funding option has the potential to raise significant revenues that align with a community's needs.

Example of this Funding Option Being Used:[12]

An example of a local government's waste collection fee is of Kaduwela Municipal Council (KMC) in Sri Lanka. This community determined that the general funds used to pay for its 3R/SWM system was insufficient. It was determined that a collection fee was needed to supplement its revenues and that government (institutions) and non-government (private) properties that received service from KMC should be targeted to bear the costs of their collection.

An initial survey was conducted of non-residential properties and an estimate was made of the quantity of waste generated by each customer. A charge was established based on a cost per volume of waste that would be collected.

With the imposition of these collection fees on just the private businesses and institutions, KMC was able to generate an additional 2,720,017 LKR per month. These revenues, therefore, increased the total revenues for the 3R/SWM system by 14% without increasing costs to individual residents.

- ***Facility Tipping Fees – Landfill, Transfer Station, Recycling, Compost, or Waste to Energy Facilities***

Building any kind of 3R/SWM facility is a major endeavor that is time and resource consuming. It is not surprising, therefore, that not all LMIC local governments can (or should) invest in creating them. Once the decision is made to build one, however, then it is appropriate that tipping fees be considered to create revenues to support the facility and/or the entire 3R/SWM system. **A tipping fee is a charge that is paid when a truckload of materials is "tipped," and the contents left at a 3R/SWM facility. This charge is generally based on the volume or weight of the materials that are tipped.** The amount charged is based on a number of factors that could include the cost of managing that unit of material and the value of that material to the facility management. Market forces, however, play a significant role.

When charging a tipping fee, the local government will need to open its facility to private companies or customers from other jurisdictions and depend on market forces to persuade those customers to tip at its facility. If customers have choices of alternative facilities within driving distance of the local government's operation, these facilities may compete to get the material by lowering tipping fees to gain more customers (and take them away as customers of the local government facility). In theory, any type of 3R/SWM facility can set a tipping fee (i.e., landfill, transfer station, or waste to energy, recycling, or compost facility, etc.). If tipping fees are established, a concern to keep in mind is that customers might consider dumping their loads illegally rather than pay the tipping fee. Therefore, enforcement measures are also important. Assuming that a local government's 3R/SWM facility is sited in a location with few, if any, competitors, then a tipping fee may be considered.

[12] Budget Report of KMC, 2019.

Considerations for Implementing Tipping Fees:

- Competition from other facilities that provide the same or similar services need to be taken into consideration if tipping fees are to be charged.
- One of the major considerations for this funding option is how much to charge. The local government should conduct a rate study to determine this, which evaluates the cost of facility operations, existence of competition, and other fees charged to customers.
- As noted for other options, a local government will need to ensure that laws or policies are in place that allow the local government to charge this type of fee.
- New administrative and financial systems and procedures may need to be created.
- Facility upgrades may be needed such as gate and fencing (to control access to prevent tipping without paying), scales (to accurately measure tonnage), or personnel (to track and bill for incoming loads).
- To benefit from this funding mechanism, a local government needs customers to charge. If all incoming material are loads collected by the government, charging itself will not make sense. Loads coming from outside the jurisdiction could make imposing a tipping fee viable. In this case, as long as there is little or no competition, tipping fees can raise revenues not only to cover costs, but to contribute to the costs of the rest of the waste management system.

When to Consider this Funding Option:

Tipping fees may be considered as a funding option when a local government owns/operates a landfill, transfer station, recycling, compost, or waste treatment facility where customers from outside the jurisdiction would benefit from being able to tip at the facility and are willing to pay a fee to do it.

Expected Yield from this Funding Option:

The funds that could be yielded from establishing this funding mechanism will vary depending on market competition and the need of neighboring localities for the services. A local government may wish to begin with a fee and increase it incrementally to see if by adding the fee whether volumes decrease because customers do not want to pay.

Example of this Funding Option Being Used:

The small town of Lambunao, Philippines built the first sanitary landfill in the Province of Iloilo and found a way to solve its garbage disposal problem while helping neighboring communities. Although Lambunao only generated 1.3 tons per day of waste for disposal, it built a landfill that accepts up to 15 tons[13] per day (and could continue accepting that quantity for up to 30 years). The landfill accepts waste from neighboring towns and private haulers from the surrounding población area. They charge a tipping fee to cover expenses of the landfill and provide funds for the 3R/SWM system.

- ***Host Fees for Regional Facilities***

In an integrated 3R/SWM system, specialized facilities are built to handle different aspects of the waste system. These facilities require capital funds to build, may be difficult to site and require suitably large quantities of incoming material to be economically sustainable. Therefore, multiple jurisdictions may join together to build them. **Typically, one jurisdiction is the "host" of the facility even though waste**

[13] https://www.pna.gov.ph/articles/1073875

that comes to the facility may come from outside the jurisdiction. To compensate the host jurisdiction, host fees may be obtained. These fees are generally collected by adding a small host fee to the tipping fee costs to the outside jurisdiction(s). As the host fee is collected by the operator of the facility, those funds are remitted to the host jurisdiction.

Example of this Funding Option Being Used:

In Indonesia, the Piyungan Landfill is owned by the Special Region of Yogyakarta Province and is jointly managed by the Municipality of Yogyakarta, Sleman Regency and Bantul Regency. The landfill is, however, located in Bantul Regency. To compensate for hosting the landfill, Bantul Regency was granted a reduction in its costs of contribution for operating the landfill. The Bantul Regency only pays 5% of the total cost of the landfill operation even though it is one of three participating cities, and about 30% of the waste that is managed at the site comes from their citizens. Subsequently, the Bantul Regency was able to substantially reduce its disposal costs by hosting a landfill.

- ***Hotel Occupancy Fees or Resort Taxes***

The United Nations Environment Program (UNEP) estimates that 4.8 million metric tons (14% of all solid waste) is produced each year by tourists.[14] This waste can potentially overload 3R/SWM systems, especially in island and coastal destinations that are more rural or have a low population like those often found in LMICs. Some local jurisdictions attract tourist populations that are 2-10 times that of the native population. UNEP research estimates that European tourists generate about 1 kilogram (kg) per person per day and Americans up to 2kg per person per day.[15]

Considerations in Setting Regional Facility Host Fees:

Before a regional facility is built, agreements between jurisdictions should be crafted and adopted. These agreements will define roles, and responsibilities including the oversight, financial controls, and operational logistics. To oversee the actions of this joint effort, a governing body is often formed that includes board of trustee representation from each of the jurisdictions. This board will oversee the siting of the facility and negotiate the host fee.

When to Consider this Funding Option:

A jurisdiction may decide to use a host fee as a means to fund it 3R/SWM system when:

- Its ability to finance a 3R/SWM facility on its own is very low;
- It has ample land to site a 3R/SWM facility;
- Insufficient quantities of waste make it impractical for the jurisdiction to build a facility of its own; and
- There are other jurisdictions that have expressed interest in working together as a region on 3R/SWM infrastructure.

Expected Yield from this Funding Option:

The yield from this funding option will vary. It will depend on the host fee that is negotiated and the quantity of material that is managed by the regional facility. It has the potential to be substantial and could endure for the life of the facility.

[14] McDowall, Jennifer, Managing Waste I Tourist Cities, resource https://resource.co/article/managing-waste-tourist-cities-11319
[15] Ibid

Hotel occupancy fees or resort taxes can generate revenues to cover the costs of managing this waste. Hotel occupancy fees are a charge on accommodations used by visitors. Hotel occupancy fees may be charged just for the sake of generating revenue, but they are usually termed a services fee. Such fees range between 1-15% of the total hotel bill that is paid to the operator of the property. Hotel occupancy fees may be charged by any level of government. Since local governments provide the facilities and services that support the tourism industry and the business sector, they typically implement and collect this fee to help offset the cost of collecting waste from tourism-related businesses.

Considerations in Charging Hotel or Resort Fees:

- Local governments must have or seek the legal authority to impose this type of fee or tax. Additionally, if the intention of this fee is to generate revenues to specifically improve the 3R/SWM system, then it will be important to codify the "ring fencing" of these funds so that they are only used for 3R/SWM expenses.
- Local governments will need to develop a mechanism for collecting the funds. Administrative procedures will need to be developed to collect and track the payments of the funds.
- There may be opposition from the tourism industry. It may seem appropriate that temporary visitors also contribute to municipal revenue to manage the waste they generate. Tourism, however, is a business and concerns may be raised as to whether the charges will put certain accommodations at a competitive disadvantage. It is recommended that stakeholders be included in the development of such a fee structure. Note that acceptance by the "hospitality sector" is generally higher if they are levied for specific purposes or services (such as garbage removal) in places visited by tourists. This may be possible for waste services since the tourism industry is highly dependent on the aesthetics of the environment and the community.

When to Consider this Funding Option:

This option of funding should be considered if:

- There is a significant tourist population upon which the economy of the local jurisdiction depends;
- The waste generated by hotels and resorts exceeds that generated by the general population; and/or
- There is a growing concern that the lack of proper 3R/SWM is negatively impacting the environment and the community, particularly by the operators of hotels and resorts.

Expected Yield from this Funding Option:

The potential funding from this option will depend on the number of room stays the local jurisdiction experiences annually, the total revenues generated by the hotel/resort industry and the rate of the fee or tax.

Example of this Funding Option Being Used:

Hotel occupancy fees are in use in the USA, Canada, Portugal, Spain, France, Belgium, the Netherlands, Germany, Switzerland, Italy, Austria, Slovenia, Croatia, Ukraine, Russia, and many other countries.[16] For this report, however, an example is provided of how this type of fee may be beneficial if applied to one of the CCBO's engagement sites, Phú Quốc. The Phú Quốc District is the largest island in Vietnam. The City has approximately 100,000 permanent residents and attracts an estimated two million tourists each year [17] and collects about 55,000 tons of waste per year. The average hotel room night costs 1,222,063 VND

[16] USAID, REVENUE MANAGEMENT: Manual for Municipalities/Cities in the Philippines, March 2018
[17] Kerber, Heide. "Vietnam's island Phú Quốc: What's left from the paradise?" PlastX. 21 February 2018

($55 US).[18] Assuming a hotel occupancy fee were established that placed a 1% tax for every room night, and each tourist stayed only one night, that would annually generate 24,440 Million VND ($1.1 Million US). This stable form of funding could bring the influx of revenues that the local government needs to develop a sanitary landfill and expand waste collection to the more rural communities in the jurisdiction.

- ***Property Taxes***

Property tax is paid on property owned by an individual or other legal entity, such as a corporation. Most commonly, property tax is a real estate ad-valorem tax. It is calculated by a local government where the property is located and paid by the owner of the property. It is usually collected on an annual basis. The administrative costs of revenue collection are low and relatively efficient. This section addresses property taxes as a funding option for 3R/SWM.

Property taxes are common in many parts of the world, but not necessarily by LMIC local governments. On average, property tax raises less than 1% of GDP in low- to middle- income countries.[19] In some countries, such as Vietnam and Thailand there are no annual property taxes.[20]

Since property taxes are one of the most efficient revenue collection methods, LMIC local governments may want to consider implementing this as a new tax or increasing their existing property tax rates to cover gaps in their 3R/SWM system funding. Local governments may consider "ring fencing" the revenues generated toward paying for 3R/SWM expenses. One alternative may be to establish a separate 3R/SWM fee that is collected by adding it to the property tax invoices. In this way it is not a separate tax, but simply a service fee that uses the property tax billing system as an efficient means of collection the funds.

Property tax may be an ideal source of local government revenue because it is generally regarded as a stable and predictable revenue source for local governments. This is because the tax base is geographically delimited and paid by residents with limited mobility. Additionally, property taxes are considered more efficient compared to other forms of taxes and can generate significant quantities of revenues.

Considerations Using a Property Tax for Waste Management:[21]

- Legal Constraints. The ability to raise property taxes will be highly dependent on local, provincial, and national laws, as well as political will of the local jurisdiction. Laws in LMIC may limit or prevent local governments from imposing property taxes. Authorization may be required.
- Ideal source of local government revenue. Property tax is generally regarded as a stable and predictable revenue source for local governments. This is because the tax base is geographically delimited and paid by residents with limited mobility.
- Efficiency. Property taxes are considered more efficient compared to other forms of taxes and can generate significant quantities of revenues

[18] www.momondo.com/hotels/phu-quoc
[19] Ali, Merima; Odd-Helge Fjeldstad; Lucas Katera, *Property Taxation in Developing Countries, 2017, CMI Brief,* www.cmi.no/publications/6167-property-taxation-in-developing-countries, n.d.
[20] ASIA Property HQ, Editorial Team, *4 Asian Countries with No Property Tax*, March 25, 2019, https://www.asiapropertyhq.com/asian-countries-without-property-tax/
[21] Ali, Merima; Odd-Helge Fjeldstad; Lucas Katera, *Property Taxation in Developing Countries, 2017, CMI Brief,* www.cmi.no/publications/6167-property-taxation-in-developing-countries, n.d.

- Equity. This form of revenue generation is considered a progressive tax because land and capital are owned by the middle and high earners. Care must be taken if the property tax must be paid by renters, however, since for poor households may find it difficult to pay the additional fees.
- Administration. If a new property tax is being imposed, a new billing system must be developed. Research will also need to be done to collect detailed data on properties.
- Ring-fencing. To ensure that revenues collected from property tax are used specifically for 3R/SWM expenses, ring-fencing measures must be put in place.

When to Consider this Funding Option:

This funding option should be considered if the legal authority is obtainable and there is a clear demand for improvements to the 3R/SWM system. Property tax increases may also be possible under these conditions and worth consideration.

Expected Yield from this Funding Option:

Property taxes have a high potential for collecting revenues. The key will be to secure these funds specifically for 3R/SWM expenses.

Example of this Funding Option Being Used:

While property taxes bills are used as a method to collect waste fees in low- to middle- income countries, Montgomery County, Maryland in the US was chosen as an example of this option. This government was chosen because not only does it use this method, but it transparently outlines exactly how the charge is calculated on its website at https://montgomerycountymd.gov/sws/swc/sf.html. There are several components to the waste fee and residential property owners only are charged a fee if they receive the related service. The service fees are:

- $47.34 per year for a tipping fee disposal charge (all single-family properties);
- $38.07 per year for a systems benefit charge (all single-family properties);
- $159.37 per year for incremental systems benefit charge (all non-municipal single-family properties) for such services as collection of segregated wastes (paper, containers, yard waste);
- $117.00 per year for collection of unsegregated waste and bulky waste pick-up (households in the county collected district); and
- $116.46 per year for leaf vacuuming services (households in areas where this is performed).

If a household received all these services, a line-item Solid Waste Charge of $478.24 could be found on the property owner's tax bill and would have to be paid along with the property tax. If not paid, the homeowner may have a lien placed on the property for the unpaid amount.

Sale of Products Generated from Waste

There is potential revenue from the sale of segregated materials and from products that can be made from waste. This section will explore these approaches as a funding option by looking at revenues that might be generated at each of the various 3R/SWM facilities that a local government may own and operate.

- ***Compost Facilities – Sale of Compost***

Local governments can use proceeds from the sale of compost as a dedicated source of funding to offset their solid waste management costs.[22] In most low- to middle- income countries, biodegradable waste accounts for more than half of the solid waste stream. To take advantage of this resource, local governments can use this organic waste to create compostable materials that can be sold to generate revenue and help supplement the cost of their 3R/SWM system. This, in turn, prolongs the life of the disposal site, reduces collection and disposal costs and has the added benefit of improving long-term land value and crop production.

Composting produces a commercial product that is a soil amendment that may have value as a revenue source. Organic waste, when properly composted creates valuable products that communities can either use to supplement their own fertilizer products or sell for financial gain in an open market system to various stakeholders.

Local demand for compost may come from plantations, farms or construction projects. If there is a limited demand for compost from end users, there are certain options that the jurisdiction can consider to reach the most customers. For example, the jurisdiction can sell their compost to fertilizer companies that can market or combine the product with other products. They can also work with the national government to create an environment that increases compost demand. This can include adopting nationwide quality standards or mandating purchase by fertilizer companies. [23]

To ensure that the value of the compost reaches its highest potential, it is imperative for jurisdictions to obtain feedstock that are pure biodegradable waste streams to make its compost (i.e., from produce markets). Note that biodegradable waste from households may contain more contaminants than from the produce markets. The price for compost will also depend on the price of competing materials in the area. Consider what is known as "geographical pricing," which relates to the market's distance from the manufacturer. For compost products, it is recommended that the maximum sales radius should be 50 miles (81 km) for bulk and 200 miles (322 km) for bagged transport.[24]

Considerations in Selling Waste-Derived Materials:

If no compost facility currently exists, the cost of developing a composting facility must be considered. These facilities can range from very basic hand-turned operations to mid-range facilities that use mechanical equipment to turn compost piles (i.e., front end loader). More sophisticated (i.e., 200 tons per day) operations might use equipment such as a windrow turner and be hard surfaced which could cost a few million in US dollars to build, whereas highly mechanized composting facilities can cost as much as $10 million US dollars.[25] Before implementing compost, local governments should first consider costs and expected revenues. According to the United Nations, low-income countries can expect to spend between $5 and $30 US dollars per metric ton to manage material by composting. This is comparable to the cost to dispose of material by landfilling which ranges from $10 to $20 US dollars per metric ton. The same is true for lower middle-income

[22] EPA. Best Practices for Solid Waste Management: A Guide to Decision-Makers in Developing Countries. October, 2020. EPA 530-R-20-002.
[23] Ibid.
[24] THE PRICE IS RIGHT: How To Sell Your Compost | Waste360
[25] What a Waste 2.0. A Global Snapshot of Solid Waste Management to 2050. 2018 International Bank for Reconstruction and Development / The World Bank.

countries where the cost to dispose of material by compost ($10-$40 US dollars per metric ton) is similar to that of landfilling (($10-$40 US dollars per metric ton).

Therefore, it is important for local governments to understand the composting infrastructure or infrastructure needs, and the cost comparison of composting vs. other disposal methods, before considering appropriate funding mechanisms. [26]

When to Consider this Funding Option:

Organic waste management strategies such as the sale of compostable materials is a feasible option to help offset the cost of collecting and processing organic materials in most developing nations. In general, developing compostable material for sale as a funding option should be considered when (1) the host jurisdiction has its own composting site (or will purchase one); and (2) when markets and customers exist for the sale of material to be sold. These potential customers can include: (a) the general public; (b) conventional and organic farmers, (c) landscapers; (d) nurseries; and (e) even the municipal entity themselves (for parks, roadsides, public spaces, etc.).

As a pretext to composting and the sale of material, the World Bank encourages communities to accurately estimate their upfront operational and maintenance costs. Many composting projects are unsuccessful because communities underestimated operational expenditures or revenue sources that are too optimistic. To use this approach as a funding option, a jurisdiction needs to know if the sale of the compostable material is enough to offset these costs.

Expected Yield from this Funding Option:

The sale of compostable material will depend on many factors as described in this report. This includes the composting technology used, the quality of the compost product, the size of the composting facility and the price of competing materials, among other market driven forces. As an example, a financial sustainability model of composting plants conducted in Asia[27] looked at three types of compost facilities – small, medium and large – to determine the economic value of products sold from each. It found that for a small-scale composting facility (in Matale City, Sri Lanka), the plant had an organic waste input capacity of 1 ton per day and could sell the product for $180 US dollars per ton at the market because of the certified high-quality compost material. A medium composting facility located in Bali, Indonesia, that can receive 60 tons per day, could sell its product for $106 US dollars per ton at the retail market, or for $53 US dollars per ton in bulk. Lastly, a large-scale composting facility located in Bekasi, Indonesia that could receive 200 tons per day, could sell its product for approximately $106 US dollars per ton as well. These expected yields will vary by region and country and should only be used as an example of recoverable costs.

Example of this Funding Option Being Used:

La Pintana, Chile, a suburb located in southern Santiago Province with a population of 182,600[28] , conducted a waste characterization study that determined that vegetable waste contributed the largest portion of the city's overall solid waste stream. In order to manage this waste appropriately, the government implemented a composting program which was built on existing infrastructure and resources. Residents of La Pintana received a 35-liter (9-gallon) bin to place the organic waste into, with local people within the environment field conducting door-to-door outreach campaigns to teach residents how to properly sort out their food waste.

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[26] Ibid.

[27] Financial sustainability of modern composting: the economically optimal scale for municipal waste composting plant in developing Asia | SpringerLink

[28] The Organisation for Economic Co-operation and Development (OECD). Chile's Pathway to Green Growth: Measuring progress at the local level.

The system for collecting the separated waste was built on existing collection routes, and therefore did not increase the number of waste collection trucks or the subsequent transportation and fuel costs. The collected vegetable waste is transported to a treatment facility to be composted. This facility includes a compost area that can process about 18 metric tons (20 tons) of waste per day and a vermiculture area (a composting process that relies on worms to degrade the biodegradables) that can treat an additional 18 to 20 metric ton (20-22 tons) of waste per day.

Approximately 35 metric tons (39 tons) of vegetable waste are collected from households and street markets around La Pintana on a daily basis. The organic waste that is diverted from the local landfill saves the city approximately $832 U.S. dollars (2021 equivalent) per day in transportation and disposal costs. Just as importantly, the compost produced by the vermiculture process can be sold for $40 U.S. dollars per kilogram. The new organics management system in La Pintana now operates at a lower daily cost than the former system which included landfilling all waste, thereby saving La Pintana a significant amount of money while generating much needed social and environmental benefits. [29]

- ***Recycling Facilities – Materials for Processing, Upcycled Products***

Management of segregated waste is sometimes referred to as recycling. Recycling is the collection and processing of materials that otherwise would have been discarded and instead turning those materials into new products. Local governments should advocate for recycling programs within their communities since recycling diverts useful material from being disposed of in landfills while at the same time providing a dedicated source of income for workers and a revenue stream for the community. [30] This section focuses on **the sale of recyclable non-biodegradable commodities** as a funding mechanism.

According to the World Bank Group,[31] the percent of materials managed by recycling varies by region – from 33 percent in North America to nine percent in East Asia (and the Pacific Islands), five percent in Latin America (and the Caribbean) and five percent in South Asia. In many countries, segregation of wastes may fall into two categories: biodegradable (e.g., food waste, marketplace scraps, yard trimmings) and non-biodegradable (which usually includes plastics, glass, metals, and paper (despite this technically being biodegradable.)

Local governments bear primary responsibility for funding community recycling programs as directed by national and sub-national laws. These programs, however, add costs since many require expanding the staff and using separate receptacles and collection vehicles.[32] Because of the value of certain wastes, jurisdictions can cover some of the costs of their program by selling valuable materials collected or processed into the marketplace. The larger the quantity of segregated waste the local government can divert into the recycling value stream, the greater financial and environmental benefit can be found. Furthermore, increasing the quality and quantity of valuable wastes increases the market power of a local government by creating the conditions to command higher prices for the material.

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[29] EPA. Best Practices for Solid Waste Management: A Guide to Decision-Makers in Developing Countries. October, 2020. EPA 530-R-20-002.
[30] Integrated Solid Waste Management for Local Governments. A Practical Guide. Asian Development Bank. 2017.
[31] What a Waste 2.0. A Global Snapshot of Solid Waste Management to 2050. 2018 International Bank for Reconstruction and Development / The World Bank.
[32] Integrated Solid Waste Management for Local Governments. A Practical Guide. Asian Development Bank. 2017.

Keep in mind that diversion of segregated materials can also be considered a cost-avoidance mechanism for jurisdictions, since it diverts material from taking up much needed landfill space, reduces transport and may help the jurisdiction avoid landfill tipping fees.

It is critical for jurisdictions to ensure that they have a clean (free of contamination) recyclable materials stream to obtain the best price for commodities. Knowing the best price that a jurisdiction can obtain from the sale of commodities such as segregated paper, cardboard, glass, metals, and plastics will help in planning operational costs. For example, the global market for recyclable plastic is expected to grow from $26.5 billion in 2020 to $34.4 billion by 2025. There is a huge appetite for certain recycled plastics (mainly polyethylene terephthalate (PET) and high-density polyethylene (HDPE)). Vietnam, Malaysia, South Korea, Japan, Indonesia, Thailand, and many other countries already have facilities to produce recycled pellets and sell them back to the Chinese market.[33] [34] Therefore, focusing collection efforts on plastics (especially PET and HDPE) can be valuable for a jurisdiction. For example, HDPE prices in Southeast Asia were trading around $1,060/metric tons in July of 2021.[35]

While sales may not cover all the expense for recovering recyclable waste, it can bring local governments a steady and important revenue stream. For example, a World Bank study showed that only 28 percent of PET, HDPE, density polyethylene (LDPE), poly propylene (PP) and other key plastic resins were recycled in the Philippines in 2019. The same study estimated that the lack of plastic recycling infrastructure costs the Philippines an estimated PH $890 Million (US $17.8 Million) in lost income annually when recyclable plastics are discarded into landfills or as litter instead of being properly recycled.[36]

Considerations in Selling Recyclables:

When markets are strong, net revenues from the sale of recyclable materials can be a considerable source of revenue. Communities that have a revenue sharing agreement with local processers can make money on the sale of recyclables collected via curbside or drop-off programs. The sale of recyclable materials can also provide an incentive for communities to maximize not only the quantity of recyclables recovered, but also the quality of the materials (as processors pay more for cleaner loads). Revenues can be volatile, however, and are market dependent, making it difficult to rely on a steady revenue stream. However, in most instances, the sale of recyclables, even with the combination of user fees, etc. will not cover the cost of a jurisdiction's segregated waste program.

When to Consider this Funding Options:

Non-biodegradable recyclable materials comprise a substantial fraction of waste streams, ranging from 16 percent paper, cardboard, plastic, metal, and glass in low-income countries to about 50 percent in high-income countries. [37] So, for low- to middle- income countries, there is some opportunity to process this

[33] The fourteenth meeting of the Conference of the Parties to the Basel Convention adopted amendments to Annexes II, VIII and IX to the Convention with the objectives of enhancing the control of the transboundary movements of plastic waste

[34] Global Plastics Recycling Markets Report 2020: China and Some Other Countries have Quickly Recovered from the Pandemic - ResearchAndMarkets.com | Business Wire

[35] There's a Massive Arbitrage Opportunity in the Plastics Market - Bloomberg

[36] World Bank report: Lack of plastic recycling costs PH $890M a year in potential income | Inquirer News

[37] What a Waste 2.0. A Global Snapshot of Solid Waste Management to 2050. 2018 International Bank for Reconstruction and Development / The World Bank.

material for sale. In more wealthy areas, local governments may be able to charge for the proper collection and transportation of this waste stream.

Gaining the benefits of using the sale of recyclable commodities as a funding mechanism is most successful with a dedicated and consistent education and outreach effort to increase quantities aggregated and reduce contamination. This, combined with strong enforcement actions and local stakeholder support, is key to a successful program. If the community already has a facility to aggregate and/or process recyclables in place (such as a Material Recycling Facilities (MRF)), there is greater potential for increased volumes of recyclables, leading to increased revenue, in addition to the potential for host fees charged to the private sector.

Having local governments take on the responsibility of centralizing the processing and sale of recyclable waste can have benefits beyond the need for revenues. For example, with the support from the USAID CCBO program, the government of Parañaque, Philippines recognized the need to enhance its material processing facility (MRF) operations that will support recycling of plastics and increase diversion of recyclable wastes from going to landfills. This facility is expected to generate revenue and employ people from the locality. The city government, thus, signed an agreement with CORA to jointly implement the CCBO-supported Circular Center project in Parañaque City. CCBO plans to provide equipment such as the MRF manual sorting line equipment to improve efficiency in segregation.

Also, CORA has signed offtake, waste recovery, and sales agreements of recyclable materials with businesses, i.e., Jollibee Foods, SM Supermalls, PARMS, Sentinel, and others. These partnerships, through feedstock agreements, will help guarantee a steady flow of materials to the Parañaque MRF/Circular Center, ensuring enough high-quality material to cover fixed operating costs, de-risking investment, and addressing the desire to demonstrate an investible small business model.

Example of Funding Option in Use:

Panaji is the capital of the state of Goa in southwest India with a population of 115,000 in the metropolitan area. After the city's only landfill was closed in 2005, the city turned to sustainable waste management practices. In 2017, it was estimated that Panaji generated approximately 50 metric tons of waste per day. Residential waste is segregated into five streams through a distinct system of colored bins.

This includes (1) green bins for wet waste; (2) black bins for glass and metals; (3) pink bins for paper and cartons; (4) orange bins for plastics; and finally (5) white bins for nonrecyclables.

The City Corporation of Panaji provides door-to-door collection of waste, with wet waste being collected from households daily, and dry waste collected twice per week. After collection, the city's dry waste is stored and aggregated at one of 12 sorting facilities. From there, the material is further segregated into 20 different streams at one of two processing MRFs. Each day, approximately 4 metric tons of dry waste is sent to a cement processing plant in Wadi, Karnataka for use, and another 3 metric tons of recyclables are auctioned to brokers and vendors. In 2016 alone, about US $22,000 in revenue was generated from the sale of recyclables which was used to help fund the city's SWM system. [38]

- ***Landfill Sales – Biogas, Electricity***

Local governments may establish a landfill to provide a sanitary means of containing waste. To have a landfill is to provide a service to the jurisdiction. While this service comes with considerable expense, there are revenues that can also be generated from having this asset. **Revenues may be generated**

[38] Ibid.

from the sale of biogas and the production of electricity that can contribute as a funding option to a local government that owns a landfill.

As a byproduct of operating a landfill, biogas, also known as landfill gas (LFG), is formed when the biodegradable waste within it degrades without the presence of oxygen. If captured, the LFG can become a small but important component of generating revenues from operating the landfill. This is especially significant given that the use of landfills continues to remain the predominant method of solid waste disposal in most countries.[39] An additional benefit of recovering landfill gas is that it is the preferred method for controlling emissions associated with the release of methane or other potent greenhouse gases from the decomposition of waste into the atmosphere. This LFG when captured can be cleaned and the methane sold on the open market or used in generators to produce electricity. LFG systems that collect and convert methane gas into energy can be sold to the electricity transmission network (or grid) to generate revenue while also being used to power in-house operations. Any local government which owns a landfill is encouraged to research the current local sale prices for LFG and electricity ($kw/hr.) and to consider using the sale of these byproducts to help fund their 3R/SWM system.

Considerations in Capturing and Selling Landfill Gas:

The feasibility of installing an LFG recovery system depends on a number of factors including gas generation rates and the availability of end-users for the sale of the product. There are several different landfill types with varying gas production rates that can potentially support energy recovery projects. Energy recovery of LFG can be implemented by use of either combustion- or non-combustion (which is not widely in use) technologies. Combustion-based technologies recover energy using internal combustion engines, gas turbines, boilers, and process heaters. These technologies combust the landfill gas to produce electricity which can be sold to the power grid or be used to meet the power needs of existing structures at the landfill.[40]

There is a lot to consider before investing in the necessary infrastructure needed to obtain revenues from LFG. A local government, for example, should first assess the financial viability of an LFG energy project before undertaking this option as a funding mechanism. This includes evaluating and understanding local and state policy drivers and financing mechanisms. Assessing the value of an LFG project is the first step to determining its financial capability.

In general, the World Bank[41] recommends three steps (right) to be performed to evaluate the potential for an LFG collection system before undertaking the design of such a project. If the initial technical and financial feasibility assessments conclude that the LFG project can meet stakeholders' environmental and/or financial goals, while producing electricity that can be sold on the open market, the next step is to consider equipment to capture LFG and potential customers for the sale of the energy.

[39] International Best Practices Guide for Landfill Gas Energy Projects. U.S. Environmental Protection Agency and the International Solid Waste Association. 2012.
[40] ATSDR - Landfill Gas Primer - Chapter 5: Landfill Gas Control Measures (cdc.gov)
[41] Financing Landfill Gas Projects in Developing Countries. World Bank Group and Climate and Clean Air Coalition. Claire Markgraf and Silpa Kaza. September 2016, No. 23.

According to the International Solid Waste Association (ISWA), electricity generation from LFG accounts for the majority of LFG energy projects around the world. Both internal combustion engines and gas turbines can use LFG as a fuel source. Standard internal combustion engines are better suited for small or mid-sized projects, while gas turbines are more appropriate for larger projects. The electricity generated from the gases can be used to self-power on site facilities and operations, or in most cases, sold to the local electricity grid for a dedicated revenue source. [42] Energy sales from an LFG collection system include revenue from the sale of electricity, steam, gas or other derived products (i.e.., carbon credits and/or renewable energy credits). The markets for the sale of LFG products are most likely to be direct sale to electrical utilities, industrial facilities, commercial or public facilities, and fuel companies. [43]

A **technical feasibility assessment** to determine the quality and quantity of gas available over an extended time frame and to find best markets for the sale of gas and potential gas usage.

↓

An **initial financial feasibility assessment** that provides likely costs and revenues from the sale of gas and potential assistance that might be available.

↓

A **detailed financial and economic study** that provides cost estimates, financing options, and payback time frames.

When to Consider this Funding Option:

Electricity generation can be a lucrative use of LFG, as long as there is both demand and sufficient capacity within existing utilities to accommodate this energy source.[44] Local governments will need to assess the best opportunities for installing a LFG energy collection system, based on their own unique circumstances. According to the United States Environmental Protection Agency (US EPA) and the ISWA, market drivers and the price paid for electricity will vary by country and region. It is up to the local government to understand electrical rates paid by utilities for LFG. Therefore, the demand for renewable energy and the cost-competitiveness to other energy sources should be compared during the initial planning stages of an LFG energy project.[45] This will help ensure that the most cost-effective combination of revenue sources can subsequently be harnessed while supporting a wide range of national and local sustainability goals.

Example of this Funding Option Being Used:

In the City of Santiago, Chile, 4 million cubic meters of biogas is recovered for residential use on average every month from sanitary landfills. This biogas has a calorific power of more than 5,000 kcal/m3. The biogas recovered is mixed with oil gas and distributed to the city through a network of pipes for domestic consumption. The sale of the gas covers 40 percent of the total demand for this fuel type. The landfill sells the biogas to the local gas company at a rate of US $1.25 per million Kcals.[46]

The Barycz Landfill located in Krakow, Poland is another example of a successful LFG energy production. The LFG collection and utilization project were financed by the landfill owner and operator as well as the Instrument for Structural Policies for Pre-Accession (ISPA)/Cohesion Fund. Before construction began, a feasibility study at the landfill was conducted to recommend a design for the LFG collection system and analyze electricity markets. The combined generating capacity of the four internal combustion engines was 1.3 megawatts (MW) with an average output of 1.0 MW. As of 2012, about 600 cubic meters per hour (m^3 /hr) of LFG with a methane content of 55 percent was being produced from more than 3.4 million

[42] International Best Practices Guide for Landfill Gas Energy Projects. U.S. Environmental Protection Agency and the International Solid Waste Association. 2012.
[43] Ibid.
[44] Financing Landfill Gas Projects in Developing Countries. World Bank Group and Climate and Clean Air Coalition. Claire Markgraf and Silpa Kaza. September 2016, No. 23.
[45] International Best Practices Guide for Landfill Gas Energy Projects. U.S. Environmental Protection Agency and the International Solid Waste Association. 2012.
[46] WTE INDUSTRY IN LATIN AMERICA (unhabitat.org)

megagrams (3.75 million tons) of waste decomposing within the landfill. The Barycz Landfill sells the corresponding electricity, and the associated Green Certificates, which produce 280 Polish Zloty – or approximately $80 USD per megawatt-hour. In addition to the sale of the conventional electricity, waste heat from the engines is being used to heat existing structures within the landfill.[47]

- ***Waste to Energy Facilities – Biogas, Electricity***

Waste-to-Energy (WtE) commonly refers to treatment technologies that convert waste into either electricity, fuel, heat, or other materials. According to the United Nations, approximately 15 percent of all waste disposed globally is treated by incineration with energy recovery (while another 1.2 percent is treated by incineration but without energy recovery).[48] These facilities combust waste at high temperatures to produce steam for electricity and/ or heat generation in a boiler or steam turbine. There are various types of WtE technologies, including direct combustion (incineration), pyrolysis, gasification, and anaerobic digestion (AD). Direct combustion, gasification, and AD can all produce power. While incineration and gasification technologies are similar, the energy product from incineration is high-temperature heat whereas the energy product from gasification is combustible gas.[49] This section focuses only on direct combustion and gasification technologies with the purpose of energy recovery for sale with a separate shorter analysis at the end on waste fuels for cement kilns and pyrolysis as a fuel source.

Considerations in Implementing Waste-to-Energy (WtE):

Energy recovery for sale as a power source can be an integral part of a local government's solid waste management system. According to solid waste management hierarchies that have been adopted by many countries, however, source reduction, reuse and recycling strategies should be considered before implementing energy recovery as an option, unless all three strategies are implemented at the same time.[50]

For direct combustion facilities, the heat produced from burning waste can be used to generate steam, which then is used to power a turbine that produces electricity. The typical range of net electrical energy that can be produced is approximately 500 to 600 kWh of per metric ton of waste incinerated. Gasification on the other hand, does not produce energy from waste via direct combustion. Instead, waste, steam, and oxygen are fed into a gasifier where heat and pressure break apart the chemical bonds to form syngas.[51]

Both direct combustion and gasification have the ability to produce electricity from waste. The costs to construct and maintain these facilities, however, are high. It should be noted, though, that compared to traditional disposal sources such as landfilling, the long-term operational costs of a WtE plant can be partially offset from the sale of electricity itself or by other funding options describe in other sections of this document.

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[47] International Best Practices Guide for Landfill Gas Energy Projects. U.S. Environmental Protection Agency and the International Solid Waste Association. 2012.
[48] EPA. Best Practices for Solid Waste Management: A Guide to Decision-Makers in Developing Countries. October, 2020. EPA 530-R-20-002.
[49] incineration(1).pdf (sustainable.org.za)
[50] EPA. Best Practices for Solid Waste Management: A Guide to Decision-Makers in Developing Countries.
[51] incineration(1).pdf (sustainable.org.za)

When to Consider this Funding Option:

Local governments should carefully consider if energy recovery for sale is the right option for their specific community. It is important to consider the following components: (1) the type of facility needed (direct combustion, gasification, etc.); (2) the cost to construct and maintain the facility; (3) the underlying waste stream itself (i.e., wet vs dry); (4) the estimated tonnages the facility will be able to receive and process on an annual basis; and (5) the expected revenue from the sale of electricity.

An important consideration is that a large-scale modern thermal WtE plant (considered here to be combustion with energy recovery) will require at least 110,000 tons of waste[52] per year (with a moisture content of less than 20%) over its lifetime to remain operational in a cost-effective manner with the calorific value of waste averaging a minimum 7 megajoules per kilogram[53] (MJ/kg). While WtE facilities can be made partially self-sufficient from a combination of tipping fees and electricity sales, it can take many years for a facility to become profitable. In many circumstances, the revenue from energy production will not be enough to cover operational costs as electricity prices can fluctuate unexpectedly.[54] Because of the high moisture content of waste in many low- to middle- income countries, WtE may not be suitable without specific pre-treatment such as pre-drying which could add considerable cost to the project.

Expected Yield from this Funding Option:

In most cases, **income received from the sale of energy is insufficient** to cover the full investment and operational cost of a thermal WtE plant.[55] The sale of electricity, however, can still be used to offset some of these costs. The table below provides a general example of the capital and operating costs for a thermal WtE facility in a developing country and the expected revenue from the generation and sale of electricity. The estimate assumes an incineration capacity of 165,000 tons (150,000 metric tons) per year with the plant having basic combustion technologies, including one furnace line.

Table 1. Estimated Costs of Thermal WtE Plants in Low- to Middle- Income Countries (in million US Dollars)[56]

	Capital Costs	Operational Costs	Total Costs	Revenue from Energy Sales	Costs to be Covered
Developing Country	26-65	24-41	50-106	2.4-12 (electricity)	47.6-94

Source: United Nations Environment Programme

As Table 1 indicates, the revenue received from the sale of electricity can be expected to offset between 1 and 11 percent of the total capital and operational costs. Revenue received from the sale of energy, however, will vary and as noted above, should first be studied to determine electric rates in your area, markets, utility composition and other key factors.

[52] Waste to Energy. Considerations for Informed Decision-Making. United Nations Environment Programme, 2019.

[53] Ibid.

[54] EPA. Best Practices for Solid Waste Management: A Guide to Decision-Makers in Developing Countries. October, 2020. EPA 530-R-20-002.

[55] Waste to Energy. Considerations for Informed Decision-Making.

[56] Original amounts provided in Euros. Re-calculated to show U.S. Dollars.

Example of this Funding Option Being Used:

Ankur Scientific constructed a pilot WtE plant in Vadodara India, using gasification technology to generate power for sale**.** The feedstock that can be used in the gasifiers are yard waste, paper, cardboard, textiles, plastics, leather, and agricultural residue, among others. The pilot plant setup has been in operation for over 2 years and the power generated is used by Ankur's gasifier manufacturing unit. Based on the success of the pilot plant, an innovative technology was commercially launched demonstrating the suitability and viability of the technology for decentralized and distributed applications. Ankur Scientific conducted an indicative economic analysis of its gasification technology for a small city or town generating approximately 50 tons per day of dry wastes. It found that the net income from sale of power could be $520,368 annually. [57]

Refuse Derived Fuels for Cement Kilns

There is significant interest from local governments to actively reduce the amount of waste entering landfill disposal sites. One method is to process materials into refuse derived fuels (RDF) for industrial machinery, such as in cement kilns. Compared with regular waste, RDF can be of higher calorific value, which ultimately enables higher efficiency in the WtE process. As a result of its high operating temperatures (about 2,640°F) and energy-intensive nature, cement kilns can use RDF as a co-fired fuel source without needing much (or any) sort of modification to its operating system.58

Using waste derived fuels (i.e., plastics, tires, regular waste, etc.), as opposed to coal or other fossil fuels, to power cement kilns reduces emissions and eliminates waste that would have otherwise been landfilled at a cost to the community. The need to move towards a circular economy has led waste generators and the cement industry to utilize the entire value chain from waste as a resource to power these devices. A major advantage of managing waste in cement kilns is that they already exist (i.e., no need for construction or financing), are very tolerant to the waste composition of materials in many countries, and have been proven to be economically viable, especially where tipping fees are high.[59]

As of 2015, there were an estimated 5,670 cement plants operating across the globe. These plants have the ability to provide local governments with economically viable solutions to manage waste. In the same year, it was estimated that the total cement industry worldwide used over 110 million tons of waste derived materials in cement kilns. This amount is only about 20 percent of its current potential.[60] Because a typical cement kiln can use as much as 12 tons of coal (or other fossil fuels) hourly to make cement,[61] using waste in its place can help local governments manage materials that otherwise would have had to be landfilled, subsequently saving disposal fees and making it a more environmentally viable option.

According to the Asian Development Bank, "RDF facilities can be economical at relatively small sizes upward of around 100 tons per day, compared with a mass burn waste-to-energy facility which usually requires at least 500 tons per day to be economical."[62] However, there are concerns relating to the use of RDF. Some of these concerns may include a lack of emissions standards from kilns in developing nations, as

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[57] Waste to Energy in the Age of the Circular Economy. Compendium of Case Studies and Emerging Technologies. November 2020. Asian Development Bank.
[58] Integrated Solid Waste Management for Local Governments. A Practical Guide. Asian Development Bank. 2017.
[59] Cement Kilns: A Ready Made Waste to Energy Solution? | Waste Management World (waste-management-world.com)
[60] Ibid
[61] 3 BIG REASONS CEMENT KILN REFINERY WASTE DISPOSAL IS BEST (cadenceenvironmental.com)
[62] Integrated Solid Waste Management for Local Governments. A Practical Guide. Asian Development Bank. 2017.

well as the potential for chlorine to negatively impact cement clinkers. [63] Local governments who choose to implement RDF should first conduct a cost benefit analysis before proceeding.

Waste Fuels for Pyrolysis

Pyrolysis is the decomposition of organic materials using heat to produce oil, carbonaceous char, and combustible gases. [64] The operational performance of a pyrolysis plant will depend on both feedstock composition and the moisture content.[65] Pyrolysis offers an alternative to incineration/combustion and landfilling.

In terms of a fuel source for electricity sales, a 100 ton per pyrolysis plant (with an average calorific value of 8-9 MJ/kg) can generate between 2 and 2 and a half MWh of electricity. Additionally, heat from steam can be sold to external customers as a revenue source.[66]

It should be noted that industrial wastes can be added to the processing stream at a pyrolysis plant. This includes items such as waste tires, plastics, wood waste, and medical waste.[67] In both developed and developing nations, pyrolysis is not widely used as a waste treatment source, and information (including successful case studies) are limited. Accordingly, many of the projects that have been developed are still in their pilot stages.

According to the World Bank, some of the challenges that local governments can expect to find are low energy production (due to the amount of energy required to power the process), difficulties in optimization the waste, and operational safety concerns. [68] Local Governments that wish to consider pyrolysis as a disposal and revenue generating option should consider the various waste stream types available to them and the cost to develop such a facility.

A local inventor from Yatiyantot, Sri Lanka had invented a method for converting plastic and polythene into usable diesel fuel. The CEA under the Environment Ministry quickly drew up plans to begin with a 60% investment. (NASSL, 2017). Moratuwa University offered assistance to develop the technology and the Treasury of Sri Lanka has provided the inventor with nearly LKR 92 million for this project (known as the "Polipto" project. The facility has been able to produce 1000 liters of fuel per day. The facility is currently seeking a waste license and registration to operate commercially.

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[63] Ibid
[64] Ibid.
[65] Large-scale waste pyrolysis plants
[66] Ibid.
[67] Ibid.
[68] Integrated Solid Waste Management for Local Governments. A Practical Guide. Asian Development Bank. 2017.

3.2 Third Party Funding Options

This section describes four additional options, which are not often used, that local governments can explore to help fund their solid waste management system:

- **Multilateral development banks** (MDBs);
- **Non-governmental organizations** (NGOs);
- **Public private partnerships** (PPPs); and
- **Informal Waste Collection and Recyclables Processing Businesses**.

These third-party funding options may donate funds to LMIC local governments or provide the services for the local governments. This may occur through either partnerships or grant arrangements that may require agreeing to certain conditions and obligations. The funders are most like to give money to local governments for one-time projects such as research, analysis, planning or design of large projects. So, other funding options provided in this report should be considered to develop stable funding for 3R/SWM systems. These options may be used, however, to supplement 3R/SWM revenues. A brief description of each of the three options, including a case study, are provided below.

Multilateral Development Banks

Multilateral Development Banks (MDBs) are international financial institutions, chartered by two or more countries, which promote economic and social progress in developing nations. Each year MDBs (such as the World Bank, the Asian Development Bank and the African Development Bank) provide approximately US$50 billion in loans, grants, and investments[69] to both the public and private sectors within their developing member countries.

MDBs can finance various projects through either short-term and long-term loans (using current or below market rates) or via **grants.** This section will explore the use of grants as a funding option, since in most cases, grants from MDB's do not have to be repaid, but still require an oversight process.

According to the U.S. Department of the Treasury,[70] a significant component of MDB lending is now in the form of these grants, which is helping to break the "lend-and-forgive cycle" that previously effected development in many of the participating countries. One example is a grant provided to Mongolia[71] by the Japan Fund for Poverty Reduction (JFPR) and administered by the Asian Development Bank, to be used specifically for solid waste infrastructure projects for local governments within the cities of Darkan-Uul, Gobi-Altai, Sukhbaatar, and Uvurkhangai, as described in the case study that follows.

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[69] 5-Multilateral Development Banks | Privacy Shield

[70] Multilateral Development Banks | U.S. Department of the Treasury

[71] Grant Number 9206-MON(EF). Grant Agreement – Managing Solid Waste in Secondary Cities Project between Mongolia and Asian Development Bank. July 2, 2020.

Example of this Funding Option Being Used:

An agreement between Mongolia and the Asian Development Bank (ADB) was signed on July 2, 2020 whereby the ADB agreed to make available to Mongolia a grant from the JFPR in the amount of US $2 million to provide "effective municipal solid waste management and recycling systems" to four local governments (Darkan-Uul, Gobi-Altai, Sukhbaatar and Uvurkhangai) within Mongolia. The grants were comprised of three separate funding measures.

1. Fund construction of new sanitary landfills and transfer stations, provide remodeled cargo containers for recycling shops, provide trucks and machinery for landfill operations, and provide capacity building for local governments to ensure functionality of the solid waste system.
2. Develop inclusive MSW recycling approaches by providing employment opportunities to improve the livelihoods of the informal sector and the poorer communities that live around the landfills and open dumps. This also includes capacity building mechanisms for community groups to maximize green jobs and business opportunities.
3. Provide capacity building initiatives to provincial governments in policy making, and planning in solid waste prevention, reduction, and recycling. Furthermore, the grants are to be used to develop actual **Solid Waste Management Plans** (SWMP) for the four local governments that when complete, will be used as a model to conduct additional SWMPs in other cities.

This is just one example of many grants provided to a member country and applied to local governments. Solid Waste officials within local governments can therefore look to either solicit these MDB grants themselves or work with their national agency to pursue as a funding option.

Non-Governmental Organizations

A non-governmental organization, or NGO, is an organization or institution with a philanthropic mission that for the most part operates independently from government influence but may still receive government funding for its cause. NGOs, depending on size and funding, rarely bring spendable resources to a project themselves, unless the project is funded by a development organization, like USAID. Independent NGOs without development resources typically provide in-kind resources, including staff and volunteers, to provide research, analysis and programs to local communities. These funds may not go directly to LMIC local governments, but the work that is done will supplement and support the 3R/SWM system. Therefore, it is important that local governments work closely with NGOs to ensure that the work done within its jurisdiction are aligned with the local government's solid waste management plan.

NGO donors may offer in-kind solid waste technical expertise in the form of consulting services to a local government or services such as purchasing equipment. This assistance, however, may come with terms and provisions that limit the control of the local government.[72] Therefore, opportunities to tap both the funding resources, and technical expertise, from NGOs can be a useful tool for local governments. It is up to the community to perform further research to determine funding options available to them from NGOs (and their partners) operating in the community.

NGOs may fund environmental, social, human rights, and other causes, both on a national and local scale, using various funding opportunities, including partnerships with development organizations. Local governments interested in this funding source should note that NGOs will most often invest in projects

[72] Sustainable Financing and Policy Models for Municipal Composting. World Bank Group – Urban Development Series. September 2016, No. 24.

that are aligned with their goals and beliefs. [73] For example, in Quy Nhon, Vietnam in 2007, the UN in conjunction with the NGO Environment and Development Action in the Third World (ENDA), funded an integrated resource recovery facility that also provided local technical assistance and promoted source separation of materials (see below).

Example of this Funding Option Being Used:

The United Nations Economic and Social Commission for Asia and the Pacific (ESCAP), through the NGO "ENDA," funded the construction of an integrated resource recovery facility (IRRC) in Quy Nhon, Vietnam. The IRRC was constructed to manage the waste generated in the ward of Nhon Phu with a focus on source separation of waste through community participation.

This IRRC (which is managed by a workers cooperative) has been able to cover all operational costs while generating surplus revenues for the local government which are also shared by the workers. The source of revenues for the IRRC is derived from the sale of compostable materials, recyclable materials and a collection fee for door-to-door waste collection from 700 residential households and 2 small marketplaces. Community mobilization for the source separation of the waste was carried out by leveraging an existing local community network of the Community Development Fund (CDF). In Quy Nhon, the CDF had organized households into various groups for income generation activities. The NGO ENDA worked with these groups and through this network, a concise message of how to properly source-separate waste was provided to the local community. Additionally, the local government authority passed a law requiring commercial establishments to source separate waste. This led to an 80 percent diversion rate among the non-residential sectors.[74]

Public Private Partnerships

As it relates to this document, PPPs can be defined as an agreement between a local government and a private sector entity to fund waste management infrastructure or services without the need for the local government to fund the largest component(s) of the project, while still reaping its benefits.

In a PPP arrangement, the private sector (either alone or in conjunction with another partner) will fund the initial project infrastructure and operational management components, but with the prospect of generating profits over the life of the agreement.[75] In the case of a PPP, there is usually some kind of cost and, therefore, is not free. There will most likely be some parts of the project that the local government will need to fund and be responsible for, but for the most part, the private sector will take on the biggest financial and operational risks.

Therefore, a PPP agreement can help shift the financial burden and risk from the local government to the private sector. In some instances, the private sector may work with NGO's and government agencies (both international and domestic) to jointly fund a solid waste project that benefits a local community. In these instances, there may be no initial financial obligation from the local government. It should be noted that these types of PPPs may be rare and since they may involve a third-party arrangement (such as a federal government agency or an NGO), could be difficult to undertake.

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[73] Ibid.

[74] Paper_ESCAP paper on IRRC ISWA Congress.pdf (unescap.org)

[75] EPA. Best Practices for Solid Waste Management: A Guide for Decision-Makers in Developing Countries. October, 2020. EPA 530-R-20-002.

Considerations in implementing Public-Private Partnerships (PPPs):

PPP agreements may occur when the local government either does not have the financial means to construct or operate a facility, provide a service, or when they may not have the technical expertise to do so. Funding a facility or a waste management service through a PPP agreement can therefore help a local government achieve environmentally sound and cost-effective diversion solutions. Additionally, this type of funding can play a significant role in improving environmental and sanitation issues throughout a developing nation.

By using PPP contracts, private companies can either construct, operate or maintain waste disposal or processing facilities, with less risks and less costs to the local government. PPP agreements are especially advantageous when operational knowledge of a facility may be limited[76] or when the national government (or an NGO) is willing to get involved as a major funding partner, effectively allowing the local government to obtain solid waste funding without being held to the same financial risk if the funding had come entirely from their own budget.

Example of this Funding Option Being Used:

A PPP-based municipal composting facility was established in Matara, Sri Lanka between Greenfield Crops (GC)(private entity) and the Matara municipal council (public entity). GC is a PPP business which provides certain waste management services within the Matara municipality. Specifically, GC adopted an open windrow technology to process unsegregated waste into compost. The business also produces fuel pellets and sells non-degradable materials obtained during the waste sorting process.[77]

The Matara composting plant was fully funded at a cost of US $1.54 million by the Pillisaru project, which is a Government of Sri Lanka initiative (under the Central Environment Authority) to improve the solid waste management system within urban locations across the island nation. In 2010 GC began operations through a seven-year PPP agreement. Under this PPP arrangement, GC spends approximately US $9,240 per month for its operations, including wages, electricity, fuel, repairs, maintenance costs and also a service fee. The US $1,500 per month service fee is **paid directly** to the municipal council for use of the land, the composting facility and machinery. [78]

GC, in turn, generates revenue from sales of the compost product, non-degradable materials and from tipping fees which are charged at US $5 per ton (paid by the municipality directly to GC for any waste received. The company processes approximately 40 tons of waste per day (about 60 percent is organic), which amounts to approximately $US 6,000 per month from tipping fees. Additionally, GC averages about US $15,400 monthly from the sales of the compost end product and another US $355 monthly from the sale of the non-degradable materials. [79]

Under this specific PPP, GC manages the compost facility and is responsible for the operational costs and maintenance. GC pays the municipal council for the use of land, the composting facility, and all equipment. In turn, the municipal council pays a tipping fee for solid waste disposal and processing. While program is dependent on government funding, it is estimated that full cost-recovery is achievable with the construction of satellite compost stations close to local end markets to reduce transportation costs.

Other benefits of this partnership include low disposal costs for the local government, a steady source of compost material for local markets, production of fuel pellets from non-degradable materials, increase in the sales of recyclables, potential to tap carbon markets as additional revenue sources, and little financial risk to the local government. Some of the weaknesses for this particular PPP include the nutrient content of the compost being fairly low (thus reducing its

[76] Ibid.

[77] Public-private partnership-based municipal solid waste composting (Greenfield Crops, Sri Lanka). Miriam Otoo, Lesley Hope, and Krishna C. Rao.

[78] Ibid.

[79] Public-private partnership-based municipal solid waste composting (Greenfield Crops, Sri Lanka).

value) and high investment requirements for both the original construction of the facility and any future expansion costs.[80]

Informal Waste Collection and Recycling Businesses

In low- to middle- income countries there have always been savvy collectors and buyers (sometimes referred to as individual or micro-enterprises) who have recognized value in what others have discarded. Some have found ways to create a livelihood from gathering and selling these wastes. Although waste picking is the lowest paid part of the recycling chain, in some places these workers earn more than the minimum wage.[81]

Considerations in Implementing Collection Using Informal Waste Collectors:

This network of informal waste collectors and buyers of scrap materials, without government intervention, aggregate tons of waste materials from within their communities and make it possible for this scrap to enter the recycling value chain; generating an income for themselves, while diverting this waste from disposal sites and keeping that wealth within the local economy. Furthermore, this shadow economy provides a service at no cost to the local government.

The contributions of these recycling and collection independent workers, however, can be either seen as an opportunity or a conflict for local governments that are struggling to implement sustainable 3R/SWM systems. On the one hand, if local governments rely primarily on the informal sector to segregate and divert waste from disposal, they do not have to establish a formal collection and recycling system for these wastes. This means that the local government will not bear the cost of those services and could be viewed to be a funding option to be considered. As of 2010, this cost contribution was estimated to range from a low of $71,000 per year in Romania to $17.9 M per year in Lima, Peru.[82]

While local governments may see a benefit to allowing the private/informal sector to essentially fund recycling activities, there are also several drawbacks to relying on this approach. These relate to the lack of control and include:

- Local governments usually have the responsibility for managing all wastes within their jurisdiction based on National and sub-national laws and regulations. This cannot be abdicated. Contracts or licensing of junkshops and informal worker cooperatives may provide a way for local governments to maintain oversight without actually providing the services with their own employees or vehicles.
- Informal workers will only collect those materials for which they can earn an income. The quantity of these materials may be limited and will not accumulate enough for the local governments to achieve their goals for segregated and managed tonnage.
- If the market price for certain recyclable materials goes down, the informal economy may no longer collect it.
- Relying on an informal system means that its less likely that the service will be uniform – this can cause a confusing variety of ways citizens can participate, increasing mixed messages and discouraging some people from participating.

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[80] Public-private partnership-based municipal solid waste composting (Greenfield Crops, Sri Lanka). Miriam Otoo, Lesley Hope, and Krishna C. Rao.

[81] *Gupta, Sanjay K., Integrating the Informal Sector for Improved Waste Management, Private Sector and Development,* November 12, 2012

[82] Ibid

- Data on the quantity of materials collected will be more difficult if there is nothing requiring that tonnage of material recycled be reported.

The way in which a local government engages with IWCs is critical to mobilizing them to support local SWM/3R System.

Example of this Funding Option Being Used:

An example of integrating IWCs into a local government SWM/3R system was provided by Dr. Sanjay K. Gupta: Solid Waste Collection and Handling, or officially, SWaCH Cooperative, is India's first wholly owned cooperative of self-employed waste pickers/waste collectors and other urban poor. It is an autonomous enterprise that provides front-end waste management services to the citizens of Pune. SWaCH was authorized by the Pune Municipal Corporation (PMC) to provide door-to-door waste collection and other allied waste management services. The scope of SWaCH includes collection, resource recovery, trade and waste processing. Through its 1,867 members, it provides services to the population of over 1.5 million people of Pune. SWaCH bridges the garbage gap between people's doors and the PMC collection points. It offers total solutions for wet garbage and dry garbage, while enabling the waste pickers and collectors to keep their livelihoods and get trained to carry out their work professionally and in an occupationally safer way. The integration of the waste pickers through SWaCH has helped to reduce waste disposal by more than 20%. For the PMC, the cost of engaging with the informal sector is much cheaper than engaging with private sector.[83]

[83] Gupta, Sanjay K., Integrating the Informal Sector for Improved Waste Management, Private Sector and Development, November 12, 2012.